TRANSACTIONS

AND

PROCEEDINGS

OF THE

NEW ZEALAND INSTITUTE

1886

VOL. XIX.

(SECOND OF NEW SERIES)

EDITED AND PUBLISHED UNDER THE AUTHORITY OF THE BOARD OF GOVERNORS OF THE INSTITUTE

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DIRECTOR

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ERRATA.

PAGE
65, lines 17 and 32, *for* Acanthodrilis *read* Acanthodrilus.
94, line 22, *for* Falces *read* Eyes.
101, line 27, *for* cocolorous *read* concolorous.
113, line 31, *for* lateral *read* central.
162, line 29, *for* Debranchiata *read* Dibranchiata.
162, line 38, *for* perouii *read* peroni.
166, line 9, *for* terrebelloides *read* terebelloides.
168, line 34, *for* Italiotidæ *read* Haliotidæ.
170, line 6, *for* mangei *read* maugei.
171, line 22, *for* Onchadella *read* Onchidella.
172, line 24, *for* Aphysiidæ *read* Aplysiidæ.
172, line 29, *for* novo-zealandica *read* novæ-zealandiæ.
174, line 28, *for* lumbata *read* lambata.
196, last line, *for* cathymetrical *read* bathymetrical.
197, line 31, *for* quinqualoculine *read* quinqueloculine.
198, line 4, *et seq.*, *for* W. and T. *read* W. and Y.

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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 its 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 before 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 the 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 specially 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—

1st. 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.

2nd. 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.

3rd. 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 October, 1868.
Otago Institute	18th October, 1869.
Westland Institute	21st December, 1874.
Hawke's Bay Philosophical Institute	31st March, 1875.
Southland Institute	21st July, 1880.
Nelson Philosophical Society	20th December, 1883.

OFFICERS OF INCORPORATED SOCIETIES, AND EXTRACTS FROM THE RULES.

WELLINGTON PHILOSOPHICAL SOCIETY.

Office-bearers for 1887:—*President*—F. B. Hutchinson, M.R.C.S.; *Vice-presidents*—W. T. L. Travers, F.L.S., Hon. G. R. Johnson, M.L.C.; *Council*—W. M. Maskell, F.M.S., A. de B. Brandon, Charles Hulke, F.C.S., A. K. Newman, M.B., M.R.C.P., R. H. Govett, F. W. Pennefather, LL.M., James Hector, M.D., C.M.G., F.R.S.; *Secretary and Treasurer*—R. B. Gore; *Auditor*—W. E. Vaux.

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 contribution 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 1887:—*President*—Professor A. P. Thomas, F.L.S.; *Vice-presidents*—Professor F. D. Brown, B.Sc., J. Pond; *Council*—C. Cooper, Rev. E. H. Gulliver, M.A., Hon. Colonel Haultain, E. A. Mackechnie, Major W. G. Mair, J. Martin, F.G.S., J. M. Moore, M.D., T. Peacock, M.H.R., Rev. A. G. Purchas, M.R.C.S.E., S. P. Smith, F.R.G.S., Rev. W. Tebbs; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—J. Reid.

Extract 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 ballotted 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 subscriptions being payable in advance on the first day of April for the then current year.

5. 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 1887:—*President*—Geo. Hogben, M.A.; *Vice-presidents*—Professor F. W. Haslam, M.A., W. H. Symes, M.D.; *Hon. Treasurer*—H. R. Webb; *Hon. Secretary*—W. Dinwiddie; *Hon. Auditor*—C. R. Blakiston; *Council*—Professor Hutton, F.G.S., R. W. Fereday, T. Crook, S. Hurst-Seager, A.R.I.B.A., Dr. J. Irving, S. C. Farr.

Extracts from the Rules of the Philosophical Institute of Canterbury.

21. 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. Any member whose subscription shall be twelve months in arrear shall cease to be a member of the Institute, but he may be restored by the Council if it sees fit.

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

OTAGO INSTITUTE.

Office-bearers for 1887:—*President*—F. R. Chapman; *Vice-presidents*—Professor Parker, A. Wilson; *Hon. Secretary*—G. M. Thomson; *Hon. Treasurer*—J. C. Thomson; *Council*—D. Petrie, M.A., G. M. Barr, Dr. Scott, C. Chilton, J. De Zouche, M.D., Dr. Hocken, E. Milland; *Auditor*—D. Brent, M.A.

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.

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

8. 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.

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

WESTLAND INSTITUTE.

Office-bearers for 1877:—*President*—J. P. Will; *Vice-president*—Rev. H. Gould; *Treasurer*—Jno. Nicholson; *Committee*—J. N. Smyth, R. Cross, J. Elcorte, M. Atkinson; C. F. A. Broad; M. L. Moss; G. J. Roberts, A. H. King, C. Horgan, E. B. Sammons, J. W. Souter, Captain Bignell; *Secretary*—Richard Hilldrup.

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 speeial 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 1887:—*President*—J. Goodall; *Vice-president*—F. W. C. Sturm; *Council*—J. S. Caro, J. Hardcastle, R. C. Harding, N. Heath, H. Hill, W. I. Spencer; *Hon. Secretary and Curator of Museum*—A. Hamilton; *Hon. Treasurer*—J. N. Bowerman; *Auditor*—T. K. Newton.

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 1887:—*President*—Ven. Archdeacon Stocker; *Vice-president*—A. Highton, B.A.; *Council*—Messrs. Bailey, McLean, C. Tanner, Dr. Galbraith, and Dr. Closs; *Treasurer*—E. Robertson; *Secretary*—E. Webber.

NELSON PHILOSOPHICAL SOCIETY.

Office-bearers for 1887 :—*President*—J. T. Meeson, B.A. ; *Vice-presidents*—The Bishop of Nelson and A. S. Atkinson *Secretary*—Dr. Coleman ; *Treasurer*—Dr. Hudson ; *Council*—Dr. L. Boor, J. Holloway, J. S. Browning, Dr. Cressey, and R. Kingsley ; *Curator*—R. Kingsley.

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,

1886.

I.—ZOOLOGY.

Art. I.—*Monograph of New Zealand* Noctuina.

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

[*Read before the Philosophical Institute of Canterbury, 7th October*, 1886.]

I have described the species of this group on the same method as that employed in my paper on the *Geometrina*,* and the remarks prefatory to that paper may be taken to apply generally to this also.

The species of *Noctuina* are commonly very dull coloured, and very similar in marking. It is, therefore, not surprising that those writers who classify by superficial appearance have found themselves in a frightful state of confusion; but the structural classification of the group is really not difficult. As an example of the sort of work produced, I will merely point out that fifteen described species of New Zealand *Noctuina*, all truly referable to the same genus, *Mamestra*, have been classed by these writers in eighteen different genera, under five distinct families. As the New Zealand fauna is very limited in character, it may be useful to remark that genera such as *Hadena*, *Xylina*, etc., to which several of these species have been referred, are really existing genera, quite distinct in structure, and have not been merged by me in *Mamestra;* I have simply corrected the erroneous reference.

The specimens described in this paper were mainly from the collection of Mr. R. W. Fereday, to whom I am greatly indebted for the loan of them. Mr. Fereday has devoted especial attention to the group, and his collection is a very valuable record of labour; but, as it was taken principally in a few limited localities, it is doubtless incomplete. I imagine that, as in the *Geometrina*, new species will come mainly from the alpine regions. During my last visit to the table-land of Mount

* "Trans. N.Z. Inst.," vol. xvi., p. 49; xvii., p. 62; xviii., p. 184.

Arthur I tried the effect of sugaring, with much perseverance and a total absence of result; the only species I took were found by day, but I think an attracting lamp would have been effective. The failure of sugar is probably due to the very great abundance of flowers.

Seventeen genera are recorded, of which number six are represented only by single wide-ranging species, and are not to be regarded as belonging to the true indigenous fauna; five are endemic, and represented in all by only six species; and the remaining six are wide-ranging, and probably almost cosmopolitan genera. Sixty-three species are given, of which nine are found also in Australia, several of them ranging much further; the remainder are endemic. Forty-two—that is, two-thirds of the whole number, or nearly seven-ninths of the endemic species—belong to the two closely-allied genera *Leucania* and *Mamestra*, the distinction between which is very slight. Compare with this the predominance of the two closely allied genera, *Larentia* and *Notoreas*, among the *Larentiadæ* (*Geometrina*); the analogy is so close as to suggest a common origin in time for the New Zealand fauna of both groups. I have little hesitation in asserting, though I cannot yet adduce conclusive proof, that the *Larentiadæ* of New Zealand approach much more nearly to those of Chili than of any other country, and perhaps the *Noctuina* may be found to display a similar relation.

NOCTUINA.

Forewings with vein 1 simple, 5 rising nearer to 4 than to 6, 7 and 8 from a common stalk. Hindwings with 1*c* obsolete, 8 rising out of upper margin of cell near base, frenum developed.

Separated from the *Geometrina* by the position of vein 5 of the forewings. The following characters are also common to all the New Zealand genera of the group, and are therefore given here, to avoid needless repetition:—Face vertical or obtusely prominent; ocelli present; tongue well-developed; palpi (unless specially mentioned) moderate, obliquely ascending, second joint densely rough-scaled or hairy, terminal joint short, smooth, cylindrical; thorax very densely hairy; tarsi more or less strongly spinose, spurs well-developed; forewings with vein 6 almost from a point with 9, 7 and 8 out of 9, 10 connected with 9 by a bar (except in *Erana*); hindwings with veins 3 and 4 approximately from a point, 6 and 7 approximately from a point.

The markings are assumed to consist typically of first, second, and subterminal lines, a median shade or cloudy line between first and second, and orbicular, claviform, and reniform spots; the position of all these is practically identical in all the New Zealand species. The first line runs from about $\frac{1}{3}$ of costa to about $\frac{2}{5}$ of inner margin, the second, rather curved on upper portion, from about $\frac{2}{3}$ of costa to about $\frac{2}{3}$ of inner margin; the orbicular and reniform successively between these above middle, the claviform immediately beyond first line below middle.

The two families represented in New Zealand differ essentially only in the structure of vein 5 of the hindwings:—

Noctuidæ. Hindwings with vein 5 imperfect, parallel to 4.

Plusiadæ. Hindwings with vein 5 well-developed, approximated to 4 towards base.

NOCTUIDÆ.

A. Eyes hairy.
  I. Abdomen more or less crested, thorax with defined crest.
    a. Wings with transverse vein wholly absent .. 5. *Erana.*
    b. ,, ,, ,, present .. .. 4. *Lamestra.*
  II. Abdomen smooth, thorax without defined crest.
    a. Palpi, in male, with terminal joint greatly swollen .. .. 1. *Physetica.*
    b. Palpi, in male, with terminal joint not greatly swollen
      1. Antennæ, in male, strongly bipectinated to apex .. .. 3. *Ichneutica.*
      2. Antennæ, in male, with at least apex filiform .. .. 2. *Leucania.*
B. Eyes naked.
  I. Eyes with long marginal cilia.
    a. Thorax with anterior angles prominent, angularly scaled .. .. 6. *Miselia.*
    b. Thorax with anterior angles not prominent.
      1. Thorax sharply crested .. .. .. 8. *Xanthia.*
      2. ,, not ,, ... 7. *Orthosia.*
  II. Eyes without marginal cilia.
    a. Antennæ in male bipectinated .. .. .. 10. *Agrotis.*
    b. ,, ,, filiform.
      1. Thorax strongly crested .. .. .. 12. *Cosmodes.*
      2. ,, not ,,
        i. Anterior tibiæ with horny apical hook 11. *Heliothis.*
        ii. ,, without ,, ,, 9. *Bityla.*

1. PHYSETICA, n. g.

Eyes hairy. Palpi with terminal joint in male greatly swollen, as broad as second, rather short, rounded, with an orifice in outer side, in female normal. Antennæ in male filiform, simple. Thorax and abdomen smooth.

1. *Phys. cærulea*, Gn.

(*Agrotis cærulea*, Gn., Ent. Mo. Mag. v., 38.)

Male, female.—38–41 mm. Head, antennæ, and thorax slaty-grey. Palpi whitish-ochreous, laterally suffused with slaty-grey. Abdomen grey, in male mixed with yellowish, anal tuft ochreous-yellowish. Legs slaty-grey, ringed with whitish-ochreous; posterior tibiæ pale whitish-ochreous. Forewings moderately dilated, costa straight, apex obtuse, hindmargin somewhat waved, slightly oblique, rounded beneath; dark slaty-grey, finely sprinkled with whitish; sub-basal first and second lines obscure, whitish, dentate, dark-margined; orbicular and reniform very obscurely indicated by pale outlines; median shade dark-grey; subterminal obscure, whitish, twice sinuate; cilia dark slaty-grey, sprinkled with whitish. Hindwings blackish-grey, becoming paler and mixed with whitish-ochreous towards base: cilia whitish-ochreous, with a faint grey line, towards tips white. Under-surface of all wings in male uniform glossy pale whitish-ochreous, in female greyish-tinged.

Blenheim and Rakaia, in October, December, and January; ten specimens; formerly very common at flowers (*Fereday*).

2. Leucania, Tr.

Eyes hairy. Antennæ in male with short pectinations or dentations terminating in tufts of cilia, or subdentate or filiform, evenly ciliated, towards apex always filiform. Thorax smooth or slightly crested anteriorly. Abdomen smooth.

The variations in the form of antennæ are simply specific, and not available even to form sections. The larvæ are 16-legged, probably generally feeding on grass. The genus is probably cosmopolitan, but is as well represented in New Zealand as anywhere.

A.	Forewings with black longitudinal streak from base	B.
	,, without ,, ,, ,,	D.
B.	Hindwings rather dark grey	5. *atristriga.*
	,, not ,, ...	C.
C.	Forewings with dark fuscous longitudinal streak in disc	6. *propria.*
	Forewings without dark fuscous longitudinal streak in disc	7. *acontistis.*
D.	Forewings with defined oblique fuscous streak from apex	16. *extranea.*
	Forewings without defined oblique fuscous streak from apex	E.
E.	Orbicular tolerably defined	2. *moderata.*
	,, imperceptible	F.
F.	Forewings with posterior series of dots absent ..	G.
	,, ,, ,, more or less distinct	H.
G.	Forewings whitish-ochreous	13. *sulcana.*
	,, light brownish-crimson	4. *purdii.*
H.	Cilia of forewings conspicuously darker	15. *blenheimensis.*
	,, ,, not ,, ,, ...	K.
K.	Hindwings dark grey	L.
	,, not dark grey	N.
L.	Forewings reddish fuscous	9. *alopa.*
	,, pale whitish-ochreous	M.
M.	Cilia of hindwings white	12. *arotis.*
	,, ,, dark grey	11. *aulacias.*

N. Forewings with darker submedian streak from base	14. *semivittata.*
„ without „ „ „	O.
O. Forewings with scattered white and black scales on veins	8. *phaula.*
Forewings without scattered white and black scales on veins..	P.
P. Forewings with first line indicated by black dots on veins	10. *unica.*
Forewings with first line not indicated by black dots on veins	3. *nullifera.*

2. *Leuc. moderata*, Walk.

(*Agrotis moderata*, Walk., Suppl., 705; *Mamestra griseipennis*, Feld., Reis. Nov., pl. cix., 22; *Chera virescens*, Butl., Cist. Ent., ii., 489; *Spaelotis inconstans*, ib., 545.)

Male, female.—35–38 mm. Head, palpi, antennæ, and thorax ochreous-grey, sometimes suffused with dark grey; antennæ in male with moderate transverse triangular dentations, terminating in tufts of long cilia. Abdomen pale ochreous-greyish. Legs dark grey, suffusedly irrorated with whitish-ochreous. Forewings moderately dilated, costa straight, apex obtuse, hindmargin waved, somewhat oblique, rounded beneath; fuscous-grey, yellowish-tinged, densely strewn with whitish scales; hairs at base of inner margin, white; two blackish dots near base, on costa and in middle, followed by pale dots; first and second lines blackish, dentate or interrupted, second followed by a series of whitish points; median shade dark grey; orbicular and reniform indistinctly outlined with pale and then with blackish; subterminal whitish, irregular, interrupted, anteriorly suffusedly margined with dark grey; a hind-marginal row of blackish dots: cilia grey, mixed with ochreous-whitish. Hindwings dark grey, lighter towards base; cilia ochreous-white.

Var. a. Thorax and forewings without ochreous tinge, with numerous white scales tending to form suffused spots and margins to lines; cilia distinctly barred with darker; hindwings grey, with dark grey irregular hind-marginal band.

Christchurch, Lake Coleridge, Rakaia, Akaroa, and Lake Guyon; a single specimen of the variety on Mount Arthur at 4,700 feet; from November to March, very common.

3. *Leuc. nullifera*, Walk.

(*Agrotis nullifera*, Walk., Noct., 742, Butl., Voy. Ereb., pl. ix., 5; *Alysia specifica*, Gn., Ent. Mo. Mag. v., 3.)

Male, female.—55–58 mm. Head, palpi, antennæ, thorax, and legs light brownish-ochreous, in female more greyish; antennæ in male with moderate transverse triangular dentations terminating in tufts of cilia; abdomen pale greyish-ochreous. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; light brownish-ochreous or fuscous; sometimes two faint dentate darker lines visible, approximated on inner margin; a posterior curved series of cloudy darker dots, followed by pale points: cilia pale ochreous or fuscous, tips whitish. Hindwings pale brownish-ochreous or fuscous; cilia pale ochreous, tips whitish.

Larva stout, glabrous; yellow-ochreous, minutely speckled with white; dorsal obscurely fuscous; a very fine fuscous subdorsal line, edged beneath with white; an obscure fuscous shade above spiracles, darker posteriorly; head yellow-ochreous. Feeds within stems of *Aciphylla colensoi* (*Umbelliferæ*).

Christchurch, Rakaia, and Mount Arthur (3,500 feet); from November to March, common.

4. *Leuc. purdii*, Frdy.

(*Leucania purdii*, Frdy., Trans. N.Z. Inst., 1882, 195.)

Male.—46 mm. Head, palpi, and thorax ferruginous, thorax between patagia posteriorly grey-whitish. Antennæ whitish-ochreous, with moderate triangular transverse dentations, terminating in tufts of cilia. Abdomen greyish-ochreous, slightly reddish-tinged. Legs dull fuscous-crimson mixed with dark grey. Forewings moderately dilated, costa slightly sinuate, apex obtuse, hindmargin obliquely rounded; light dull brownish-crimson, with a few whitish scales; costa narrowly deep yellow, more broadly near base; a narrow deep yellow suffusion along basal half of inner margin; a moderately broad deep yellow suffusion below middle from base to middle; a moderately broad deep yellow suffusion above middle from $\frac{1}{3}$ to $\frac{2}{3}$: cilia yellowish-white, basal half pale reddish-ochreous. Hindwings dark grey; cilia pale ochreous-yellowish, tips whitish.

Dunedin; one specimen, sent by Mr. Purdie.

5. *Leuc. atristriga*, Walk.

Xylina atristriga, Walk., Suppl., 756; *Mamestra antipoda*, Feld., Reis. Nov., pl. cix., 23.)

Male, female.—33–36 mm. Head, palpi, antennæ and thorax pale fuscous, tinged with ochreous or reddish, sometimes irrorated with whitish; antennæ in male filiform, subserrate towards base, moderately ciliated. Abdomen and legs greyish-ochreous, spurs banded with blackish. Forewings moderately dilated, costa hardly arched, apex abtuse, hindmargin waved, somewhat oblique, rounded beneath; light reddish-fuscous, towards inner margin broadly mixed with whitish-ochreous, towards costa paler and irrorated with whitish, especially near base; a black median streak from base to one-third, extremities attenuated; first and second lines very faintly indicated, on costa marked by two black dots, second with a series of inconspicuous minute black dots; all spots tolerably defined by pale margins partially surrounded with dark fuscous, claviform elongate, orbicular oval, reniform with posterior margin concave, followed by a yellow-ochreous spot; subterminal obscurely indicated by a cloudy costal mark; a hind-marginal series of minute black dots: cilia pale reddish-fuscous. Hindwings rather dark fuscous-grey; cilia greyish-ochreous, apical, half white.

Nelson, Christchurch, Lake Coleridge, and Dunedin, from January to March; very common.

6. *Leuc. propria*, Walk.

Leucania propria, Walk., Noct. iii., Gn., Ent. Mo. Mag. v., 2, Butl., Voy. Ereb., pl. ix., 4.)

Male, female.—32–36 mm. Head, palpi, antennæ, thorax, abdomen, and legs whitish-ochreous, slightly brownish or reddish-tinged; antennæ in male with moderate transverse triangular dentations, terminating in tufts of cilia; thorax slightly crested anteriorly, with a blackish anterior transverse line; spurs dark fuscous, except towards apex. Forewings moderately dilated, costa almost straight, apex obtuse, hind-margin slightly waved, somewhat oblique, rounded beneath; whitish ochreous, sometimes more or less suffused with light brownish-ochreous; a black median streak from base to $\frac{2}{5}$; a minute black dot above it towards base, and another towards inner margin at $\frac{1}{3}$; a dark fuscous longitudinal streak in disc, suffused beneath with reddish-fuscous, from above apex of basal streak to near hind-margin; orbicular sometimes indicated, reniform tolerably defined, pale-margined, posteriorly edged with dark fuscous, sometimes intersecting discal streak; a posterior curved series of minute black dots; a hind-marginal series of larger black dots: cilia whitish-ochreous or pale ochreous, indistinctly barred with greyish. Hindwings light grey, sometimes tinged with whitish-ochreous; a dark grey interrupted hind-marginal line; cilia ochreous-whitish.

Mount Arthur (3,800 feet), Blenheim, and Mount Hutt, from January to March; common.

7. *Leuc. acontistis*, n. sp.

Male.—36 mm. Head, palpi, antennæ, thorax, abdomen, and legs whitish-ochreous, slightly brownish tinged; antennæ with strong triangular transverse dentations, terminating in tufts of cilia; collar with an imperfect blackish transverse line. Forewings moderately dilated, costa hardly arched, apex obtuse, hindmargin rather oblique, rounded beneath; whitish-ochreous, brownish-tinged; a slender attenuated black streak below middle from base to $\frac{2}{5}$: cilia ochreous-whitish. Hindwings light grey, tinged with whitish-ochreous; cilia ochreous-whitish.

Castle Hill; one specimen, sent by Mr. J. D. Enys.

8. *Leuc. phaula*, n. sp.

Male.—38 mm. Head, palpi, antennæ, thorax, abdomen, and legs light brownish-ochreous; antennæ with moderate triangular longitudinal dentations, terminating in tufts of cilia. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin somewhat oblique, rounded beneath; rather light fuscous, ochreous-tinged; veins marked with scattered white and black scales; an obscure white dot at each extremity of transverse vein; a minute black dot towards inner margin at $\frac{1}{3}$; a posterior series of obscure minute black dots, bent above middle: cilia fuscous, base more ochreous, tips whitish. Hindwings fuscous-grey, base somewhat lighter; cilia whitish-ochreous, with a faint grey line, tips more whitish.

Christchurch, in November; two specimens; bred from tussock-grass.

9. *Leuc. alopa*, n. sp.

Male.—41 mm. Head, palpi, and thorax reddish-fuscous, mixed with ochreous-whitish; face whitish-ochreous; thorax, posteriorly between patagia, grey-whitish. Antennæ ochreous-whitish, flatly subdentate, moderately ciliated. Abdomen light grey, anal tuft whitish-ochreous, mixed with reddish. Legs reddish-ochreous, mixed with grey. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, somewhat oblique, rounded beneath; reddish-fuscous, slightly ochreous-tinged; costa somewhat irrorated with whitish; a black dot towards inner margin at $\frac{1}{3}$; reniform represented by a subcrescentic whitish-ochreous mark, bordered beneath by a cloudy dark-grey spot; a posterior curved series of obscure black dots: cilia reddish-fuscous, tips white. Hindwings dark grey; cilia ochreous-whitish, slightly reddish-tinged.

Lake Coleridge and Lake Guyon, in March; two specimens.

10. *Leuc. unica*, Walk.

(*Leucania unica*, Walk., Noct. 112, Butl., Voy. Ereb., pl. ix., 9; *Nonagria juncicolor*, Gn., Ent. Mo. Mag., v. 2.)

Male, female.—34–35 mm. Head, palpi, antennæ, thorax, abdomen, and legs whitish-ochreous, slightly brownish-tinged; antennæ in male moderately bipectinated, pectinations strongly ciliated. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, somewhat oblique, rounded beneath; whitish-ochreous, slightly brownish-tinged, sometimes with a few scattered black scales; first line represented by three pairs of obscure black dots; a posterior curved series of black dots: cilia whitish-ochreous. Hindwings grey, more or less tinged with whitish-ochreous; cilia pale whitish-ochreous.

Blenheim and Rakaia, in November; nine specimens.

11. *Leuc. aulacias*, n. sp.

Male.—41 mm. Head, palpi, and thorax whitish-ochreous; palpi externally mixed with blackish; thorax with a slender black transverse line on each side of back, anteriorly. Antennæ whitish, flatly subdentate, moderately ciliated. Abdomen ochreous-whitish. Legs whitish, outer spurs black, except apex, two apical joints of anterior tarsi black. Forewings moderately dilated, costa hardly arched, apex obtuse, hindmargin crenulate, somewhat oblique, rounded beneath; pale whitish-ochreous, faintly brownish-tinged in disc; a black basal dot below middle; veins posteriorly and in disc lined with blackish, and interneural spaces with central brown lines leaving pale marginal lines but somewhat suffused near hindmargin; a cloudy blackish dot towards inner margin at $\frac{2}{5}$; a short very obscure longitudinal streak of blackish scales beneath middle; a posterior curved row of black dots: cilia fuscous, mixed with ochreous-whitish. Hindwings dark grey; cilia dark grey, mixed with whitish.

Dunedin, in March; one specimen.

12. *Leuc. arotis*, n. sp.

Male, female. — 39–42 mm. Thorax tolerably crested anteriorly; submedian streak not traceable; cilia of forewings whitish-ochreous, sprinkled with fuscous and blackish, of hindwings white, with indications of a grey line: all else as in *L. aulacias*.

Blenheim, Christchurch and Rakaia, in November and December; nine specimens. This may eventually prove to be a form of the preceding species, but at present it is easily distinguishable by the different cilia of the hindwings.

13. *Leuc. sulcana*, Frdy.

(*Leucania sulcana*, Frdy., Trans. N.Z. Inst., 1879, 267, pl. ix.)

Male, female.—40–42 mm. Head, palpi, antennæ, thorax, and legs whitish-ochreous, partly tinged with brownish-ochreous; palpi mixed with blackish; antennæ in male flatly sub-dentate, moderately ciliated; two apical joints of anterior tarsi black; outer spurs with median black band. Abdomen dark-grey above, anal tuft whitish-ochreous. Forewings moderately dilated, costa slightly arched, apex rectangular, hindmargin almost straight, rather oblique; whitish-ochreous, with a few scattered black scales; costal edge slenderly bright ochreous from base to $\frac{2}{3}$; a slender ochreous-brown streak along submedian fold from base to $\frac{3}{4}$, posteriorly very indistinct, towards base somewhat mixed with black; a slender ochreous-brown suffused median streak from end of cell to hindmargin; indications of darker lines posteriorly between veins; a distinct black dot above middle at $\frac{1}{6}$, another at $\frac{1}{3}$, and a third, sometimes obsolete, towards inner margin at $\frac{1}{3}$; a rather large black dot between origins of veins 3 and 4, and another on middle of vein 6; a hind-marginal series of minute black dots: cilia whitish-ochreous. Hindwings blackish-grey; cilia pale ochreous, with a cloudy dark-grey line.

Akaroa and Dunedin, in February; ten specimens.

14. *Leuc. semivittata*, Walk.

(*Leucania semivittata*, Walk., Suppl. 628.)

Male, female.—36–40 mm. Head, palpi, antennæ, thorax, abdomen, and legs pale whitish-ochreous; antennæ in male serrate, shortly ciliated; outer spurs with median black band. Forewings moderately dilated, costa hardly sinuate, apex obtuse, hindmargin slightly waved, rather oblique, rounded beneath; pale whitish-ochreous; space between veins posteriorly sometimes pale brownish, veins sometimes marked with black scales; a slender pale ochreous median streak, irrorated with black, from base to $\frac{2}{5}$; a black dot above middle at $\frac{1}{6}$, sometimes another at $\frac{1}{3}$, and one towards inner margin at $\frac{1}{3}$, a fourth between origins of veins 3 and 4, and a fifth between veins 6 and 7, near origin; a curved posterior series of black dots; a hind-marginal series of minute black dots: cilia pale whitish-ochreous. Hindwings grey, in female more or less suffused with pale whitish-ochreous; cilia white, base ochreous-tinged.

Christchurch, Mount Torlesse, and Dunedin; common.

15. *Leuc. blenheimensis*, Frdy.

(*Leucania blenheimensis*, Frdy., Trans. N.Z. Inst., 1882, 196.)

Male.—40 mm. Head, palpi, antennæ, thorax, abdomen, and legs whitish-ochreous, slightly brownish-tinged; palpi externally suffused with blackish; antennæ subserrate towards base, moderately ciliated; anterior legs suffused with dark grey, all tarsi and spurs banded with blackish. Forewings moderately dilated, costa hardly sinuate, apex obtuse, hindmargin waved, somewhat oblique, rounded beneath; whitish-ochreous, tinged with pale brownish-ochreous along hindmargin; veins partially white, irregularly irrorated with black; first line represented by three minute black dots; a cloudy black dot between veins 3 and 4 at origin; a posterior curved series of obscure black dots: cilia blackish-grey, irrorated with whitish. Hindwings fuscous-grey, towards base tinged with whitish-ochreous; cilia grey-whitish, with a cloudy grey line.

Napier and Blenheim; three specimens.

16. *Leuc. extranea*, Gn.

(*Leucania extranea*, Gn., Noct. v., 77, Butl., Voy. Ereb., pl. ix., 2.)

Male, female.—32–42 mm. Head, palpi, antennæ, thorax, abdomen, and legs pale brownish-ochreous, sometimes sprinkled with dark fuscous; antennæ in male filiform, rather shortly ciliated; thorax somewhat crested anteriorly; outer spurs banded with black. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin rather oblique, rounded beneath; light brownish-ochreous, with numerous scattered short fuscous strigulæ and black scales; orbicular and reniform indistinct, roundish, more yellow-ochreous, dark-centred; a white dot, sometimes very obscure, on lower margin of reniform, preceded and followed by dark scales; a curved posterior series of black dots; a straight oblique slender fuscous streak from apex to this series; a hind-marginal series of black dots: cilia pale brownish-ochreous, apex whitish. Hindwings grey-whitish, towards hindmargin broadly suffused with dark-grey, especially on upper half, veins dark-grey; cilia whitish, sometimes with an indistinct grey line.

Napier, Wellington, Nelson, and Christchurch, from January to April; not uncommon. Occurs also in Australia, Java, India, and North and South America.

3. ICHNEUTICA, n. g.

Eyes hairy. Antennæ in male strongly bipectinated throughout. Thorax and abdomen smooth.

17. *Ichn. ceraunias*, n. sp.

Male.—41 mm. Head, palpi, antennæ, thorax, abdomen, and legs brownish-ochreous; palpi externally suffused with dark fuscous; stalk of antennæ white above. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin rather oblique, rounded beneath; whitish-ochreous, brownish-tinged; a pale yellow-ochreous gradually dilated streak from base above middle to $\frac{3}{5}$, where it separates abruptly into two strong remote branches, nearly reaching hindmargin, upper acutely pointed, lower with two acute points; space between and beyond these, and on a broad streak beneath them, reaching from $\frac{1}{3}$ to hindmargin but acutely attenuated anteriorly, ochreous-brown, sprinkled with black on margins; a small blackish spot between branches at origin, and an irregular black divided streak from base beneath median streaks to middle: cilia whitish-ochreous (imperfect). Hindwings light fuscous-grey; cilia whitish-ochreous (imperfect).

Mount Arthur (4,700 feet); I took a single specimen, flying by day in January; it is in rather poor condition, but could not be mistaken.

4. MAMESTRA, Tr.

Eyes hairy. Palpi with terminal joint rarely elongate. Antennæ in male dentate or filiform, ciliated evenly or with fascicles, or moderately bipectinated, apex always filiform.

Thorax more or less strongly crested anteriorly and often posteriorly. Abdomen more or less distinctly crested towards base.

Probably cosmopolitan, but relatively much more numerous in New Zealand than elsewhere. Larvæ 16-legged, feeding on grasses and low plants.

	Abdomen partly rosy	A.
	,, not ,,	B.
A.	Hindwings rosy	25. *pictula.*
	,, grey	26. *rhodopleura.*
B.	Forewings distinctly green	21. *plena.*
	,, not ,, ,,	C.
C.	All veins conspicuously pale	18. *disjungens.*
	,, not ,, ,,	D.
D.	A distinct short blackish median streak from base	E.
	No black basal streak	K.
E.	A dark brown interrupted discal patch from first line to hindmargin	19. *paracausta.*
	No such patch	F.
F.	A black dash above anal angle	G.
	No black supra-anal dash	H.
G.	Black dash broadly suffused with dark fuscous	20. *polychroa.*
	,, ,, slender, defined	23. *mutans.*
H.	Orbicular and reniform very small or obsolete	I.
	,, ,, ,, large	J.
I.	Lower edge of reniform forming a white semi-annular mark	33. *composita.*
	Lower edge of reniform not defined	34. *steropastis.*
J.	Orbicular conspicuously pale-margined	38. *stipata.*
	,, not ,, ,,	36. *omoplaca.*
K.	A conspicuous interrupted dark fuscous dash above anal angle	41. *ustistriga.*
	No such dash	L.
L.	Subterminal with two long teeth below middle reaching hindmargin	M.
	Subterminal without teeth reaching hindmargin	O.
M.	Costa suffused with white	35. *arachnias.*
	,, not suffused with white	N.
N.	Markings grey	40. *lignana.*
	,, reddish-brown	39. *rubescens.*
O.	Orbicular oblique, suboval	P.
	,, roundish or obsolete	S.
P.	Reniform marked posteriorly with an oval white or yellowish spot	29. *vitiosa.*
	Reniform not marked posteriorly with an oval white or yellowish spot	Q.
Q.	A sharply-marked dark fuscous triangular mark above anal angle	37. *dotata.*
	No such defined mark	R.
R.	Reniform followed by a dark fuscous spot	31. *tartarea.*
	,, not ,, ,, ,,	30. *ochthistis.*
S.	Forewings brown	T.
	,, grey	U.
T.	Antennæ of male shortly bipectinated	24. *agorastis.*
	,, ,, filiform	28. *pelistis.*
U.	Orbicular white	W.
	,, not white	V.

V. Median shade conspicuously darker	.. ..	44. *cucullina.*
,, ,, nearly obsolete ..	.. ..	X.
W. Terminal joint of palpi elongate	.. ..	43. *temperata.*
,, ,, short ..	.. ..	22. *lithias.*
X. Lines very strongly dentate, tending to form longitudinal streaks ..	.. .. ..	42. *prionistis.*
Lines normal	.. ..	Y.
Y. First line preceded and second followed by white dots ..	.. ..	32. *homoscia.*
First line without white dots ..	.. ..	27. *sistens.*

The following rough analysis may also be of use in helping to fix the identity of species :—

A. Antennæ of male shortly bipectinated ..	sp. 18-24.
B. ,, ,, subdentate or filiform.	
1. Subterminal with two much stronger teeth below middle	sp. 33-40.
2. Subterminal without much stronger teeth.	
a. Terminal joint of palpi rather elongate	sp. 43, 44.
b. ,, ,, short ..	sp. 25-32, 41, 42.

18. *Mam. disjungens*, Walk.

(*Heliophobus disjungens*, Walk., Noct., 1681, Butl., Voy. Ereb., pl. ix., 1; *Hadena nervata*, Gn., Ent. Mo. Mag. v., 40.)

Male, female.—35–37 mm. Head whitish-ochreous, mixed with fuscous, with a dark fuscous band on face. Palpi whitish-ochreous, externally suffused with dark fuscous. Antennæ whitish-ochreous, in male moderately pectinated. Thorax slightly crested, ochreous-whitish, with a central dark fuscous line, collar and patagia with submarginal dark fuscous rims, an ochreous transverse band behind collar. Abdomen ochreous-grey-whitish. Legs dark fuscous, mixed and ringed with ochreous - whitish. Forewings moderately dilated, costa straight, apex obtuse, hindmargin crenulate, obliquely rounded; brownish-ochreous; all veins conspicuously whitish; spots moderate, margined first with white and then with black except on veins; orbicular round, claviform elongate, reniform oblong; lines black, waved, interrupted on veins; subterminal white, obscurely blackish-margined on both sides, with two acute teeth touching hindmargin below middle; a hind-marginal row of black lunules: cilia whitish-ochreous, mixed with fuscous. Hindwings fuscous-grey, lighter towards base; veins sometimes whitish; a dark fuscous hind-marginal line; cilia whitish, with a cloudy grey line.

Rakaia; November to January, formerly very common, now scarcer.

19. *Mam. paracausta*, n. sp.

Male, female.—37 mm. Head whitish, mixed with reddish-ochreous above, with two blackish transverse lines on face. Palpi whitish, externally somewhat mixed with reddish-ochreous and black. Antennæ whitish, in male moderately pectinated

(4). Thorax and abdomen grey mixed with white and black, collar mixed with reddish-ochreous, and with a transverse blackish line, outer edge of patagia blackish. Legs ochreous-whitish, suffusedly mixed with blackish. Forewings moderately dilated, costa slightly sinuate, apex obtuse, hindmargin waved, rather oblique, rounded beneath; pale ochreous, towards costa irrorated with dark fuscous and whitish, in female more whitish; lines slender, dentate, obscure, dark fuscous; first anteriorly whitish-margined, second posteriorly white-margined on lower half; spots hardly perceptible; a slender black sinuate streak from base to middle, margined beneath rather broadly with dark ochreous-brown to first line, terminating beneath a rather broad posteriorly dilated dark ochreous-brown discal patch extending from first to second line, between which and inner margin the ground-colour is irrorated with white; the discal dark patch is continued beyond second line to hindmargin, where it is dilated and extends over lower $\frac{3}{4}$, becoming blackish-fuscous, cut on veins 3 and 4 by light streaks terminating in whitish arrow-headed spots extending into cilia, and containing a double whitish mark on anal angle: cilia pale ochreous mixed with whitish and dark fuscous. Hindwings dark grey mixed with white; an irregular obscurely marked darker post-median line; a dark fuscous interrupted hind-marginal line; cilia whitish mixed with grey.

Castle Hill; two specimens, taken by Mr. J. D. Enys.

20. *Mam. polychroa*, n. sp.

Male, female.—34–36 mm. Head and palpi dark fuscous mixed with grey-whitish. Antennæ fuscous, in male moderately pectinated. Thorax with angles subprominent, small anterior, median, and posterior crests; fuscous irrorated with whitish, with black angulated anterior and sinuate lateral lines. Abdomen grey, and tuft ochreous-whitish, sometimes reddish-tinged. Legs dark fuscous, irrorated with white. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin crenulate or waved, obliquely rounded; light reddish-fuscous, densely suffusedly irrorated with grey white-tipped scales, discal space darker; a short black median streak from base; a short suffused black very oblique streak from inner margin near base, connected with apex of basal streak by a dull green spot; sometimes a dull green dorsal suffusion before middle; spots outlined first with dull green and then with black; orbicular rather large, roundish, claviform roundish, incomplete, reniform oblong, posterior half paler and sometimes clear white; lines slender, dentate, indistinct, black; subterminal very slender, whitish, anteriorly margined with greenish and partially with black, preceded towards inner margin by a triangular blackish spot, posteriorly suffusedly margined with black except towards extremities, with two acute teeth below middle almost touching hindmargin: a hind-marginal row of black dots: cilia fuscous, obscurely and slenderly barred with paler. Hindwings fuscous; cilia whitish, with a fuscous line.

Blenheim and Christchurch; from April to June, very common. This species appears in some collections to stand for *Agrotis admirationis*.

21. *Mam. plena*, Walk.

(*Erana plena*, Walk., Suppl., 744; *Mamestra sphagnea*, Feld., Reis. Nov., pl. cix., 17; *Dianthoecia viridis*, Butl., Cist. Ent. ii., 547.)

Male, female.—33–34 mm. Differs from *M. polychroa* only as follows:—Head, thorax, and forewings wholly suffused with green; no black streak from base; sub-basal line double, well-defined; first and second lines and a median shade tolerably distinct; triangular supra-anal spot fuscous.

Christchurch and Mount Hutt; November to May, very common.

22. *Mam. lithias*, n. sp.

Male.—33 mm. Head, palpi, and thorax white, densely irrorated with black and fuscous; patagia with two obscure black longitudinal streaks. Antennæ grey, with strong triangular transverse dentations (1), terminating in tufts of cilia. Abdomen grey. Legs dark grey, irrorated with white, banded with black and white, spurs white with median black band. Forewings moderately dilated, costa straight, apex obtuse, hindmargin waved, somewhat oblique, rounded beneath; fuscous, irregularly suffused with grey; veins coarsely and broadly irrorated with black and white; lines white, slender, subdentate, irregularly blackish-margined; a dark median shade; orbicular small, round, white, fuscous-centred, black-margined; claviform very small, but conspicuous, round, black, minutely white-centred; reniform oblong, white, fuscous-centred, black-margined; subterminal more obscure, nearly touching hindmargin beneath costa, with two indistinct, rather more acute, teeth below middle: cilia rather dark grey, slenderly barred with white. Hindwings grey; a darker hind-marginal line; cilia white, with a pale grey line.

Castle Hill; two specimens, taken by Mr. J. D. Enys.

23. *Mam. mutans*, Walk.

(*Hadena mutans*, Walk., Noct., 602; *H. lignifusca*, ib., 603; *Mamestra angusta*, Feld., Reis. Nov., pl. cix., 18; *M. acceptrix*, ib., pl. cix., 19; *Hadena debilis*, Butl., Proc. Zool. Soc. Lond., 1877, 385, pl. xlii., 6.)

Male, female.—34–39 mm. Head and palpi light reddish-ochreous, or white mixed with fuscous and blackish. Antennæ grey, in male moderately bipectinated. Thorax with angles subprominent, moderate anterior and small posterior crests; light reddish-ochreous, or light grey irrorated with white, with a black angulated anterior line, patagia with obscure black submarginal lines. Abdomen and legs whitish, irrorated with ochreous or grey. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; pale reddish-ochreous, or grey, more or less ochreous-tinged, more or less suffusedly irrorated with white; veins irrorated with blackish; a short black sinuate median streak from base; spots black-margined, orbicular roundish, claviform semicircular, reniform curved oblong, not margined with black on posterior edge; lines indistinct; subterminal pale or whitish, hardly waved, suffusedly margined with dark fuscous, except at extremities and on a single tolerably acute dentation below middle, preceded on submedian fold by a short longitudinal black streak; an interrupted black hindmarginal line: cilia ochreous or grey, mixed with white and black. Hindwings grey, base somewhat lighter; a dark grey hind-marginal line; cilia whitish, with a grey line.

Wellington, Christchurch, Rakaia, Lake Guyon, probably everywhere; from August to March, very common.

24. *Mam. agorastis*, n. sp.

Male, female.—35 mm. Head, palpi, and thorax reddish-fuscous; thorax with small anterior and median crests. Antennæ fuscous, in male with rather short strongly ciliated pectinations. Abdomen grey, anal tuft light reddish. Legs reddish-fuscous, irrorated with ochreous whitish. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; rather dark reddish-fuscous, lines greyish-tinged, edged with dark reddish-fuscous, tolerably defined; claviform small, obscure, greyish; orbicular and reniform dark grey, margined with white and then with dark reddish-fuscous, orbicular round, reniform oblong: a tolerably distinct median shade; subterminal whitish-ochreous, obscure, waved; a hind-marginal series of black lunules: cilia reddish-fuscous. Hindwings fuscous; cilia whitish, with a fuscous line.

Akaroa and Lake Guyon, in February and March; three specimens.

25. *Mam. pictula*, White.

(*Dianthoecia pictula*, White, Tayl. New Zeal., pl. i., 3; *Meterana pictula*, Butl., Proc. Zool. Soc. Lond., 1877, 386, pl. xlii., 1.)

Male, female.—36 mm. Head and palpi blackish-grey, face with a yellowish-green band. Antennæ grey, in male submoniliform, moderately ciliated. Thorax with angles subprominent, small anterior, median, and posterior crests; blackish-grey, with sinuate anterior and curved sublateral yellowish-green streaks.

Abdomen light rosy, with dorsal and lateral streaks, anal tuft and ventral surface towards apex dark grey. Legs blackish-grey, apex of tarsal joints whitish. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin crenulate, obliquely rounded; dark grey; markings yellowish-green, suffusedly black-margined; orbicular roundish, grey-centred; claviform roundish, grey; reniform irregular, clear white except anterior edge; lines tolerably distinct; subterminal evenly waved; a submarginal series of green lunules: cilia grey, mixed with blackish, with greenish bars and a basal row of white dots. Hindwings pale crimson-rosy; a grey discal lunule, postmedian series of cloudy dots, and rather broad hind-marginal band; cilia grey.

Lake Coleridge, in March; three specimens.

26. *Mam. rhodopleura*, n. sp.

Male, female.—35 mm. Only differs from *M. pictula* as follows:—Head and thorax with ground-colour brownish; forewings with ground-colour pale ochreous, becoming grey in disc; median shade distinct, black; reniform not white; cilia blackish, barred with pale ochreous, without white dots. Hindwings grey, with a postmedian series of indistinct darker dots followed by pale dots. Abdomen in male with very large dense tuft of ochreous-whitish hairs from base beneath.

Napier and Wellington; three specimens.

27. *Mam. sistens*, Gn.

(*Eumichtis sistens*, Gn., Ent. Mo. Mag. v., 39.)

Male, female.—32–33 mm. Head, palpi, antennæ, thorax, abdomen, and legs light greyish-ochreous; antennæ in male with short triangular transverse dentations ($\frac{1}{2}$), strongly ciliated; thorax with very slight crests. Forewings moderately dilated, costa slightly sinuate, apex obtuse, hindmargin waved, obliquely rounded; light grey, with a slight irregular greenish-ochreous suffusion; lines tolerably distinct, blackish-margined; spots obscurely dark-margined; orbicular small, reniform tolerably distinct; median shade perceptible; subterminal hardly defined, hind-marginal space somewhat darker grey; a hind-marginal series of black lunules: cilia light ochreous-grey, with faint slender paler bars. Hindwings grey; a dark-grey hind-marginal line; cilia whitish, with a cloudy grey line.

The crests appear very slight, and it is therefore possible that this species ought to be transferred to *Leucania*; it bears a close resemblance to *L. moderata*, from which it may be distinguished by the grey line of the cilia of hindwings, and by the subterminal not being defined by a darker anterior marginal shade.

Rakaia, in February; eight specimens.

28. *Mam. pelistis*, n. sp.

Male, female.—34–35 mm. Head, palpi, antennæ, thorax, abdomen, and legs pale whitish-ochreous, partially suffused with pale brownish, and mixed with reddish-fuscous; antennæ in male submoniliform, moderately ciliated; thorax with moderate anterior and small posterior crests; anal tuft whitish-ochreous. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; whitish-ochreous, tinged with fuscous; disc and hindmargin wholly suffused with reddish-fuscous; lines tolerably defined, margined with dark reddish-fuscous; median and subdorsal veins irrorated with blackish and white; orbicular rather small, round, margined with ochreous-whitish; claviform small, roundish, grey, black-margined; reniform oblong, grey, lower part dark grey, margined with ochreous-whitish, and then laterally with dark reddish-fuscous; subterminal ochreous-whitish, with two acute, sometimes undefined, dentations below middle: cilia dark grey, mixed with whitish and reddish fuscous. Hindwings dark fuscous; cilia grey-whitish, with a cloudy dark grey line.

Akaroa and Lake Coleridge, from January to March; nine specimens.

29. *Mam. vitiosa*, Butl.

(*Apamea vitiosa*, Butl., Proc. Zool. Soc. Lond., 1877, 384, pl. xlii., 3.)

Male, female.—32–35 mm. Head, palpi, and thorax dark reddish fuscous; thorax with moderately large anterior and small posterior crests. Antennæ dark grey, in male serrate, rather strongly ciliated. Abdomen and legs dark grey, anal tuft whitish-ochreous, reddish-tinged. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin crenulate, obliquely rounded; dark reddish-fuscous, disc and hindmargin blackish-tinged; lines somewhat paler, dark-margined, very indistinct; orbicular oblique oval, sometimes pale-margined, externally black-margined; claviform semicircular, black-margined; reniform oblong, margined obscurely with blackish and sometimes partially with pale, marked with a whitish-ochreous or white dot at each posterior angle, and a small oval clear white or whitish-ochreous spot lying between these; subterminal obscure, with two moderately acute dentations below middle: cilia dark reddish-fuscous, with a basal series of white dots on veins. Hindwings and cilia rather dark fuscous.

Christchurch, in May and June; very common.

30. *Mam. orthistis*, n. sp.

Male, female.—34–36 mm. Head, palpi, and thorax reddish-fuscous, mixed with dark fuscous; thorax with angles subprominent, rather large anterior and small posterior crests, with a small black posteriorly whitish-margined spot on each side of back anteriorly. Antennæ dark grey, in male filiform moderately ciliated. Abdomen grey, sides and anal tuft light reddish-ochreous. Legs reddish-fuscous, base of tarsal joints sharply black. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin crenulate, obliquely rounded; reddish-fuscous, veins suffusedly dark fuscous; lines dark-margined, tolerably defined; orbicular oblique-oval, margined with pale and then sharply with black; claviform subtriangular, black-margined; reniform curved oblong, rather narrow, margined anteriorly with black and posteriorly with white, with a grey middle line; median shade blackish-fuscous, tolerably defined; subterminal ochreous-whitish, suffusedly dark-margined, with two moderately acute dentations below middle: cilia reddish-fuscous, mixed with blackish, with a basal series of white dots on veins. Hindwings rather dark grey, base paler; a tolerably distinct central darker lunule; cilia ochreous-whitish, with a cloudy reddish-grey line.

Christchurch, from November to April; very common.

31. *Mam. tartarea*, Butl.

(*Graphiphora tartarea*, Butl., Proc. Zool. Soc. Lond., 1877, 384, pl. xlii., 2.)

Male, female.—36–37 mm. Head, palpi, and thorax reddish-fuscous, mixed with dark fuscous; thorax with rather small anterior and posterior crests. Antennæ grey, in male subdentate, moderately ciliated. Abdomen grey, anal tuft whitish-ochreous. Legs reddish-fuscous, tarsi dark grey. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin crenulate, obliquely rounded; reddish-fuscous, sometimes wholly suffused with dark fuscous except a hind-marginal band; lines paler, dark-margined, tolerably defined; claviform semicircular, dark fuscous, black-margined; orbicular and reniform laterally margined with ochreous-whitish and then with black, orbicular oblique-oval, reniform oblong, preceded and followed by a dark reddish-fuscous spot; a dark reddish-fuscous spot preceding second line on fold, forming a dentation inwards; subterminal sinuate, not waved or dentate: cilia reddish-fuscous, obscurely barred with darker. Hindwings dark grey; cilia grey-whitish, with a cloudy grey line.

Christchurch, in April; common.

32. *Mam. homoscia*, n. sp.

Male.—38 mm. Head, palpi, antennæ, thorax, abdomen, and legs grey; antennæ with short triangular transverse dentations ($\frac{1}{2}$), strongly ciliated; thorax with moderate anterior crest; anal tuft ochreous-tinged. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin crenulate, obliquely rounded, grey; veins irrorated with black and white, marked with two tolerably distinct series of white dots, preceded and followed by black marks, before first and beyond second lines; lines dark-margined, tolerably defined; orbicular and claviform hardly traceable; reniform indicated by whitish lateral margins; subterminal faintly paler, not dark-margined, waved: cilia grey. Hindwings grey, darker posteriorly; cilia grey-whitish, with a cloudy grey line.

Wellington; one specimen, given me by Mr. G. V. Hudson, who has taken others.

33. *Mam. composita*, Gn.

(*Cloantha composita*, Gn., Noct. vi., 114; *Auchmis composita*, Walk., Noct., 616; Butl., Voy. Ereb., pl. ix., 12; *Mamestra maori*, Feld., Reis. Nov., pl. cix., 24; *Leucania dentigera*, Butl., *teste* Skellon, but reference not found.)

Male, female.—32–36 mm. Head, palpi, antennæ, thorax, abdomen, and legs ochreous-whitish; face with a dark fuscous band; palpi more or less mixed with dark fuscous; antennæ in male serrate, moderately ciliated; thorax with moderate double anterior and posterior crests, tinged with brownish-ochreous, with a black posteriorly white-margined anterior line, and a sometimes indistinct blackish streak on patagia; abdomen in male reddish-tinged; legs irrorated with fuscous, anterior tarsi with two apical joints black. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; pale whitish-ochreous, towards disc and hindmargin brownish-tinged; subcostal and subdorsal spaces more or less suffused with white; a fine black median streak from base to $\frac{1}{3}$; a fine black line, bordered above with white and beneath suffusedly with fuscous, from first to second lines above middle, interrupted by a small semiannular white mark representing lower edge of reniform; first line obsolete; second fine, dark fuscous, very strongly dentate; subterminal fine, obscure, dark fuscous, preceded by a whitish suffusion, extremely strongly and very irregularly dentate, receding widely from hindmargin above middle and towards lower extremity, but with two long dentations touching hindmargin below middle: cilia greyish-ochreous barred with white. Hindwings grey, ochreous-tinged, becoming dark-grey posteriorly; cilia white, with a pale grey line.

Larva longitudinally striped with dark and light, feeding on grasses; sometimes occurs in great profusion.

Napier, Wellington, Christchurch, and Lake Coleridge, in February and March; sometimes abundant. Occurs also in South-East Australia and Tasmania.

34. *Mam. steropastis*, n. sp.

Male, female.—40–43 mm. Head ochreous, mixed with whitish, and irregularly marked with dark reddish-fuscous.

Palpi dark reddish-fuscous, mixed with whitish. Antennæ fuscous, in male subdentate, rather shortly ciliated. Thorax with moderately large double anterior and small posterior crest; reddish-fuscous, with a black posteriorly whitish-margined anterior line; patagia with two black internally whitish-margined streaks on each. Abdomen grey, and tuft pale reddish-ochreous. Legs ochreous-whitish, mixed with reddish-fuscous. Forewings moderately dilated, costa hardly arched, apex obtuse, hindmargin crenulate, obliquely rounded; reddish-fuscous; veins dark fuscous, margined with whitish or ochreous-whitish; a short black median streak from base; a slender dark reddish-fuscous longitudinal streak in disc from above apex of this to $\frac{3}{5}$, posterior extremity somewhat dilated; a minute white discal dot near beyond its extremity; a very oblique short blackish streak from inner margin near base; second line hardly indicated; subterminal hardly traceable except by two very long whitish dentations touching hindmargin below middle: cilia reddish-fuscous, slenderly barred with whitish. Hindwings dark grey; cilia white or ochreous-whitish, with a grey line.

Napier, Blenheim, and Christchurch, in November and February; seven specimens.

35. *Mam. arachnias*, n. sp.

Female.—37 mm. Head, palpi, and thorax reddish-fuscous, slightly irrorated with white; forehead with two black transverse lines; collar with a slender white line; thorax with strong anterior double tuft. Antennæ white. Abdomen light reddish-grey. Legs reddish-fuscous irrorated with whitish, anterior tibiæ and tarsi white, all tarsi with two apical joints black except apex, spurs banded with black. Forewings moderately dilated, costa slightly sinuate, apex obtuse, hindmargin waved, obliquely rounded; reddish-fuscous, slightly irrorated with whitish-ochreous, except on a suffused somewhat darker median streak from base to $\frac{2}{3}$; an obscure moderately broad white costal streak from base to $\frac{2}{3}$, posteriorly suffused, sharply defined near base only, containing several very oblique ill-defined blackish strigulæ; orbicular moderate, narrow-oval, longitudinal, very finely margined with white and then with black; claviform obsolete; reniform only indicated by two white dots representing its lower angles; lines very acutely dentate but hardly traceable; subterminal indicated only by three very acute slender whitish-ochreous dentations, one below apex, two touching hindmargin below middle: cilia reddish-fuscous mixed with whitish. Hindwings dark grey; cilia whitish-ochreous, with a faint grey line, tips white.

Napier and Blenheim; only one specimen seen, sent by Mr. Skellon.

36. *Mam. omoplaca*, n. sp.

Male, female.—40–41 mm. Head, palpi, and thorax dark reddish-fuscous, sometimes blackish-tinged; thorax with rather large double anterior crest, an anterior black anteriorly ochreous-margined angulated line, apex of anterior angles ochreous-whitish. Antennæ fuscous, in male submoniliform, moderately ciliated. Abdomen grey, and tuft reddish-whitish. Legs reddish-fuscous mixed with blackish, anterior pair ochreous-whitish, with three apical joints of tarsi black. Forewings moderately dilated, costa almost straight, apex obtuse, hind-margin waved, obliquely rounded; reddish-fuscous; a short black median streak from base, margined above with ochreous-white; space between this and costa marked with suffused ochreous-whitish lines; in one specimen a blackish suffusion extending from base of inner margin obliquely to orbicular and reniform, space between this and subterminal line suffused with pale whitish-ochreous; orbicular and reniform blackish-fuscous, black-margined, connected by a blackish-fuscous spot; orbicular large, roundish; reniform with outer edge white; claviform small, suboval, blackish-fuscous; lines indistinct; subterminal obscurely paler or hardly traceable, with two somewhat acute dentations below middle; hind-marginal space mixed with blackish-fuscous: cilia reddish-fuscous mixed with blackish. Hindwings fuscous-grey; cilia grey-whitish, with a grey line.

Lake Coleridge and Rakaia, in December, February, and March; three specimens.

37. *Mam. dotata*, Walk.

(*Dasypolia dotata*, Walk., Noct., 522.)

Female.—42 mm. Head, palpi, thorax, and legs dark fuscous, somewhat mixed with reddish, whitish-ochreous, and black. Antennæ dark fuscous. Abdomen fuscous. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin crenulate, obliquely rounded; dark fuscous, reddish-tinged; a blackish suffused spot on inner margin at $\frac{1}{3}$; lines somewhat paler, obscurely blackish-margined; orbicular large, oblique-oval, partially finely margined with whitish and then with black; claviform moderate, triangular, black-margined; reniform oblong, partially white-margined, posteriorly strongly, then with black, containing a cloudy reddish-whitish median line; a tolerably distinct median shade; space between second and subterminal lines paler, mixed with reddish-whitish, cut by an acute triangular dark fuscous mark on submedian fold; subterminal cloudy, whitish-ochreous, dark-margined, waved, regular; a fine black waved submarginal line, anteriorly finely margined with obscure pale ochreous marks; a hind-marginal series of minute ochreous-whitish dots on veins: cilia dark fuscous mixed with ochreous-whitish. Hindwings rather dark fuscous; cilia reddish-fuscous, with a dark fuscous line, tips whitish.

One specimen, without note of locality.

38. *Mam. stipata*, Walk.

(*Xylina stipata*, Walk., Suppl., 753.)

Male, female.—46–47 mm. Head and palpi whitish-ochreous mixed with reddish-fuscous. Antennæ ochreous-whitish, in male filiform, shortly ciliated. Thorax with angles subprominent, large double anterior and small posterior crests; reddish-fuscous, obscurely streaked with whitish-ochreous and darker. Abdomen grey, mixed with reddish-fuscous and whitish-ochreous. Legs reddish-fuscous, mixed with ochreous-whitish, anterior pair with tibiæ suffused with ochreous-whitish, base of tarsal joints black. Forewings moderately dilated, costa hardly arched, apex obtuse, hindmargin crenate, obliquely rounded; reddish-fuscous, suffusedly mixed with whitish-ochreous, especially towards costa and on a band beyond second line; lines paler, dark-margined, tolerably distinct; a short blackish-fuscous median streak from base, interrupted by a whitish-ochreous mark; orbicular large, oblique-oval, conspicuously margined or almost wholly suffused with pale whitish-ochreous, and then narrowly with dark fuscous; claviform semicircular, black-margined; reniform oblong, margined laterally with ochreous-whitish, and then with dark fuscous; a series of pale dots margined by dark fuscous dots on veins beyond second line; subterminal ochreous-whitish, suffusedly margined with dark reddish-fuscous except towards costa and below middle, with two acute suffused dentations touching hindmargin below middle; hindmarginal space mixed with blackish-fuscous; a hindmarginal row of black dots: cilia reddish-fuscous, mixed with blackish and ochreous-whitish. Hindwings dark grey; cilia ochreous-whitish, with a fuscous-reddish line.

Christchurch, from October to May; common.

39. *Mam. rubescens*, Butl.

(*Xylophasia rubescens*, Butl., Cist. Ent. ii., 489.)

Male, female.—40–42 mm. Head, palpi, and thorax whitish-ochreous, irrorated with reddish-ochreous; palpi externally mixed with blackish; thorax with moderate anterior and small posterior double crests, with a few scattered black scales, crests suffused with blackish. Antennæ ochreous-whitish, in male subdentate, moderately ciliated. Abdomen grey, mixed with whitish-ochreous, reddish-tinged. Legs whitish-ochreous, mixed with reddish-ochreous, middle tibiæ with two blackish bars, spurs with black bands. Forewings moderately dilated, costa hardly arched, apex obtuse, hindmargin waved, obliquely rounded; whitish-ochreous, slightly reddish-tinged; lines margined with reddish-ochreous, sharply dentate, very indistinct; orbicular moderate, round, margined with reddish-ochreous, containing a blackish dot near anterior edge; claviform suboval, margined with reddish-ochreous; reniform oblong, margined first with blackish, then with whitish-ochreous, then reddish-fuscous; a faint median shade; a series of dark fuscous dots on veins beyond second line; subterminal very obscure, with two distinct very acute dentations touching hindmargin below middle, above and below which is a reddish-fuscous patch on hindmargin; a hind-marginal row of dark fuscous lunules: cilia reddish-fuscous, barred with whitish-ochreous. Hindwings grey, reddish-tinged; cilia whitish, basal half reddish.

Castle Hill and Lake Wakatipu, in January and February; five specimens.

40. *Mam. lignana*, Walk.

(*Hadena lignana*, Walk., Noct., 758; ? *Xylophasia morosa*, Butl., Cist. Ent. ii., 543.)

Male, female.—38–39 mm. Head, palpi, antennæ, thorax, abdomen, and legs whitish, irrorated with ochreous-grey and a few black scales; face with a dark fuscous band; palpi externally mixed with blackish; antennæ in male filiform, moderately ciliated; thorax with moderately large anterior and small posterior crests; anterior tarsi with two apical joints black, spurs with black bands. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; ochreous-grey, densely and suffusedly irrorated with whitish; lines dark-margined, indistinct; spots obscurely dark-margined laterally; orbicular roundish, claviform semicircular, reniform oblong, marked beneath with a roundish blackish-grey spot; an obscure median shade; subterminal suffusedly dark-margined, except beneath apex and below middle, with two acute dentations touching hindmargin below middle; a hind-marginal row of black dots: cilia ochreous-grey, barred with ochreous-whitish. Hindwings grey, darker posteriorly; cilia white, with a cloudy grey line.

Wellington and Mount Hutt, in March; five specimens.

41. *Mam. ustistriga*, Walk.

(*Xylina ustistriga*, Walk., Noct., 630; *X. lignisecta*, ib., 631.)

Male, female.—40–45 mm. Head, palpi, and thorax grey, sometimes more or less suffused with fuscous-reddish; thorax with moderate anterior and slight posterior crests. Antennæ grey, in male with short triangular transverse dentations ($\frac{1}{2}$), moderately ciliated. Abdomen whitish-grey or whitish-ochreous, reddish-tinged. Legs reddish-grey, irrorated with whitish. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; grey, sometimes strongly reddish-tinged, suffusedly irrorated with white; lines hardly traceable: orbicular large, roundish, margined first very obscurely with pale, and then finely with black; claviform triangular, black-margined; reniform curved-oblong, margined very obscurely with whitish, and then anteriorly with black; a cloudy median shade; a short curved blackish line marking anterior margin of a dentation of second line opposite claviform; a black streak, suffused with fuscous or reddish-fuscous, connecting second and subterminal lines opposite this; subterminal waved, whitish, indistinct, margined with dark fuscous on a spot above middle: cilia whitish, with reddish-fuscous or grey basal and median interrupted lines. Hindwings fuscous-grey, darker posteriorly; cilia white, with a grey line.

Blenheim, Christchurch, and Lake Coleridge, from February to May; common.

42. *Mam. prionistis*, n. sp.

Male.—45 mm. Head, palpi, thorax, and legs grey-whitish; crown with two brown lines meeting in front; palpi with second joint externally brown; thorax with large anterior crest, two brown dorsal lines meeting in front, diverging and very indistinct posteriorly. Antennæ grey, filiform, moderately ciliated. Abdomen grey, sides and anal tuft paler, and ochreous-tinged. Forewings moderately dilated, costa straight, apex obtuse, hindmargin crenulate, obliquely rounded; pale ochreous-grey, densely and suffusedly irrorated with white, tending to form longitudinal streaks; inner margin suffused with brownish; lines hardly traceable, strongly dentate; reniform narrow, white, anteriorly suffused, posteriorly edged with an interrupted blackish line; subterminal indicated by a posterior brownish dentate margin, diverted to hindmargin below apex: cilia ochreous-grey, mixed with white. Hindwings rather dark grey; cilia whitish, with a grey line.

Rakaia, in February; three specimens.

43. *Mam. temperata*, Walk.

(*Bryophila temperata*, Walk., Noct., 1648; *Xylina inceptura*, ib., 1736; *X. deceptura*, ib., 1737.)

Male, female.—38–39 mm. Head, palpi, antennæ, thorax, and legs grey, irrorated with white; terminal joint of palpi elongate; antennæ in male filiform, very minutely ciliated ($\frac{1}{5}$); thorax with rather small anterior crest. Abdomen grey, mixed with ochreous-whitish. Forewings moderately dilated, costa almost straight, apex subacute, hindmargin waved, obliquely rounded; grey, densely irrorated with white; lines dark-margined, more or less indistinct; a tolerably distinct median shade; orbicular roundish, wholly white, including a faint greyish ring;

claviform obsolete; reniform oblong, margined with white and then with black; subterminal indicated by suffused dark-grey subdentate anterior margin throughout; a hind-marginal series of dark grey lunules: cilia white, irrorated with grey. Hindwings grey, slightly ochreous-tinged; cilia whitish, with a very faint grey line.

Christchurch and Lake Coleridge, in December, February, March, and June; six specimens.

44. *Mam. cucullina*, Gn.

(*Xylocampa cucullina*, Gn., Ent. Mo. Mag. v., 40; *Agrotis mitis*, Butl., Proc. Zool. Soc. Lond., 1877, 383, pl. xlii., 5.)

Male, female.—31–32 mm. Head, palpi, antennæ, thorax, abdomen, and legs dark grey irrorated with white; terminal joint of palpi rather elongate; antennæ in male filiform, shortly ciliated ($\frac{1}{2}$); thorax slightly crested. Forewings moderately dilated, costa straight, apex obtuse, hindmargin waved, obliquely rounded; grey, irrorated with white; lines whitish, dark-margined, very indistinct; a rather conspicuous darker median shade; spots margined first obscurely with white and then with black; orbicular round, claviform very small, semi-oval, reniform curved oblong; subterminal indicated by a posterior suffused darker grey subdentate margin; a hind-marginal row of blackish lunules; cilia ochreous-grey mixed with white. Hindwings grey, darker posteriorly; cilia whitish, with a grey line.

Rakaia, in March; three specimens.

5. Erana, Walk.

Eyes hairy. Antennæ in male filiform, simple, with scattered single cilia. Thorax with anterior and posterior crests. Abdomen with strong dorsal crests towards base. Forewings in male beneath with a very long dense tuft of scent-giving hairs from base; transverse vein absent, 7 and 8 out of 9, 10 free. Hindwings with transverse vein absent, costa in male broadly dilated.

45. *Eran. graminosa*, Walk.

(*Erana graminosa*, Walk., Noct., 605; *E. vigens*, ib., Suppl. 743.)

Male.—30–33 mm. Head and thorax yellowish-green; thorax with small anterior and larger double posterior crest. Palpi whitish-ochreous, externally mixed with blackish. Antennæ fuscous. Abdomen whitish-ochreous, back towards apex suffused with grey. Legs pale whitish-ochreous, greenish-tinged, spotted with black. Forewings narrow, moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; light yellowish-green mixed with olive-green; lines whitish-tinged, partially black-margined, distinct; reniform margined with white and then with black; three clear white dots on costa posteriorly; subterminal suffused with white towards apex; a submarginal waved whitish line: cilia olive-greenish; tuft of under-surface pale whitish-ochreous. Hindwings with rounded costal dilation, twice as broad as forewings; light fuscous-reddish, suffused with grey towards hindmargin; costa broadly ochreous-whitish; a small apical spot and three others on hindmargin towards middle greenish; cilia ochreous-whitish, suffused with greenish on upper half of hindmargin and with pale reddish on lower part.

Larva (according to *Mr. Purdie*) light green, with white dorsal and subdorsal lines, spots black; feeds on *Melicytus ramiflorus*, in February and April.

Wanganui, Masterton, and Wellington, in February and March; four specimens. The large tuft of the forewings is the source of a very strong vanilla-like perfume, which scents the box in which the specimens are contained for more than a week after their death; the scent is excited more strongly, even in the dead specimen, by stirring the tuft with a pin.

6. MISELIA, Stph.

Eyes naked, margins strongly ciliated. Antennæ in male filiform, moderately ciliated. Thorax with anterior angles projecting, somewhat crested. Abdomen not crested.

46. *Mis. pessota*, n. sp.

Male.—26 mm. Head, palpi, and antennæ dark fuscous. Thorax dark fuscous, slightly irrorated with white, collar ochreous-brown, with a black transverse line. Abdomen greyish, anal tuft whitish-ochreous. Legs dark fuscous, ringed with whitish. Forewings moderately dilated, costa straight, apex obtuse, hindmargin crenate, rather obliquely rounded; dark fuscous, slightly purplish-tinged, with a few scattered ochreous-whitish scales; lines obscurely paler; a blackish acute-triangular spot towards base of inner margin, containing a hooked ochreous-whitish mark; orbicular moderate, round, whitish-margined; claviform represented by a short ochreous-whitish mark; reniform connected with orbicular by a quadrate blackish-fuscous spot, ochreous-white, anteriorly margined first with dark fuscous and then with pale ochreous; subterminal hardly traceable; a hind-marginal row of obscure whitish dots: cilia dark fuscous. Hindwings rather dark fuscous; cilia fuscous, tips whitish.

Christchurch, in December; two specimens.

7. ORTHOSIA, Tr.

Eyes naked, margins ciliated. Antennæ in male subdentate or filiform, moderately ciliated. Thorax without defined crest. Abdomen not crested.

47. *Orth. comma*, Walk.

(*Mamestra comma*, Walk., Noct., 239; Butl., Voy. Ereb., pl. ix., 6; *Graphiphora implexa*, Walk., Noct., 405; *Hadena plusiata*, ib., Suppl. 742; *Nitocris bicomma*, Gn., Ent. Mo. Mag. v., 4.)

Male, female.—31–40 mm. Head fuscous, crown more or less ochreous-whitish. Palpi dark fuscous, terminal joint and apex of second ochreous-white. Antennæ fuscous, in male subdentate. Thorax fuscous or dark fuscous, collar with two black lines, space behind it sometimes ochreous-whitish. Abdomen fuscous. Legs dark fuscous, anterior tibiæ and tarsi whitish-ochreous, tarsi with three apical joints blackish. Forewings moderately dilated, costa hardly arched, apex obtuse, hindmargin hardly waved, rather obliquely rounded; ochreous-brown, suffusedly irrorated with grey and sometimes with dark fuscous; lines not paler, blackish-margined, tolerably distinct; a slender dark fuscous angulated median shade; orbicular minute, dot-like, ochreous-white, very minutely fuscous-centred, dark-margined; claviform obsolete; reniform narrow, oblong, almost occupied by strong whitish-ochreous or yellowish-white lateral margins, lower posterior angle sending an acute short white projection towards hindmargin; subterminal indicated by suffused darker somewhat irregular almost straight anterior margin, sometimes blackish on upper half: cilia dark grey, irrorated with whitish, with a fine pale ochreous basal line dotted with blackish. Hindwings fuscous; cilia white, with a cloudy fuscous line.

Wellington, Blenheim, Christchurch, and Rakaia, from December to February; common.

48. *Orth. immunis*, Walk.

(*Tæniocampa immunis*, Walk., Noct., 430; *Cerastis innocua*, ib., 1710 (locality probably erroneous); *Agrotis acetina*, Feld., Reis. Nov., pl. cix., 6.)

Male.—34 mm. Head and thorax light reddish-fuscous, sprinkled with whitish, face suffused with white. Palpi reddish-ochreous, terminal joint and apex of second white. Antennæ whitish (?). Abdomen pale greyish-ochreous, and tuft whitish-ochreous. Legs reddish-fuscous irrorated with white, anterior tarsi white. Forewings moderately dilated, costa hardly arched, apex obtuse, hindmargin slightly waved, rather obliquely rounded; light reddish-fuscous, irrorated with pale grey; lines obscurely darker-margined; orbicular moderate, roundish, laterally margined with darker; claviform small, suboval, indicated only by posterior darker margin; reniform oblong, outer edge indented, with lateral yellowish-white margins coalescing in centre, posterior followed by a dark fuscous margin; subterminal yellow-whitish, nearly straight, slightly sinuate: cilia light reddish-fuscous, irrorated with whitish. Hindwings pale grey; cilia whitish-ochreous, reddish-tinged, tips white.

Blenheim; two specimens.

8. XANTHIA, Tr.

Eyes naked, margins ciliated. Antennæ in male filiform, moderately ciliated. Thorax with sharp compressed anterior and small posterior crest. Abdomen not crested.

49. *Xanth. ceramodes*, n. sp.

Male.—35–36 mm. Head, palpi, and thorax dark reddish-fuscous, terminal joint and apex of second of palpi sometimes whitish-ochreous. Antennæ dark fuscous. Abdomen reddish-fuscous. Legs dark reddish-fuscous irrorated with pale ochreous. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; dark reddish-fuscous; lines ochreous-whitish, very ill-defined; orbicular and reniform very small, margined with ochreous-whitish, open beneath, connected by a semi-oval black spot margined with ochreous-whitish beneath, reniform followed by a very small black spot; subterminal somewhat sinuate, very indistinct: cilia reddish-fuscous. Hindwings rather dark fuscous, with a darker discal spot, conspicuous on under-surface; cilia rather dark fuscous, tips whitish.

Dunedin and North Island; two specimens.

9. BITYLA, Walk.

Eyes naked. Antennæ in male filiform, shortly ciliated. Thorax not crested, collar suberect. Abdomen not crested.

50. *Bit. defigurata*, Walk.

(*Xylina defigurata*, Walk., Suppl. 756; *Bityla thoracica*, ib., 869.)

Male, female.—38–39 mm. Head and antennæ dark fuscous. Palpi dark fuscous, terminal joint and apex of second ochreous. Thorax fuscous, collar dark fuscous. Abdomen fuscous-grey. Legs dark fuscous, apex of joints ochreous-whitish. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; brown, glossy; lines dark-margined, tolerably defined; spots and subterminal line not traceable: cilia brown. Hindwings rather dark fuscous-grey, glossy; cilia white, basal half suffusedly fuscous.

Blenheim, Christchurch, Lake Coleridge, and Dunedin, from January to March; eight specimens.

51. *Bit. sericea*, Butl.

(*Bityla sericea*, Butl., Proc. Zool. Soc. Lond., 1877, 387, pl. xlii., 12.)

Male, female.—35–36 mm. Head, palpi, antennæ, and thorax brown. Abdomen grey, anal tuft whitish-ochreous. Legs dark fuscous, apex of joints ochreous-whitish. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded; glossy, greyish-fuscous; first line indicated by an obscure darker margin; median shade thick, faintly traceable; second line cloudy, very obscure, grey-whitish, anteriorly obscurely dark-margined; spots and subterminal line absent; a conspicuous waved whitish hind-marginal line: cilia grey, suffusedly mixed with whitish. Hindwings fuscous-grey, lighter towards base; cilia whitish, base suffused with pale fuscous.

Wellington, Christchurch, and Lake Guyon, in February and March; six specimens.

10. Agrotis, Tr.

Eyes naked. Antennæ in male moderately bipectinated, towards apex filiform, simple. Thorax and abdomen without defined crests.

A large cosmopolitan genus, but little represented in New Zealand. The larvæ are frequently subterranean, feeding on roots.

A. Claviform produced to base	53. *admirationis.*
,, not ,, ,, ...	B.
B. Costa of forewings somewhat concave ..	56. *ceropachoides.*
,, ,, not concave	C.
C. Forewings brown	52. *ypsilon.*
,, grey	D.
D. Cilia of hindwings in male wholly white ..	55. *inconspicua.*
,, ,, ,, with a grey line ..	54. *sericea.*

52. *Agr. ypsilon*, Rott.

(*Noctua ypsilon*, Rott.; *Agrotis suffusa*, Hb.)

Male, female.—40–42 mm. Head reddish-fuscous. Palpi and antennæ dark fuscous. Thorax greyish fuscous, somewhat mixed with reddish, with a strong black angulated anterior line. Abdomen light-grey. Legs blackish, mixed with whitish, anterior pair ochreous-whitish. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin slightly waved, obliquely rounded; fuscous, reddish-tinged; basal area and a band beyond second line suffused with whitish-ochreous except towards costa, median space blackish-tinged towards costa; lines dark-margined, distinct, second straight on lower half; spots outlined with black; orbicular round, dark-centred; claviform elongate; reniform followed by a short black longitudinal mark; a cloudy median shade; subterminal whitish-ochreous, with two strong dentations nearly reaching hindmargin below middle, anteriorly fuscous-margined and with two short dark fuscous dashes above middle, hind-marginal space suffused with dark fuscous: cilia pale ochreous mixed with dark-grey. Hindwings grey-whitish, becoming grey posteriorly, veins and a hind-marginal line dark-grey; cilia white, with a grey line.

Larva feeding on roots of grass.

Napier, Christchurch, and Lake Coleridge, from January to March; very common. Also occurs in Australia, China, India, Africa, Europe, North and South America.

53. *Agr. admirationis*, Gn.

(*Agrotis admirationis*, Gn., Ent. Mo. Mag. v., 38.)

Male, female.—32–34 mm. Head, antennæ, and thorax in male whitish-ochreous, brownish-tinged; in female fuscous mixed with whitish. Palpi whitish, second joint externally dark fuscous except apex. Abdomen grey-whitish, anal tuft ochreous-whitish. Legs ochreous-whitish, anterior tarsi black towards base of joints. Forewings moderately dilated, less in female, costa straight, apex obtuse, hindmargin straight, rather oblique, rounded beneath, hardly waved; in male whitish-ochreous, in female fuscous mixed with whitish; costa mixed with blackish towards base and sometimes posteriorly; lines obsolete; claviform suffusedly outlined with blackish-fuscous, elongate and produced as an obscure streak to base; orbicular narrow-oval, dark-fuscous, margined with whitish-ochreous, and then imperfectly with dark-fuscous, posterior extremity of whitish-ochreous margin produced to touch reniform, and margined below by a dark fuscous spot; reniform irregular, dark fuscous, obscurely pale-margined; subterminal indistinct, with two strong dentations below middle, margined anteriorly by several small dark fuscous triangular marks, and posteriorly by a suffused dark fuscous hind-marginal space above middle; a hind-marginal row of small black triangular spots: cilia whitish-ochreous. Hindwings in male grey-whitish, in female slightly greyer; a hind-marginal row of dark-grey lunules; cilia white, with a faint grey line.

Christchurch, at roots of tussock-grass on sand-hills; very common.

54. *Agr. sericea*, Butl.

(*Chersotis sericea*, Butl., Cist. Ent. ii., 490.)

Male, female.—33–35 mm. Head, palpi, antennæ, and thorax grey, fuscous-tinged; palpi with second joint suffused with dark fuscous externally. Abdomen grey, and tuft ochreous-tinged. Legs dark grey, apex of joints whitish. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin waved, somewhat oblique, rounded beneath; grey, fuscous-tinged; lines obscurely paler and dark-margined, or obsolete; spots blackish-margined; claviform elongate; orbicular roundish, dark-centred, connected with reniform by a dark fuscous spot; reniform containing a darker inner ring; subterminal obsolete; a hind-marginal row of black dots: cilia ochreous-whitish, with three cloudy grey lines. Hindwings grey, paler and whitish-tinged towards base; cilia whitish, with a cloudy grey line.

Christchurch, in October and November.

55. *Agr. inconspicua*, Butl.

(*Chersotis inconspicua*, Butl., Cist. Ent. ii., 545.)

Male, female.—33–35 mm. Differs from *A. sericea* as follows:—Head, thorax, and forewings sometimes suffusedly irrorated with white; abdomen in male grey-whitish. Forewings with sub-basal line black-margined, first and second lines blackish-margined on discal side; no distinct dark fuscous spot between orbicular and reniform; subterminal sometimes tolerably defined, with three acute dentations below middle. Hindwings in male suffused with grey-whitish; cilia wholly white.

Christchurch and Rakaia, in December and January.

56. *Agr. ceropachoides*, Gn.

(*Agrotis ceropachoides*, Gn., Ent. Mo. Mag. v., 39.)

Male.—33–34 mm. Head, palpi, antennæ, thorax and abdomen grey-whitish; second joint of palpi banded with blackish. Legs white, irrorated with black, tarsi black, with apex of joints white. Forewings moderately dilated, costa subconcave, apex obtuse, hindmargin entire, obliquely rounded; dark grey, very densely irrorated with whitish, slightly greenish-tinged; lines and spots paler, dark-margined, almost obsolete; a hind-marginal row of black dots: cilia ochreous-grey, apical third clear white. Hindwings grey; cilia as in forewings.

Rakaia, in July, August, and September.

11. Heliothis, Tr.

Eyes naked. Antennæ in male filiform, shortly ciliated. Thorax and abdomen not crested. Anterior tibiæ with apical hook.

57. *Hel. armigera*, Hb.

(*Heliothis armigera*, Hb.; *H. conferta*, Walk., Noct. 690.)

Male, female.—36–37 mm. Head, palpi, antennæ, thorax, and legs whitish-ochreous, slightly tinged with reddish-ochreous. Abdomen ochreous-whitish. Forewings moderately dilated, costa almost straight, apex obtuse, hindmargin slightly waved, obliquely rounded; whitish-ochreous, tinged with pale reddish-ochreous; lines margined with reddish-ochreous, distinct, second marked with grey and a series of white dots; orbicular indicated by a dot; claviform obsolete; reniform very small, mixed with blackish-grey; a reddish-ochreous line representing median shade; subterminal absent; a hind-marginal row of very minute black dots: cilia reddish-ochreous, with a fine grey line. Hindwings ochreous-whitish, reddish-tinged; a moderately broad blackish-grey hind-marginal band, reddish-tinged: cilia white, base ochreous-tinged, with a fine reddish line.

Larva feeding in various flowers and seeds.

Christchurch, Rakaia, Wellington, and Waimarama; December to March; abundant, but in some localities less so than formerly. Occurs also in Australia, Samoa, India, Ceylon, Madagascar, Africa, Europe, North and South America, thus practically cosmopolitan.

12. Cosmodes, Gn.

Eyes naked. Antennæ in male filiform, shortly ciliated. Thorax with strong transverse anterior and posterior crests. Abdomen strongly crested towards base. Hindwings with veins 6 and 7 short-stalked.

58. *Cosm. elegans*, Don.

(*Phalaena elegans*, Don., Ins. N.H.; *Cosmodes elegans*, Gn., Noct. vi., 290.)

Male, female.—29–30 mm. Head grey-whitish, with two dark ferruginous bands. Palpi dark ferruginous, mixed with reddish-whitish. Antennæ dark fuscous. Thorax whitish-reddish, crests posteriorly dark ferruginous, anterior crest mixed in front with black. Abdomen grey-whitish, crest dark ferruginous. Legs grey, anterior and middle tibiæ reddish. Forewings moderately dilated, costa slightly arched, apex obtuse, hindmargin oblique, with strong broad triangular projection below middle; dark ferruginous, mixed with blackish-fuscous; four pale green spots margined with white; first large, irregularly elongate, extending almost from base to middle, curved downwards in middle; second moderate, oval, above and touching posterior extremity of first; third moderate, subtriangular, beyond second; fourth moderate, trapezoidal, above anal angle; centre of disc between these lighter, with veins whitish; a transverse light ferruginous streak towards hindmargin in middle, anteriorly white-margined, representing subterminal line: cilia fuscous-reddish mixed with black. Hindwings whitish; posterior half suffused with fuscous-reddish: cilia whitish, with a fuscous-reddish line.

Napier, Christchurch, and Governor's Bay, in March and April; several specimens. Occurs also commonly in Eastern Australia.

PLUSIADÆ.

A. Eyes with marginal cilia	13. *Plusia.*
B. „ without cilia.	
1. Antennæ in male bipectinated	17. *Rhapsa.*
2. „ „ filiform.	
a. Tarsi in male strongly thickened with dense scales	16. *Dasypodia.*
b. Tarsi in male not thickened.	
i. Terminal joint of palpi rather long	14. *Ophideres.*
ii. „ „ short ..	15. *Achaea.*

13. Plusia, Tr.

Eyes naked, margins ciliated. Antennæ in male filiform, very shortly ciliated. Thorax with large double posterior crest. Abdomen with dorsal crests towards base.

Larva 12-legged, feeding externally; pupa in a silken cocoon.

A cosmopolitan, yet not very large genus.

59. *Plus. eriosoma*, Dbld.

(*Plusia eriosoma*, Dbld., Dieff. N. Zeal. 285, Butl., Voy. Ereb., pl. x., 1, 2; *P. argentifera*, Gn., Noct. vi., 352.)

Male, female.—32–36 mm. Head, palpi, and thorax fuscous, mixed with darker and ferruginous. Antennæ greyish-ochreous. Abdomen grey, in male with whitish-ochreous lateral tufts of long hairs beyond middle, and apical tuft black beneath. Legs grey, irrorated with whitish-ochreous. Forewings elongate-triangular, costa almost straight, apex obtuse, hindmargin waved, obliquely rounded, anal angle slightly prominent; fuscous; sub-basal line straight, golden-white, not reaching inner margin, followed by a blackish-bronze spot in disc; first line straight, golden-white, angulated and interrupted beneath costa; median space suffused with deep bronze on dorsal half, containing a golden-white ?-shaped longitudinal mark and small oval spot beyond it beneath middle of disc; second line nearly straight, obscurely paler, dark-margined; an oblique sub-apical streak terminated by a straight sub-marginal line before upper half of hindmargin, and a spot on anal angle deep bronze: cilia grey, irrorated with whitish. Hindwings fuscous grey, darker posteriorly; cilia ochreous-whitish, with a cloudy grey line.

Var. a. Golden-white discal spots wholly absent.

Larva polyphagous, on various garden plants.

Taranaki, Napier, Wellington, and Nelson; rather common. Also occurs commonly in Eastern Australia. *P. chalcites*, Esp., from Europe, India, and Madagascar, appears to differ in having the hindwings yellowish anteriorly, but is otherwise almost exactly similar.

14. OPHIDERES, Hb.

Eyes naked. Palpi with terminal joint rather long, slender. Antennæ in male filiform, simple. Thorax and abdomen not crested. Forewings with tooth of scales on inner margin towards base.

An Indo-Malayan genus.

60. *Oph. fullonica*, L. (?)

(*Noctua fullonica*, L.S.N. 812, Cl. Icon., pl. xlviii., 1-4; *Noctua pomona*, Cr. 77c; *Ophideres fullonica*, Gn., Noct. vii., 111.)

100 mm. Forewings brown, marked with lighter and darker and greenish; hindwings orange, with large lunule and broad hind-marginal band black.

A single greatly-damaged specimen of what may be this species was taken in Christchurch and brought alive to Mr. Fereday; but as it is too fragmentary for identification, I give only a rough diagnosis from an Australian specimen; the species must not be quoted as from New Zealand without further proof, but in any case it is probably only a stray immigrant. The principal reason for supposing the New Zealand specimen to be referable to this species is its geographical range, which includes Samoa, Australia, India, Ceylon, and South Africa.

15. ACHAEA, Hb.

Eyes naked. Antennæ in male filiform. Thorax and abdomen not crested.

61. *Ach. melicerte*, Drury.

(*Noctua melicerte*, Drury, Ins. Exot. i., 46, pl. xxiii., 1, Cr. 323, C.D.; *Achaea melicerte*, Gn., Noct. vii., 247.)

Female.—64 mm. Head, palpi, antennæ, thorax, abdomen, and legs light greyish-ochreous. Forewings rather elongate-triangular, costa posteriorly arched, apex obtuse, hindmargin slightly waved, straight, somewhat oblique, slightly rounded beneath; pale greyish-ochreous irrorated with fuscous; lines darker; two dark fuscous discal dots on extremities of transverse vein; second line preceded by a fuscous band, containing a paler suffused subdentate line near its anterior edge; subterminal cloudy, fuscous, preceded by a narrow suffused reddish-ochreous band: cilia ochreous-whitish, with a cloudy dark-grey line. Hindwings blackish, becoming grey towards base; a straight cloudy white fascia from middle of costa to anal angle, gradually attenuated beneath; a moderate white sub-quadrate spot on hindmargin above middle, and an irregular white spot on hindmargin below middle; cilia whitish.

Wellington; one specimen. Occurs also in Australia, Fiji, Celebes, Ceylon, and India.

16. Dasypodia, Gn.

Eyes naked. Palpi with terminal joint very slender. Antennæ in male filiform, hardly pubescent. Thorax and abdomen not crested. Tarsi in male very much thickened, with dense scales (*teste Guénée*).

62. *Das. selenophora*, Gn.

(*Dasypodia selenophora*, Gn., Noct. vii., 175.)

Female.—75 mm. Head dark fuscous. Palpi dark fuscous, second joint ochreous-yellowish beneath, terminal joint ⅜ of second. Antennæ whitish - ochreous, base dark fuscous. Thorax, abdomen, and legs ochreous-brown, anterior edge of collar, under-surface, and hairs of femora ochreous-yellowish. Forewings elongate-triangular, costa posteriorly moderately arched, apex obtuse, hindmargin waved, slightly rounded, oblique; brown, slightly purplish - tinged, on median fascia paler and tinged with pale ochreous; first and second lines hardly indicated by darker margins in disc; a rather large crescentic dark grey spot in disc, margined first with whitish-blue, then black, then orange, then black again, concavity filled with a circular black spot; a median series of three fine dark-brown lines near beyond this, innermost sending three very acute teeth inwards beneath discal ocellus; a marginal series of bluish-white crescentic dots: cilia brown. Hindwings brown, lighter and ochreous-tinged towards base; a median series of three waved lines obscurely indicated; marginal dots and cilia as in forewings.

Napier, Richmond and Christchurch, in January; apparently not common. Occurs commonly in Eastern Australia.

17. Rhapsa, Walk.

Eyes naked. Palpi very long, obliquely ascending, loosely rough-scaled throughout, second joint with dense long projecting tuft above towards apex, terminal joint moderate. Antennæ in male moderately bipectinated, apex simple. Thorax and abdomen not crested. Forewings in male beneath with large broad costal fold on anterior half.

63. *Rhaps. scotosialis*, Walk.

(*Rhapsa scotosialis*, Walk., Suppl., 1150; *Herminia lilacina*, Butl., Proc. Zool. Soc. Lond., 1877, pl. xlii., 11.)

Male, female.—32–37 mm. Head, palpi, antennæ, and thorax fuscous or greyish-ochreous. Abdomen pale greyish-ochreous. Legs dark fuscous, apex of joints ochreous-whitish. Forewings very elongate-triangular, costa arched posteriorly, apex obtuse, hindmargin waved, rather obliquely rounded;

greyish-ochreous, suffusedly irrorated with fuscous; lines darker fuscous, tolerably distinct or obsolete; orbicular very small, round, varying from orange to whitish, black-margined; claviform absent; reniform moderate, whitish-ochreous, outer edge indented, anterior half margined with black and ferruginous, posterior half containing a curved transverse fuscous line; a series of dark fuscous dots beyond second line; subterminal pale, dark-margined, rather irregular, terminating in a pale triangular costal blotch; a hind-marginal row of blackish dots: cilia fuscous, irrorated with grey-whitish. Hindwings pale greyish-ochreous; a faint discal dot, slender postmedian line, and very obscure submarginal band darker grey; sometimes a hind-marginal row of dark grey dots; cilia pale greyish-ochreous.

Auckland, Napier, Wellington, Christchurch, Nelson, Akaroa and Invercargill, April to February; generally common.

APPENDIX.

The following names represent unidentified descriptions; probably they are synonymous with some of the preceding. I do not quote the descriptions, which are of little value:—

64. *Xylina spurcata*, Walk., Noct., 631.

65. *Orthosia infensa*, Walk., Noct., 748.

66. *Xylina provida*, Walk., Noct., 1737; *X. canescens*, ib., Suppl. 757.

67. *Orthosia communicata*, Walk., Suppl. 716.

68. *Xylina turbida*, Walk., Suppl. 754.

69. *Xylina vexata*, Walk., Suppl. 755.

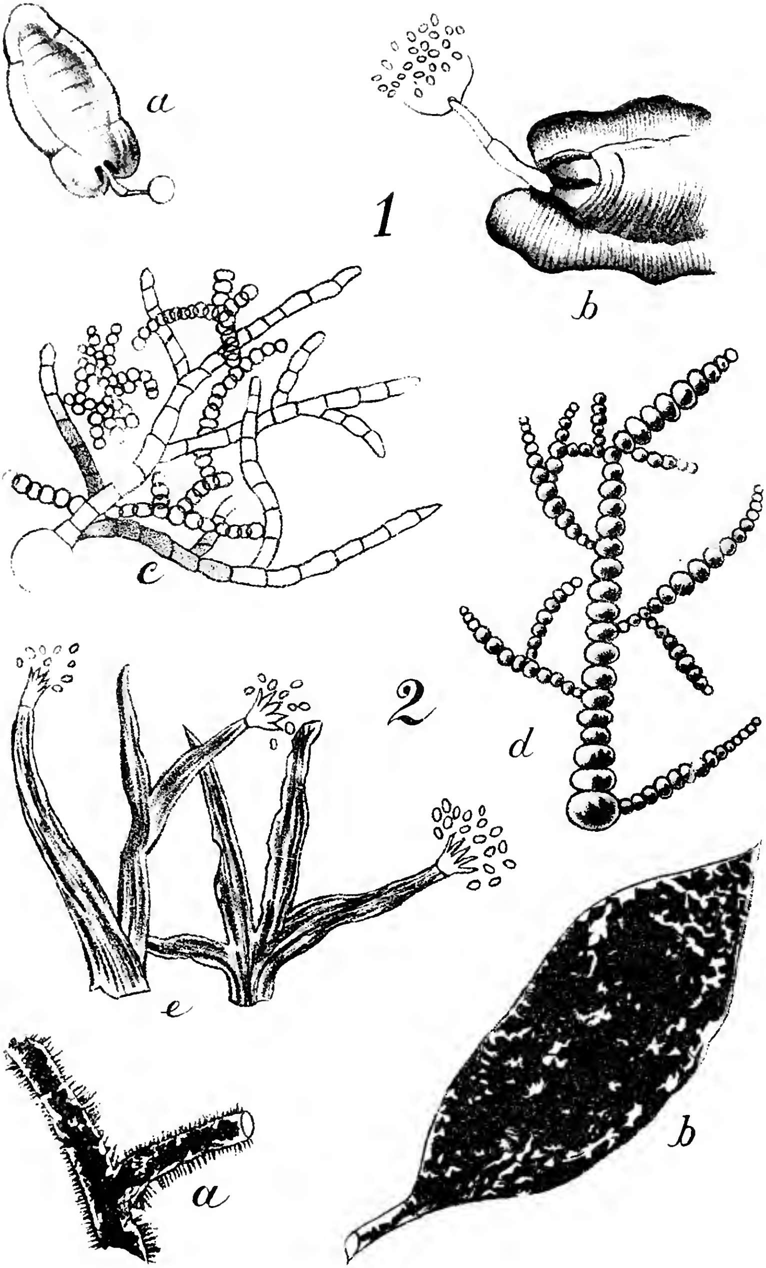
70. *Euplexia insignis*, Walk., Suppl. 724.

Walker and Butler quote two other species, *Agrotis munda* and *Heliothis peltigera*, but there is no reason to doubt that these records are erroneous, and founded on a mistaken identification.

INDEX OF GENERA.

Index of Species.

Names italicized are synonyms.



W.M.M., delt. ad nat.

A. D. WILLIS WANGANUI, N.Z.

To accompany paper by W. M. Maskell.

ART. II.—*On the "Honeydew" of* Coccidæ, *and the Fungus accompanying these Insects.*

BY W. M. MASKELL, F.R.M.S.

[*Read before the Wellington Philosophical Society, 25th August,* 1886.]

Plate I.

IT has long been known that, in common with the *Aphididæ*, *Psyllidæ*, and other Rhynchota, the Coccidæ secrete a glutinous fluid, which has received the name of "honeydew." In the other families mentioned, this fluid serves to attract and to feed various insects: thus, for example, Aphides are commonly visited by ants, which devour the honeydew, and even, it is said, go so far as to tickle the Aphides, in order to make them secrete additional fluid. Whether the secretion of Coccids may serve as food for other insects is not certain. I have never noticed anything tending to this idea: often, minute dipterous and hymenopterous insects may be seen amongst Coccids on leaves, but I incline to the belief that certainly the latter, and possibly the former, are seeking rather a place for depositing their eggs than a meal of honeydew. Hymenopterous insects are very often parasitic on Coccids: and out of a hundred pupæ of, say, *Ctenochiton perforatus*, as many as seventy-five may often be found with hymenopterous pupæ or larvæ inside them. Acarids of various kinds are also very numerous on leaves where Coccidæ are found; but, whilst it is quite possible that they may be attracted by the honeydew, this may not be the case, as Acarids are numerous and common on all plants, whether infested with Coccids or not. On the whole, I cannot affirm that the Coccid honeydew affords nutriment to any insects. I have never seen an ant amongst Coccids: but ants are not common in New Zealand, and this point is only negative, after all.

Still, the fact remains that Coccidæ exude, like other Rhynchota, a glutinous fluid. This is well known, but I think that nobody as yet has described either the mode or the organ of the secretion. An observation lately made enables me to fill this lacuna, and the points noted are not without interest in the study of the family. It happened that I was lately examining some specimens of the second, or pupa, stage of the female of *Ctenochiton elæocarpi*, mihi.* In one of these I noticed a sudden protrusion of an organ from between the

* "Trans. N.Z. Inst.," vol. xvii., 1884, p. 26.

two dorsal abdominal lobes, and the excretion of a drop of honeydew.

Ctenochiton elæocarpi, like all Lecanids, exhibits at the abdominal extremity a deepish narrow cleft, on the dorsal side of which are two roundly-triangular protruding lobes. In a specimen of the second female stage it may be seen, under the microscope, that these lobes lie in a shallow groove formed by the sides of the cleft. At intervals, which may vary in length, the insect protrudes rapidly from beneath the lobes a cylindrical organ (figs. 1*a*, 1*b*,), composed of a basal, thickish tube, bearing at its extremity another, similar, but much thinner. The organ being pushed out to its full extent, a minute globule of transparent glutinous fluid appears at its extremity, rapidly expands, something like a soap-bubble, and then suddenly breaks and falls in spray on the leaf. The excreting organ is then rapidly withdrawn.

I do not entertain much doubt that the process just described is the same used by all the "honeydew"-secreting Coccids. Some of these, like *Rhizococcus fossor*, *Planchonia epacridis*, etc., produce much less than others; but even they, I think, excrete some. The observation which I have made as above throws a light upon an organ which I noted as occurring in the second female stage of *Cœlostoma zœlandicum*, in vol. xiv. of the "Transactions," page 227, and in the adult female of the same insect in vol xii., p. 295. I then considered this organ as an oviduct, remarking, however, that I could not see its use in the pupal stage. I never saw it exserted, and was not aware that it ever was so; but it seems clear to me now that this is an organ similar to the one excreting honeydew in *Ctenochiton elæocarpi*, and it probably occurs in at least most of the other Coccids.

But observation of this organ is extremely difficult, if not in most cases impossible. The best and most careful work on the anatomy of Coccids is that of Professor Targioni-Tozzetti, "Studie sulle Coccineglie" (Milano, 1867); and there is no mention in it of any such organ. I have carefully, at various times, examined in every way many specimens of different genera, and, with the exception of *Cœlostoma* (an exceptionally gigantic species), I have not seen it.

There is no doubt of the quantity of glutinous matter secreted by Coccids; but, as observed above, the origin and mode of the excretion have not been noticed before. There does not appear to be any other organ, or any other portion, of the insect's body, producing this secretion; and it may well be that the absence of insects feeding on the honeydew may be due to the fact that the excreting organ, instead of being constantly protruded like the cornicles of the Aphididæ, is only now and then exserted and then withdrawn. In many genera, such as *Aspidiotus*, *Ctenochiton*, *Inglisia*, *Eriococcus*, etc., the character of the shield or test, waxy or cottony or felted, would prevent the honeydew from exuding anywhere but at the abdominal extremity; there, however, there is almost always some kind of orifice or cleft permitting the extrusion of the excreting organ.

A point of considerable economic importance is connected with this honeydew of Coccids, namely, the growth upon it of various fungi; and I take this opportunity of drawing the attention of farmers and tree-growers to it, as I believe that a good deal of misconception exists in its regard. Everybody, doubtless, has observed how, in gardens or in greenhouses, in plantations or in forests, many plants have an unpleasantly blackened appearance; and it frequently happens that the true colours of the twigs and leaves are much, if not quite, obscured by the black coating on them (see figs. 2*a* and 2*b*). Now, it will generally be observed that this black coating is in most cases thicker and more unsightly on the lower than on the upper leaves and branches: sometimes, indeed, the uppermost leaves will be bright green, whilst the lowest look as if they were covered with soot. It will also be noticed that the black coating is abundant, not only in the damp recesses of the forest, but also in comparatively dry greenhouses, and just as much so in open-air gardens.

The primary cause of this is usually the presence of some homopterous insects, whether *Aphididæ*, *Psyllidæ*, *Coccidæ* or others. The "honeydew" excreted by them drops, or in the case of Coccids falls in spray, over the leaves beneath them: it very soon furnishes a glutinous and congenial soil for the spores of fungi. If one may judge from the quantity of black coating often found, the act of excretion above described must be repeated somewhat frequently, though so seldom observed.

As to the question, what is this black sooty coating: there is no doubt of its fungoid character, but I am not able to identify it precisely. There seem to be, in fact, several species in it. On the leaves, the fungus forms usually a flat, black, thinnish, closely woven covering; on the twigs and stem it has a looser texture, and generally forms a mass of small erect threads (see figs. 2*a* and 2*b*). These appearances are by no means confined to New Zealand, and most writers on Coccidæ devote some phrases in passing to the fungus. Signoret* calls it "*fumagine;*" Comstock † calls it "*Fumago salicina:*" in an early paper of mine (1878) I attributed it to "*Antennaria.*" In point of fact, a good many of the Hyphomycetes and Physomycetes may be found amongst this fungoid growth. I have attached to this

* "Essai sur les Cochenilles."

† Report of the Entomologist, U.S. Department of Agric., 1880.

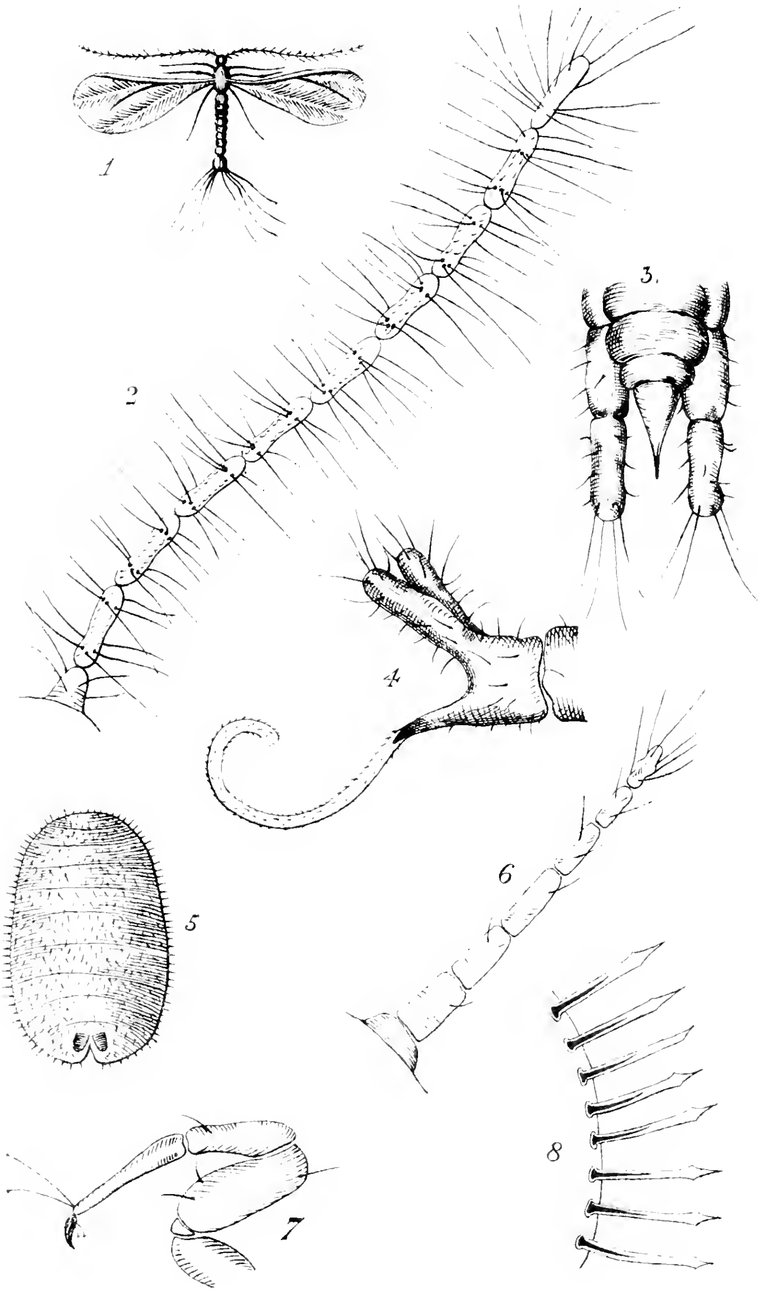
paper (figs. 2*c*, 2*d*, 2*e*) rough representations of three different forms observed.‡

The economic point, however, to which I draw attention is that, as a general rule (I might even put it more strongly), the appearance of this black fungus is an indication of the presence of homopterous insects; probably, in New Zealand, of Coccidæ, because they are the most numerous of the order in this country. Now, a great deal has been heard of late years of the damages by scale-insects, and all sorts of people have written or experimented about them. I find that, amongst the diseases of trees, this black fungus-growth has attracted attention: but the misconception to which I alluded just now is that it has been considered as a separate, or primary, disease, which I do not think it is.

In Mr. Kirk's "Report upon the Diseases of Lemon and other trees in New Zealand," the common notion is embodied, and, under the head of "Lemon Smut, or Black Blight," the writer even emphasizes it, by saying that the excreta of *Icerya purchasi* (a scale-insect) had no share in its production, and that it was of "purely vegetable origin." In answering, in 1885, questions by a Select Committee of the General Assembly upon tree-diseases, I combatted this view, and ascribed the black "smut" to fungoid growths, the result of the presence of homopterous insects. I believe that Mr. Kirk has now come round to this view of the question, which is, undoubtedly, the right one.

It stands to reason, then, that if a farmer, or orchard-grower, or gardener, observing this black growth on his trees, imagines it to be the primary cause of disease, and sets to work to eradicate it without attending to the insect pests, he will be simply throwing his labour away. And there is this important fact to be remembered, that it is not with scale-insects as with other insects. Coccidæ are impervious to many things which might, in other cases, be efficacious. There is a common belief which, like most superstitions, it is excessively difficult to destroy, that sulphur is an useful ingredient in what are called "scaly-blight destroyers." I should not be in the least surprised to find that many who hold this belief do so because they have found the black fungus disappear, or lessen, after its use, for sulphur is undoubtedly a remedy for fungoid blights—*e.g.*, *oidium*, etc.; and probably they never thought of looking more closely into the matter. All experience goes to show that sulphur, unless applied in such strength as to burn up insects, fungus, tree and all, is not a remedy against Coccids. Comstock, Riley, Hubbard, and others agree in this: and although, in newspaper

‡ Boudier (Assoc. Fran. pour l'avancement des Sc., 1884) includes the European fungi developed in the honeydew of Aphis in the genus *Cladosporium* (Quart. Journ. Roy. Micros. Soc., Aug. 1886, p. 597).



W.M.M. delt

NEW ZEALAND COCCIDÆ.

accounts, and in the replies of farmers to questions from officials or committees, we find sulphur a common ingredient in the thousand-and-one mixtures recommended, I doubt very much if anybody could give an intelligent reason for its employment.

No harm will therefore have been done, I think, if this paper should induce gardeners and fruit-growers to go direct to the true origin of disease in their trees and neglect the secondary one. That the fungus will grow independently of scale-insects is, of course, indisputable: but those who wisely consider it as, in the vast majority of cases, merely an accessory to their presence, and who set themselves to destroy the Coccidæ or Aphididæ on the plants, will find the black fungus also very quickly disappear.

EXPLANATION OF PLATE I.

Fig. 1*a*. *Ctenochiton elæocarpi* (larva) magnified, with waxy test removed; showing excreting organ, and bubble of honeydew.
Fig. 1*b*. Abdominal extremity of same, magnified, with waxy fringe; honey-dew bubble bursting.
Fig. 2*a*. Fungoid growth on twig.
Fig. 2*b*. Fungoid growth on leaf.
Fig. 2*c*. }
Fig. 2*d*. } Varieties of fungoid growths.
Fig. 2*e*. }

ART. III.—*Further Notes on New Zealand* Coccidæ.

By W. M. MASKELL, F.R.M.S.

[*Read before the Wellington Philosophical Society, 19th January*, 1887.]

Plate II.

Group COCCIDINÆ.

Icerya purchasi, mihi. Plate II., figs. 1–4 (male).

BY the kindness of the Rev. Mr. Colenso, of Napier, I have received some specimens of the male of this species. No published description of the male *Icerya* is known to me, though the insect must be common in California. The following description is therefore here given:—

Male insect large; body red, with a shining, diamond-shaped, black patch on the dorsal surface of the thorax; legs and antennæ black; wings dark-brown, marked with numbers of parallel, wavy, oblique, narrow stripes; main nervure red, branching once; there are also two longitudinal whitish stripes in each wing. Antennæ long, slender, with ten joints, all nearly equal; the last joint is clavate; all except the first are constricted in the middle and with two dilations, at each of which there is a ring of very long hairs, giving to the antennæ almost a plumose appearance. From these dilations and the median constriction the antenna appears to have nineteen joints, and it requires close examination to show that there are really only ten. Eyes very large and prominent, dark-brown, and divided into numerous semi-spherical facets; at the base of each eye is a prominent tubercle. Feet long, and very hairy; coxæ short and thick, tibiæ long and slender; claw thin. The digitules appear to be represented by two minute bristles on the claw, as in *Cœlostoma zealandicum*. Abdomen long and slender, with eight cylindrical segments, each segment bearing some hairs; the last segment ends in two conspicuous, thick, cylindrical processes which, when the insect is viewed sideways, are seen to turn upwards, and beneath them the conical, sharp-pointed sheath of the penis turns downwards (figs. 3, 4); penis large, reddish-coloured, with many recurved short hairs, and at the end a ring of short spines. Each terminal process of the abdomen bears three or four long strong setæ.

Length of the body somewhat variable; some of my specimens attain $\frac{1}{8}$ inch; expanse of wings $\frac{1}{4}$ inch; length of antenna $\frac{1}{9}$ inch.

This is a very handsome insect, clearly showing the characters of the group *Monophlebidæ*, and a little resembling the male of *Cœlostoma*; but specially fine in its variety of colours. The antennæ approach those of *Leachia*; the two abdominal terminal processes recall the six or eight tassels of *Monophlebus*. Mr. Colenso informs me that the insect flies strongly and swiftly, which is rather exceptional amongst Coccids, whose wings usually seem too weak for them.

Group LECANIDINÆ.

Sub-section Lecano-Coccidæ.*

Abdominal cleft and lobes present in all stages of female. Insects covering themselves with a secretion of cottony or felted matter, forming more or less complete sacs.

Genus, **Eriochiton**, gen. nov.

Secretion white, felted, formed of agglutinated threads issuing from prominent spiny spinnerets; inconspicuous or absent on adult female, more or less noticeable on female larvæ and pupæ; thick on male pupa. Abdominal cleft and lobes normal. Feet and antennæ present in all stages. Adult antennæ seven-jointed.

Differs from *Lecanodiaspis*, Targioni, in retaining the feet, and in the antennæ; from *Philippia*, Targioni, in not constructing its sac, or test, simply for gestation.

* "Trans. N.Z. Inst.," vol. xvi., 1883, p. 128.

The fact that the tibia is shorter than the tarsus in the adult female, in both the species here given, is quite exceptional in the family. It occurs only, besides in these, in some species of *Acantho-coccidæ*: in all others, a tibia shorter than the tarsus is an indication that the specimen examined is not full-grown. I have hesitated to include this amongst the generic characters of *Eriochiton* until at least a third species has been found possessing it. Some persons are fond of creating genera and species from a single specimen or two. I do not agree with this.

Eriochiton spinosus.

(*Ctenochiton spinosus*, mihi.)

From closer examination of the female test of this species I find that it is not formed of waxy plates but of felted threads.* and I am therefore obliged to remove it from the genus *Ctenochiton*. It should be described as follows:—Test of female white, thin, formed of felted threads; inconspicuous in all stages and often absent from the adult, but distinguishable on the larva and on the second, or pupal, stage.

The male test (which I have only lately found) is white, thick, felted, oval, convex, averaging $\frac{1}{16}$ inch in length.

To the description of the adult female already given in former papers, it must be added that the tibiæ are shorter than the tarsi, a very exceptional character.

The adult male (only lately found, and apparently very rare) is of the normal Lecanid form; colour generally dark brown. Eyes: two dorsal, two ventral; and two ocelli. Antennæ of ten joints; the second thicker than the rest, the third and fourth the longest, the eighth, ninth, and tenth moniliform; all the joints hairy, and on the five last joints are several hairs with clubbed extremities. Feet slender, hairy; digitules fine hairs. Abdominal spike somewhat strong and sharp; and on each side of its base is a tubercle bearing two long setæ, and each pair of setæ becomes enclosed in a long white cottony thread, the two threads forming conspicuous "tails," as is common with many male Coccids.

Eriochiton hispidus, sp. nov. Plate II., figs. 5–8.

Test of female white, very thin, felted, formed of threads secreted by the numerous spiny spinnerets. At the edge

* The tests of all Lecanids may be said to be more or less "waxy;" and I am not certain that there is any *chemical* difference between them: but there must be some reason why, in certain species, the secretion forms plates of wax which are apparently homogenous, whilst in others the threads issuing from the spinneret tubes never entirely coalesce. I believe the distinction which I have made between "waxy," "cottony," and "felted," and which is made also by other writers, is quite clear enough for generic purposes; though it may never be worth while for anybody to ascertain the chemical reasons for it.

each thread corresponds with one of the marginal spines, and forms a more or less conspicuous fringe, the segments of which are cylindrical tubes, not feather-shaped as in *E. spinosus*. Test often absent on the adult female, and always fragmentary: it is better observed on the second, or pupal stage, or on the larva.

Test of male white, thick, felted, oval, and convex, completely covering the pupa. Length about $\frac{1}{16}$ inch. As the test exhibits a kind of segmented appearance, with transverse obscure grooves, it may at first sight be mistaken for a dactylopid insect.

Larva normal of the Lecanid group; flat, elliptical, active, exhibiting the abdominal cleft and lobes. Dorsal surface covered with numerous spiny spinnerets, from which issue the threads of the test and fringe.

Female of the second (pupal) stage more or less elliptical, slightly convex, reddish-brown in colour beneath the thin white felted secretion, which often presents an obscurely segmented appearance, due to the transverse rows of spiny spinnerets. Dorsum covered thickly with these spines, which are sub-cylindrical, with rounded tips, and spring from tubercular bases. On the ventral surface many small spiny hairs. Abdominal cleft normal, the lobes large. Mentum monomerous, the tip bearing several hairs. Antennæ of six somewhat hairy joints. Feet with rather large femora; digitules all fine hairs. Anogenital ring bearing several hairs.

Adult female elliptical, convex, reddish-brown in colour, hollow beneath; usually affecting the twigs of the plant in preference to the leaves. Apparently naked, but on close inspection found to retain at least portions of the thin felted secretion. Dorsum covered with great numbers of the spiny prominent sub-cylindrical spinnerets; ventral surface bearing many small spiny hairs. Antennæ of seven joints (fig. 6). Feet with large coxæ and femora; tibia a good deal shorter than the tarsus; lower digitules only fine hairs.

Adult male reddish-brown in colour; form normal of Lecanidæ. Two dorsal eyes, two ventral eyes, two ocelli. Antennæ ten-jointed, the last three moniliform; second, third, and fourth the longest. On the five last joints are several hairs with clubbed extremities. Feet slender, hairy. Abdominal spike rather strong and sharp; and on each side of its base is a broad tubercle bearing two long setæ, which become joined in long cottony "tails."

Habitat.—On *Olearia haastii*, found as yet (in great numbers) only on a plant cultivated in the Botanical Gardens, Wellington. It is rapidly killing the shrub. *O. haastii* is, I believe, an alpine plant.

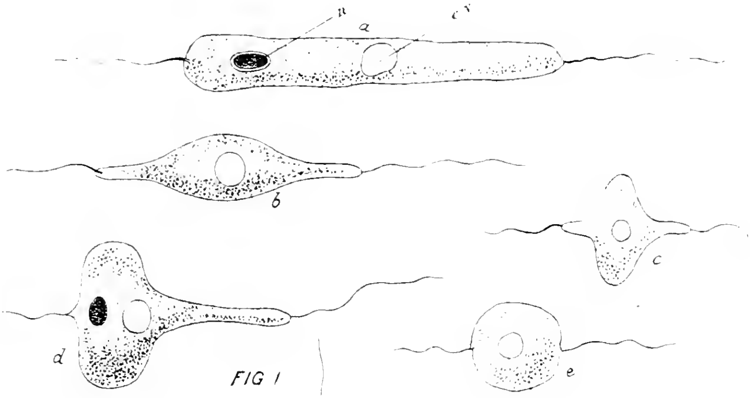


FIG 1

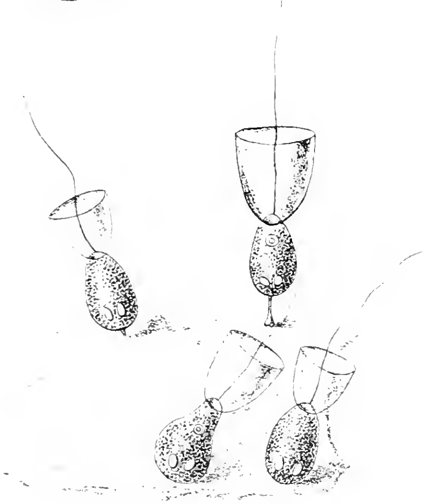


FIG 2

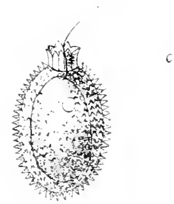


FIG. 3.

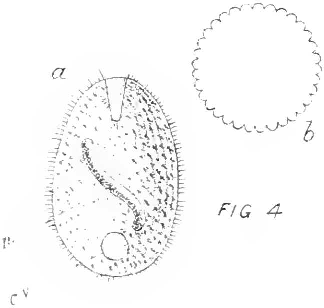


FIG 4

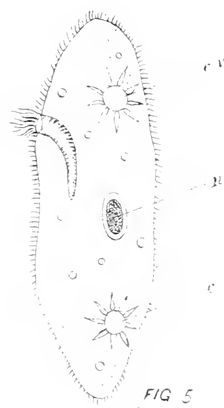


FIG 5

W.M.M. delt. NEW ZEALAND INFUSORIA.

This species is distinguished from *E. spinosus* by the great number of spiny spinnerets on the dorsal surface of the female, and by the cylindrical tubes of the fringe. Its colour is also rather redder and lighter; but that is not a valuable character. I cannot find any clearly distinguishing marks in the males of the two species.

DESCRIPTION OF PLATE II.

Fig. 1. *Icerya purchasi*, male insect.
Fig. 2. ,, ,, part of antenna.
Fig. 3. ,, ,, extremity of abdomen, viewed from beneath.
Fig. 4. ,, ,, extremity of abdomen, side view.
Fig. 5. *Eriochiton hispidus*, adult female.
Fig. 6. ,, ,, Antenna.
Fig. 7. ,, ,, Foot.
Fig. 8. ,, ,, Marginal spines and fringe of test.

ART. IV.—*On the Freshwater Infusoria of the Wellington District.*

By W. M. MASKELL, F.R.M.S.

[*Read before the Wellington Philosophical Society, 30th June,* 1886.]

Plates III., IV., V.

THE following is the result of some investigations by the Microscopical Section of the Wellington Philosophical Society, Messrs. A. Brandon, jun., W. F. Barraud, C. P. Powles, T. W. Kirk, and the writer. These investigations have only been undertaken in the intervals of leisure afforded to men engaged in the ordinary work of life: the result, therefore, can be taken simply as complete as far as it goes; that is, merely a systematic list of the freshwater infusorian life here. The preparation of similar lists appears to be desirable in any country, and especially so in New Zealand, where the fauna and flora offer still so large a field for the inquiries of students of Nature.

The want of full opportunities and ample time, hinted at above, and the difficulty of arranging and working with apparatus constantly requiring attention, have prevented the members of the section from properly investigating the development of the animalcules herein presented as new to science. But, as these have not necessitated the establishment of any new genera, and as the processes of reproduction have been so fully studied and described in other countries, the defect in the present case is not of great importance. The phenomena of reproduction by fission have, of course, been frequently noticed, but time and opportunity have not been available for their continuous observation.

Two points require slight mention here. First, it is to be noted that in many instances, where animalcules have been referred in this paper to described species, there have been observed minute variations, not considered sufficiently important to induce the erection of a new species, yet often tending to make identification a matter of some difficulty. Instances of this may be mentioned in the genera *Stentor*, *Euglena*, and others, and especially, perhaps, in the Heterotrichous Order. It has been considered desirable to avoid as much as possible the multiplication of species. Secondly, it is noticeable that in some instances —*e.g.*, *Aspidisca turrita*, *Licnophora setifera*—animalcules inhabit freshwater here which are only reported from sea-water in Europe or elsewhere.

Finally, it is to be observed that examination has only been made into strictly *freshwater* animalcules, excluding marine or "infusion" types. The present paper, being only the beginning of what may easily be a long task, has been purposely complicated as little as possible.

Catalogue of Infusoria.

Class I. FLAGELLATA.

Order. Flagellata-Pantostomata.

Genus Monas.

Monas fluida, Duj. Wellington.

Monas attenuata, Duj. Wellington; Wainui.

Probably several others of this genus may also occur here.

Genus Scytomonas.

Scytomonas pusilla, Stein. Wellington.

Genus Oikomonas.

Oikomonas mutabilis, Kent. Wainui.

Genus Cercomonas.

Cercomonas grandis, sp. nov. Plate III., fig. 1, *a*, *b*, *c*, *d*, *e*.

Animalcules free-swimming, variable in shape, globular or elongate, with a single anterior terminal flagellum, and a somewhat shorter posterior terminal filament. Flagellum about half the length of the fully extended body. Contractile vesicle single, central.

Length when fully extended $\frac{1}{400}$ inch = 62 μ. No oral aperture.

Wellington, *W. M. Maskell.*

Differs from described species in its very large size. The presence of a caudal filament and the absence of an oral aperture remove it from the genus *Astasia*.

Genus **Dendromonas.**

Dendromonas virgaria, Weisse. Wainui.

Genus **Anthophysa.**

Anthophysa socialis, De From. Wellington; Wainui.

Anthophysa vegetans, Müller. Wellington.

Genus **Goniomonas.**

Goniomonas truncata, Fres. Wellington.

Genus **Rhipidodendron.**

Rhipidodendron huxleyi, Kent. Wainui.

This is a peculiar and interesting form, and it is remarkable that the only other recorded specimens are from Dartmoor, in England. Curiously, also, the Wainui infusorian is accompanied, as in England, by the following species, *Spongomonas sacculus*.

Genus **Spongomonas.**

Spongomonas discus, Stein. Wainui.

Spongomonas sacculus, S. Kent. Wainui.

The occurrence of this curious monad with *Rhipidodendron*, here, as at Dartmoor in England, seems to suggest possible connection between the two. Neither of the two appears to have been recorded from any other locality. The character of the zoocytium, or common gelatinous granuliferous mass enclosing the animalcules, seems scarcely to vary in the two genera; and the main difference would appear to lie in the fact that the animalcules of *Rhipidodendron* inhabit separately the tubes of a branching zoocytium, those of *Spongomonas* living together in the common mass. Time has not yet permitted a continuous investigation of the two forms, which might not impossibly be found, as hinted above, to be in some way connected.

Genus **Heteromita.**

Heteromita lens, Müller. Wellington.

Order. FLAGELLATA-DISCOSTOMATA, or CHOANO-FLAGELLATA.

(The "collared" monads.)

Genus **Monosiga.**

Monosiga consociata, Kent. Wainui. Plate III., fig. 2.

A figure of this species is given to illustrate the peculiar "collar" of the order.

Genus **Salpingæca.**

Salpingæca amphoridium, James-Clark. Wainui, Karori, Porirua.

Order Flagellata-Eustomata.

Genus **Phialonema.**

Phialonema cyclostomum, Stein. Wellington.

Genus **Astasia.**

Astasia tricophora, Ehrenberg. Wellington, Wainui, Hutt Valley.

Genus **Euglena.**

Euglena viridis, Ehrenberg. Wellington, Wainui, Mungaroa, Hutt Valley.

Euglena spirogyra, Ehrenberg. Wellington, Wainui.

Euglena acus, Ehrenberg. Wellington.

Genus **Amblyophis.**

Amblyophis viridis, Ehrenberg. Wainui.

Genus **Phacus.**

Phacus triqueter, Ehrenberg. Wainui, Hutt Valley.

Genus **Trachelomonas.**

Trachelomonas volvocina, Ehrenberg. Wellington.

Trachelomonas armata, Ehrenberg. Wellington, Wainui, Hutt Valley.

Trachelomonas crenulatocollis, sp. nov. Plate III., fig. 3.

Lorica elliptical, covered with sharp conical spines, which at the edge form a continuous border of points; anterior aperture large, and produced in a short tubular fluted neck slightly widening to the end, and terminated by a crenulated edge. Animalcule green; lorica dark yellow with red edge. Flagellum single.

Wainui, Pukerua, Hutt Valley, *W. M. Maskell.*

An elegant little species, distinguished from *T. hispida* by the fluted tubular neck; from *T. eurystoma* by the rough lorica; and from *T. armata* by the absence of caudal spines.

Genus **Uvella.**

Uvella virescens, Ehrenberg. Wainui, Karori.

Genus **Dinobryon.**

Dinobryon sertularia, Ehrenberg. Wellington.

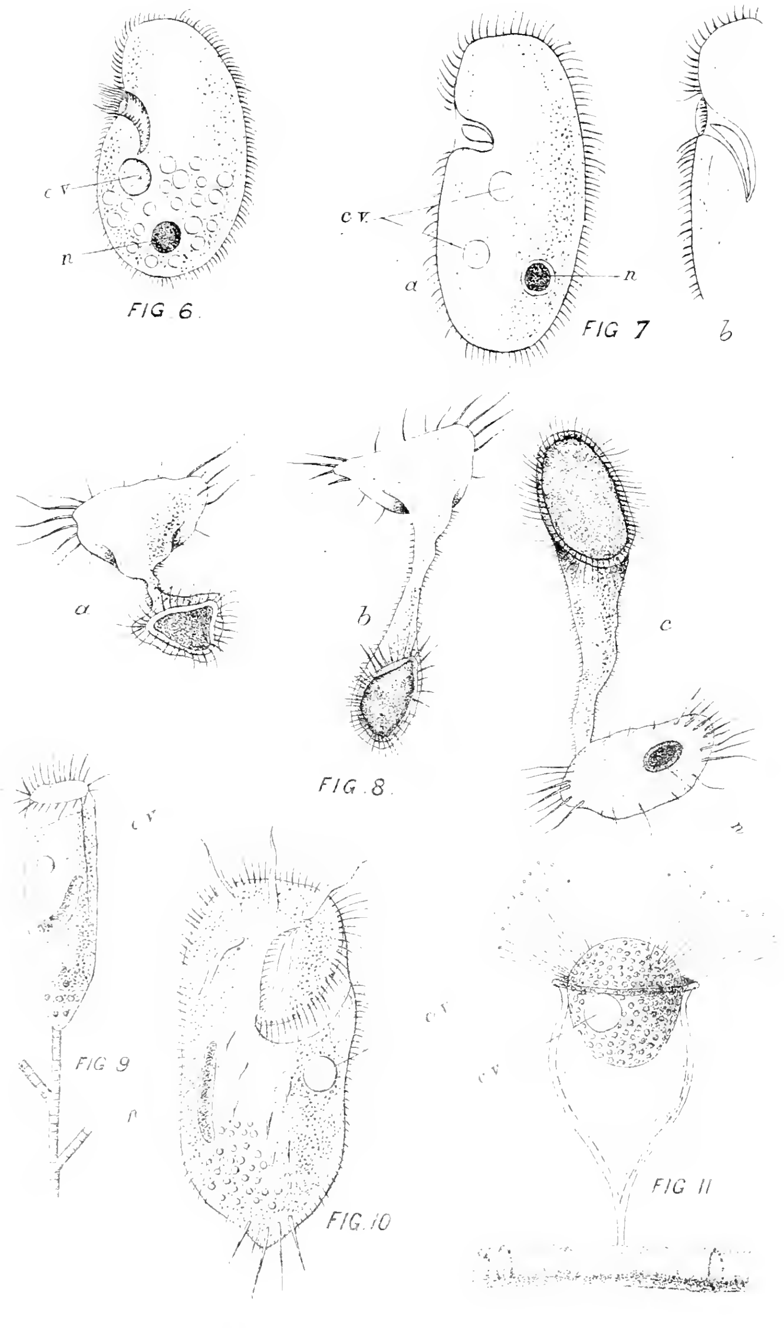
Genus **Sterromonas.**

Sterromonas formicina, Kent. Wellington, Wainui.

Order. Cilio-Flagellata.

Genus **Peridinium.**

Peridinium tabulatum, Ehrenberg. Wainui, Mungaroa, Karori.



W.M.M. delt. NEW ZEALAND INFUSORIA.

A variation of this infusorian, which might perhaps be a new species, was observed on one occasion, but not sufficiently examined. The cuirass was nearly twice as long as broad, almost ovate, and the posterior extremity exhibited a narrow, not very deep, slit.

Class II. CILIATA.

Order. Holotricha.

Genus **Paramœcium.**

Paramœcium aurelia, Müller. Wellington, Wainui, Hutt Valley.

Paramœcium bursaria, Ehrenberg. Wellington, Hutt Valley.

Genus **Prorodon.**

Prorodon sulcatus, sp. nov. Plate III., fig. 4; *a*, *b*.

Animalcules free-swimming; motion gliding, sometimes rotatory, not rapid. Body persistent in shape, cylindrical, ovate, slightly narrowed anteriorly, longitudinally furrowed by numerous, somewhat deep, striæ. Oral aperture terminal, narrow; pharynx narrow, cylindrical, somewhat deep, armed with numerous rod-like teeth which are very inconspicuous. Nucleus band-like, curved, sub-central. Contractile vesicle single, at the posterior extremity.

Length, $\frac{1}{300}$ inch = 83 μ; greatest width, about $\frac{1}{400}$ inch = 62 μ.

Wellington, *W. M. Maskell.*

No mention appears to be made in descriptions of recorded species of the longitudinal furrows mentioned above. These show as conspicuous striæ in viewing the animalcule on the side; but in end view they become apparent as furrows. Other differences from *P. niveus*, *P. teres*, etc., are size, the narrowness of the pharynx, and the inconspicuous rods. After treatment with iodine, a kind of protrusion of the oral aperture is sometimes visible.

Genus **Trachelophyllum.**

Trachelophyllum apiculatum, Perty. Mungaroa.

Genus **Coleps.**

Coleps hirtus, Ehrenberg. Wellington, Wainui.

Genus **Tillina.**

Tillina enormis, sp. nov. Plate III., fig. 5.

Animalcule free-swimming; motion rapid, gliding, sometimes spiral. Persistent in shape, elongated, scarcely showing any reniform outline; length about three times the greatest width. Oral aperture ventral, slightly in advance of the median line; simple, fringed with cilia longer than those of the body;

followed by a distinct curved pharynx. Pharynx simply ciliated throughout. Nucleus oval, conspicuous, sub-central. Contractile vesicles two, near the extremities, often exhibiting stellate appearance, as in the figure. Body finely ciliated throughout, also sparsely striated longitudinally.

Length $\frac{1}{30}$ inch = 833 μ.

Wellington, *W. M. Maskell.*

A large and distinct species, placed here in the genus *Tillina* on account of the characters of the oral aperture and pharynx. The longer cilia of the former remove it from *Paramœcium*, and the absence of a vibratile membrane in the latter distinguishes it from *Plagiopyla* or *Colpidium*. *Anophrys* has no cilia in the pharynx. Kent assigns to the genus only one contractile vesicle, and in his species, as well as in those reported from America by Professor Stokes,* the outlines are distinctly reniform; but these points do not seem sufficient to demand a new genus for the New Zealand animalcule. The shape and dimensions given above were very constant in a large number of specimens observed.

Tillina inequalis, sp. nov. Plate IV., fig. 6.

Animalcules free-swimming; motion rapid, gliding; persistent in shape, outline sub-reniform, the posterior portion larger than the anterior. Oral aperture ventral, a little in advance of the median line, situated in the shallow and not extensive depression of the body. Oral cilia longer than those of the body. Pharynx curved, not conspicuous, simply ciliated: no vibratile membrane. Nucleus inconspicuous, circular, posteriorly sub-central. Contractile vesicle single, sub-central, near the extremity of the pharynx. The food particles usually collected in a number of circular masses. Body finely ciliated throughout.

Length, $\frac{1}{240}$ inch = 104 μ; greatest width, $\frac{1}{400}$ inch = 62 μ.

Wellington, *W. M. Maskell.*

This animalcule seems most nearly allied to *T. inflata*, Stokes, but differs in the inequality of the anterior and posterior portions, and in the shallowness of the depression between them. The form and dimensions given are quite constant. *Tillina campyla*, Stokes†, is much narrower and smaller generally.

Genus **Trachelocerca.**

Trachelocerca filiformis, sp. nov. Plate V., fig. 15; *a*, *b*, *c*.

Animalcule highly elastic and variable; body fusiform, somewhat pointed posteriorly, produced when extended into

* "Ann. and Mag. of Nat. Hist.," vol. xv., 5th series, p. 441.
† "Ann. and Mag. of Nat. Hist.," Feb., 1886, p. 101.

an exceedingly long filiform neck, often reaching six or seven times the length of the body, and terminating in an obtuse sub-conical region rather wider than the neck, with a circle of longer cilia beneath it. Contractile vesicle single, posterior: endoplast elliptical, sub-lateral. The whole body and neck are marked with a network of striæ.

Length when fully extended reaching perhaps $\frac{1}{70}$ inch = 357 μ, but the twistings and curlings of the thread-like neck are so rapid that measurement is very difficult.

Wellington, *W. F. Barraud.*

Closely allied to *T. olor*, Müller, but differing in the position of the single contractile vesicle and the character of the nucleus.

Genus **Amphileptus.**

Amphileptus anser, Ehrenberg. Wellington.

Genus **Colpidium.**

Colpidium cucullus, Schrank. Wellington.

Genus **Plagiopyla.**

Plagiopyla varians, sp. nov. Plate IV., fig 7; *a*, *b*.

Animalcules free-swimming; motion rapid, gliding; persistent in shape, sub-reniform. Oral fossa ventral, a little in advance of the median line, sometimes shallow, broad, and at right angles to the axis of the body, sometimes tubular, conical and oblique; containing a narrow vibratile membrane which does not quite reach to the aperture. Nucleus posteriorly located, conspicuous, circular. Contractile vesicles 2, placed between the oral fossa and the posterior extremity.

Length, $\frac{1}{200}$ inch = 125 μ.

Wellington, *W. M. Maskell.*

Resembling *P. nasuta*, Stein, but differs in the position of the nucleus, the *two* contractile vesicles, and the variation of the oral fossa. The animalcules observed presented this variable arrangement in a large number of specimens, and were at first thought to be distinct; but on further consideration they seemed to be really the same.

Genus **Pleuronema.**

Pleuronema coronata, Kent. Wainui.

This animalcule appears to be identical with Kent's infusorian in everything except size. The European species is stated to have a length of only $\frac{1}{290}$ inch = 86 μ, whilst the Wainui specimens reached $\frac{1}{200}$ inch = 125 μ. It is not *P. chrysalis*, as it possesses long, fine, rigid setæ in addition to the cilia.

Pleuronema cyclidium, sp. nov. Plate V., fig. 16.

Animalcules sub-reniform, with very shallow groove, about twice as long as broad, having a number of long fine hair-like setæ over the whole body; setæ of equal length throughout. Extensile membrane of the oral region narrow, and rather deep when extended. Contractile vesicle single, at one extremity; nucleus sub-central, elliptical. A number of granular masses often visible in the parenchyma.

Length, $\frac{1}{1330}$ inch $= 19\ \mu$.

Wellington, *A. Brandon.*

Differs from *P. chrysalis* and *P. coronata* in its extremely small size, which was constant in many hundreds of specimens observed, and which would make it approach nearer to *Cyclidium* or *Uronema*, except for the absence of the long caudal setæ characterizing those genera.

Genus **Cyclidium.**

Cyclidium glaucoma, Ehrenberg. Wellington.

Genus **Uronema.**

Uronema marinum, Dujard. Wainui.

Order Heterotricha.

Genus **Metopus.**

Metopus sigmoides, Müller. Wellington.

Genus **Spirostomum.**

Spirostomum ambiguum, Ehrenberg. Wainui, Hutt Valley.

Genus **Stentor.**

Stentor gracilis, sp. nov. Plate V., Fig. 13; *a*, *b*.

Body of moderate size, highly extensile, white or light-brown: when fully extended very slender for almost all its length and suddenly widening to the peristome, giving something of the appearance of a broad-headed nail. Peristome at full extension nearly half as wide as the length of the body. Sides of the extended stem nearly parallel, average width below the peristome region about one-fifteenth of the total length. Parenchyma containing often several dark-coloured granular masses. Contractile vesicle spherical, situated below the peristome. Endoplast band-like. Peristome border narrow, slightly emarginate in its whole extent, with a very deep cleft on one side extending for some distance down the stem; the cleft bears the usual peristomal cilia. Body when free-swimming elongate, racket-shaped, exhibiting the cleft of the peristome almost closed, as a narrow longitudinal slit.

Length of the extended animalcule rather more than $\frac{1}{30}$ inch $= 833\ \mu$.

Wellington, Hutt Valley, *W. F. Barraud.*

The slenderness of the extended stem, the sudden widening of the peristome, the deep lateral cleft and the white colour, separate this from all described species. The dimensions and form given were constant in several specimens observed.

Stentor striatus, sp. nov. Plate V., fig. 14; *a*, *b*.

Body very large, dark-green with almost a blue tinge, highly elastic. When fully extended it has something of the shape of an old-fashioned deep champagne-glass, being narrow and very long, widening gradually from the point of attachment to the peristome, which is not recurved and widened, being scarcely wider than the portion of the body beneath it. The peristome edge is irregular, rising at one spot to a sharp point, and in another depressed in a not very deep groove, beneath which is a sub-cylindrical transverse region of very dark-green colour, reaching nearly to the median line: this appears, when the animalcule is free-swimming, as a conspicuous helical coil. Parenchyma containing several large granular masses, often coloured brown. Contractile vesicle spherical, below the peristome. Endoplast long, moniliform. The whole body is marked with broad, conspicuous striæ, which are most perceptible in the contracted state, and which give a crenulated appearance to the edge when the animalcule rolls over and is seen from one end.

Length of the fully extended body $\frac{1}{11}$ inch = 2260 μ.

Wellington, Ohariu, *W. F. Barraud.*

The very large size, dark-green colour, conspicuous striæ, and scarcely expanded peristome of this species are sufficiently characteristic. Dimensions and form constant in many specimens.

Order. Peritricha.

Genus **Halteria.**

Halteria grandinella, Müller. Wellington, Wainui, Hutt Valley, Karori.

Genus **Strombidium.**

Strombidium claparedii, Kent. Wellington.

Genus **Gyrocoris.**

Gyrocoris oxyura, Stein. Wellington, Wainui.

Genus **Urocentrum.**

Urocentrum turbo, Müller. Wainui, Hutt Valley.

Genus **Licnophora.**

Licnophora setifera, sp. nov. Plate IV., fig. 8; *a*, *b*, *c*.

Animalcules free-swimming, sometimes attached; motion very rapid, jerking or twisting. Body very irregularly shaped; the foot-like region more or less oval beneath, tumid, and bearing instead of cilia a few, about 20, somewhat strong setæ, of which the greater number are collected in two groups at the extremities of the foot. Neck-like region long, slender, compressed, elastic, bearing numbers of short fine cilia. Anterior portion or head variable in form from triangular to oval; peristome-cilia long and conspicuous, surrounding the large oral aperture. Nucleus oval, inconspicuous, situated in the foot-region. Contractile vesicle not observed.

Length variable, from $\frac{1}{900}$ inch = 28 μ when contracted, to $\frac{1}{350}$ inch = 71 μ when extended.

Wellington, *W. M. Maskell.*

This is the first species of the genus as yet reported in fresh water. It is somewhat larger than either of the two European marine animalcules, and differs also in the presence of strong setæ, instead of cilia, on the foot-region.

Genus **Vorticella.**

Vorticella annularis, Müller. Karori.

Vorticella longifilum, Kent. Wellington.

Vorticella campanula, Ehrenberg. Wellington.

Vorticella cratera, Kent. Wainui.

Vorticella citrina, Ehrenberg. Wellington.

Vorticella zealandica, Kirk. Wellington.

Vorticella elongata, De From. Wellington.

Vorticella patellina, Müller. Wellington, Wainui.

Vorticella nebulifera, Ehrenberg. Wellington.

Vorticella aperta, De From. Wellington.

All the above species are reported by Mr. T. W. Kirk, in "Trans. N.Z. Inst.," vol. xviii., 1885, p. 215.

Genus **Zoothamnium.**

Zoothamnium affine, Stein; var. *granulatum*, var. nov.

Resembles almost entirely the European infusorian, but has a longer pedicle and a rough granular surface. It was also not observed on aquatic animals, but on plants.

Wellington, *A. Brandon.*

Genus **Epistylis.**

Epistylis leucoa, Ehrenberg. Wellington.

Ehrenberg's species, according to Kent, p. 705, has not been observed for many years. The present infusorian agrees with it entirely, with the exception that the surface is granular and the colonies larger, containing 20 to 35 individuals.

Genus **Opercularia.**

Opercularia parallela, sp. nov. Plate IV., fig. 9.

Body slender, about three times as long as broad, sides parallel for about two-thirds the length from the margin, then tapering rapidly to the pedicle. Peristome border not, or only slightly, thickened. Ciliary disc moderately elevated, cilia in a single row. Endoplast band-like, curved, nearly transverse. Cuticular surface granular. Contractile vesicle single, near anterior margin. Pedicle annulated, branched.

Length of body $\frac{1}{350}$ inch = 71 μ.

Wellington, *T. W. Kirk.*

Closely allied to *O. cylindrata*, Wrzes., but more cylindrical and rough, without striæ.

Genus **Vaginicola.**

Vaginicola crystallina, Ehrenberg. Karori.

Genus **Platycola.**

Platycola longicollis, Kent. Wellington.

Order. HYPOTRICHA.

Genus **Litonotus.**

Litonotus fasciola, Ehrenberg. Wellington, Wainui.

A specimen from Karori appeared to be also of this species, but exhibited a number of transverse corrugations.

Genus **Chilodon.**

Chilodon cucullulus, Müller. Wellington, Hutt Valley.

Genus **Loxodes.**

Loxodes rostrum, Ehrenberg. Wellington. Doubtful.

Genus **Stichotricha.**

Stichotricha remex, Hudson. Wainui.

Genus **Psilotricha.**

Psilotricha acuminata, Stein. Wainui.

Genus **Uroleptus.**

Uroleptus musculus, Müller. Wellington, Hutt Valley.

Genus **Gastrostyla.**

Gastrostyla Steinii, Engelmann. Wainui.

Genus **Histrio.**

Histrio acuminatus, sp. nov. Plate IV., fig. **10.**

Animalcules elongate-elliptical, with nearly parallel sides, somewhat pointed at the posterior extremity; border evenly ciliated. Peristome-field large, with long cilia and conspicuous reflected border, ciliated on left side. Three large uncinate frontal styles and a few smaller ventral setæ. Five simple anal styles, which project for about two-thirds of their length beyond the posterior extremity. Contractile vesicle single, situated just below the peristome-field. Endoplast elongated, conspicuous.

Length about $\frac{1}{180}$ inch = 139 μ.

Wellington, Wainui, *A. Brandon.*

This animalcule resembles *H. similis*, Quennerstedt, but differs in the acuminate posterior extremity, and in the freshwater habitat.

Genus **Stylonichia.**

Stylonichia mytilus, Ehrenberg. Wellington, Wainui, Hutt Valley.

Genus **Aspidisca.**

Aspidisca turrita, Claparède. Wellington.

The European species only inhabits salt-water. There appear to be no differences between it and our New Zealand form, and the only point to be noted is the freshwater habitat.

An animalcule observed, having a very short and blunt dorsal spine, even in some instances without spine, is taken to be only a variety of this species.

Genus **Glaucoma.**

Glaucoma scintillans, Ehrenberg. Hutt Valley.

Genus **Euplotes.**

Euplotes patella, Ehrenberg. Wellington, Wainui, Hutt Valley, Mungaroa, Karori.

Class III. TENTACULIFERA.

Order. Tentaculifera-Suctoria.

Genus **Sphærophrya.**

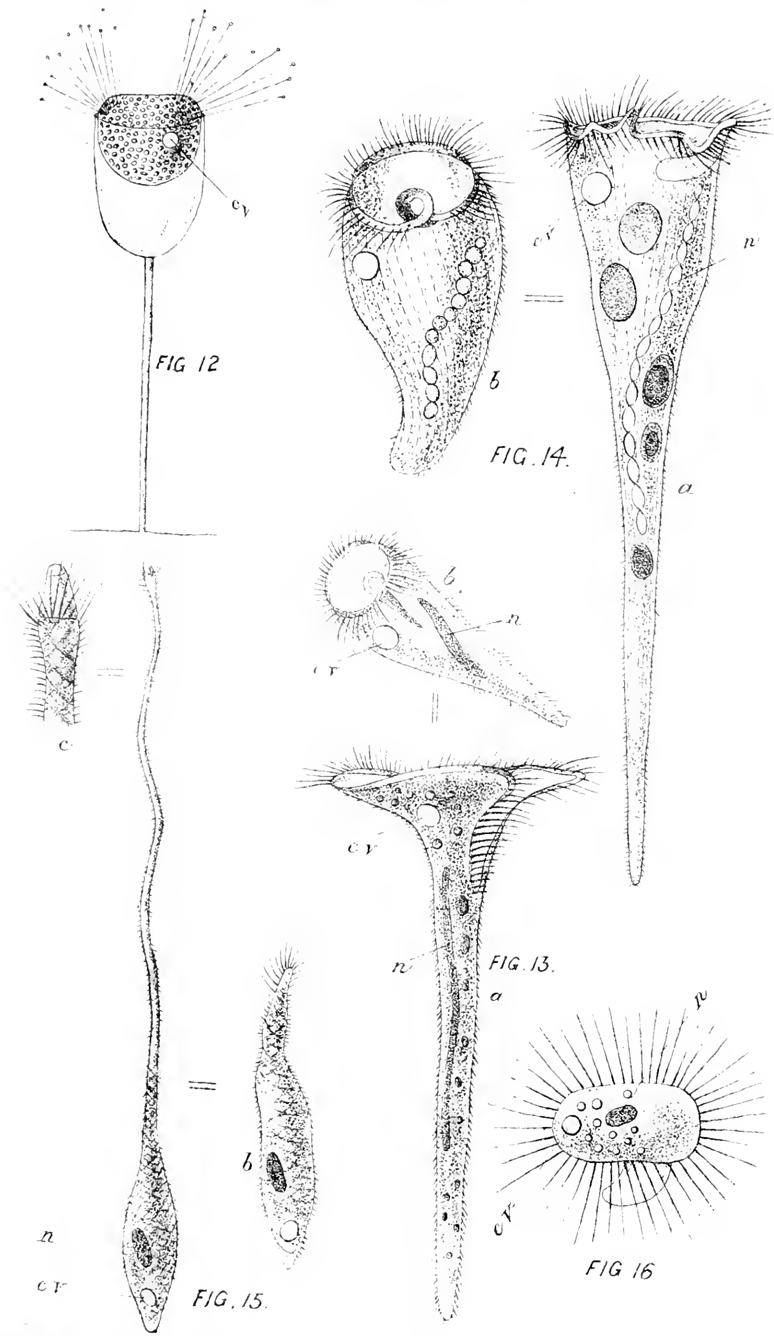
Sphærophrya magna, Maupas. Wellington.

This animalcule seems to agree entirely with Maupas' species (which is reported only from Algeria), with the exception of its size, which reaches $\frac{1}{450}$ inch = 55 μ as against $\frac{1}{600}$ inch = 41 μ in the African infusorian. All other characters being similar, it is not thought desirable to consider it as even a variety.

Genus **Acineta.**

Acineta elegans, sp. nov. Plate IV., fig. 11.

Lorica vase-shaped, with distinctly reversed margin, which is chiefly apparent at each side. Lorica widening somewhat below the edge, and rapidly compressed beneath, though not at once closing, but produced downwards to a point whence there is a short pedicle. Length from the point to the orifice about twice the width of the expanded margin. Animalcule nearly spherical, only occupying the upper half of the cup; tentacles forming two antero-lateral groups with about fourteen in each group; tentacles distinctly capitate, rather longer than the diameter of the animalcule. Contractile vesicle spherical, eccentric. Endoplast indistinct. Parenchyma granular.



W.M.M delt. NEW ZEALAND INFUSORIA.

Length of lorica, exclusive of pedicle, $\frac{1}{300}$ inch = 83 μ; width at margin $\frac{1}{600}$ inch = 41 μ; length of pedicle, $\frac{1}{2000}$ inch = 12 μ usually, but reaching sometimes $\frac{1}{1500}$ inch = 16 μ.

Wellington, *C. P. Powles.*

The animalcule of this species very nearly resembles that of *A. grandis*, Kent; but the form of the lorica separates it from all described species. *A. poculum*, Hartwig, a saltwater infusorian somewhat resembling it, has apparently a long pedicle.

Acineta simplex, sp. nov. Plate V., fig. 12.

Lorica wine-glass shaped, anterior edge not narrowed, lip not reversed, posterior extremity rounded, sides nearly parallel; pedicle moderately stout, about twice as long as the lorica. Animalcule occupying the anterior half of the lorica, subspherical. Tentacles capitate, arranged in two groups of about ten in each. Contractile vesicle situated on one side near the anterior margin.

Length of lorica, $\frac{1}{500}$ inch = 50 μ; width of edge, $\frac{1}{600}$ inch = 41 μ.

Wellington, *T. W. Kirk.*

Amongst the division of *Acinetæ* having the tentacles in two groups, the nearest to this seems to be *A. grandis*, Kent; but the sizes differ greatly, the European species having a length of $\frac{1}{100}$ to $\frac{1}{75}$ inch = 250 to 333 μ; also its lorica tapers much more rapidly to the base, which is obtusely pointed.

EXPLANATION OF PLATES.

PLATE III.

Fig. 1. Cercomonas grandis.
Fig. 2. Monosiga consociata (after S. Kent).
Fig. 3. Trachelomonas crenulatocollis.
Fig. 4. Prorodon sulcatus.
Fig. 5. Tillina enormis.

PLATE IV.

Fig. 6. Tillina inequalis.
Fig. 7. Plagiopyla varians.
Fig. 8. Licnophora setifera.
Fig. 9. Opercularia parallela.
Fig. 10. Histrio acuminatus.
Fig. 11. Acineta elegans.

PLATE V.

Fig. 12. Acineta simplex.
Fig. 13. Stentor gracilis.
Fig. 14. Stentor striatus.
Fig. 15. Trachelocerca filiformis.
Fig. 16. Pleuronema cyclidium.

Art. V.—*On New Zealand Glow-worms.*

By G. V. Hudson.

[*Read before the Wellington Philosophical Society, 4th August,* 1886.]

Plate VIa.

The following article by Mr. Meyrick appeared in the "Entomologists' Monthly Magazine," for April, 1886:—

"*A Luminous Insect Larva in N.Z.*—Whilst collecting recently after dark beside a densely shaded creek near Auckland, New Zealand, I observed the precipitous earthy banks of the creek illuminated with great numbers of a larva, which has, I believe, never been reared. It resembles in general appearance an Annelid, being about an inch and a half in length, very slender, slimy, and without apparent organs; but under a microscope (as Prof. Hutton has shown me) the head appears that of a predaceous coleopterous larva—*e.g.*, one of the *Staphylinidæ*. The light consists of a small light-greenish white erect flame, rising from the back of the neck. The larva burrows in the earth, exposing the head and anterior portions from the burrow, but having in front of them a sort of irregular slimy network. They occur in great numbers; I have counted fifty in a square foot of surface. The same or a similar species has been noticed in caves and mines elsewhere in New Zealand. It is impossible for a wandering entomologist to attack a larva of these habits. I should therefore be interested if any reader can give me a clue to its systematic identification. I suppose that it is carnivorous, feeding on minute insects, and I conjecture that it uses its lamp (as I do mine) to attract them, or perhaps to see to eat them.—E. Meyrick, Wellington, N.Z.—24th January, 1886."

"[There is distinct necessity for further information (with examples in fluid) respecting the animal noticed above. The larvæ of *Staphylinidæ* are ordinarily so like the perfect insect in form (allowing for absence of elytra, etc.) that we venture to doubt the connection of the animal with that family.—Editors, 'Ent. Mon. Magazine.']"

It is extremely unfortunate that such an erroneous statement as the above, concerning one of our most interesting insects, should be the first to reach the ears of the London entomologists; and as it is the opinions of those gentlemen that will most influence us out here, I have instituted a number of observations on the insect, a summary of which I have sent in answer to the Editors' note, and propose to relate them to-night in a somewhat more extended form. But in order that my remarks may be better understood, I will commence by stating that the *Staphylinidæ* are one of the most well-marked families of the *Coleoptera*, being none other than the famous Cocktail or Rove Beetles; their larvæ are furnished with six strong thoracic legs, a large head, and powerful mandibles, thus differing, as will be seen, in the widest possible manner from the insect under review.

Everyone who has walked in the bush at night, or, indeed, along any road at the bottom of a steep gully, cannot fail to have noticed the little points of light, mentioned as occurring in such vast numbers by Mr. Meyrick. I have not yet, however, seen 50 to the square foot of surface, although perhaps others may have been more fortunate; but, in my case, I should regard 20 of these little stars visible from one standpoint as indicating an exceptionally wealthy region.

When carefully examined with a bull's-eye lantern and pocket lens, this light is found to proceed from a large glutinous knob, situated at the *posterior* extremity of the larva, a fact I have verified by repeated investigations: but the insect's curious habit of occasionally travelling backwards has doubtless led to this mistake. It inhabits irregular cavities in the bank, where it hangs suspended in a glutinous web, which also appears to envelope the body, large quantities of sticky mucus being periodically shot out of the mouth of the larva, and formed into threads as required; but I have never seen anything like a net extended in front of the insect, neither have I found flies or gnats detained in the webs, although I have examined a large number. At the back of this irregular chamber the larva constructs a small hole, into which it retreats with great rapidity when alarmed.

With regard to its food, I am unable to speak with absolute certainty on this point at present, but have little doubt that it consists of decaying vegetable matter. One individual I kept alive for eight weeks was enclosed in a small jar of mud, taken from his native bank, and placed in a caterpillar cage, where no flies or other small insects could possibly be obtained; as, however, there were some small earthworms in the mud, it might have subsisted on these, although I examined the insect nearly every night and morning and never saw it eat anything.

The light is not shown by any means regularly. On several occasions I have observed no light all the evening, and then a brilliant display at 3 or 4 o'clock in the morning, but have not noticed any peculiar meteorological conditions to affect this. As to its use, I do not think that Mr. Meyrick's explanation can be entertained, as I am sure everyone who has attracted insects at night will know how utterly inadequate such a minute point of light would be to draw them from the shortest distance. If the larva requires a lamp to see to eat by, nearly all the New Zealand insects should have lights, as they are chiefly nocturnal. When, however, we reflect that the construction of the bee's comb is always carried on in utter darkness, the light would seem unnecessary for this purpose. If I might be allowed to suggest a use, I think it may often assist the larvæ in escaping from enemies, as when disturbed they nearly always gleam very brilliantly for a few seconds, suddenly shutting off the light and retreating into the earth. Of the pupa state I am as yet quite ignorant, as the only larva I succeeded in rearing was left undisturbed during that condition, in order to insure the appearance of the imago. This turns out to be a small gnat, apparently one of the *Tipulidæ*, and not differing materially from many of those little long-legged Dipterons so often noticed on window-panes and in similar situations. The specimen, which is the only one I have as yet found, is now on its way Home for identifica-cation by a systematic dipterist, and will in all probability be found undescribed.

Note.—Since the above was written, I have been informed by Baron Osten-Sacken, to whom I sent the perfect insect for identification, that it is *Trimicra pillipes*, the larva of which is well-known and different from the glow-worm. He still agrees, however, that the glow-worm is the larval condition of a gnat (*Mycetophilidæ*), and certainly not of a Coleopterous insect.—G. V. H.

DESCRIPTION OF PLATE VIA.

Fig. *a*. N.Z. Glow-worm; larva of a small gnat (*Tipulidæ*).
Fig. *b*. Larva of a Rove Beetle (*Staphylinidæ*).

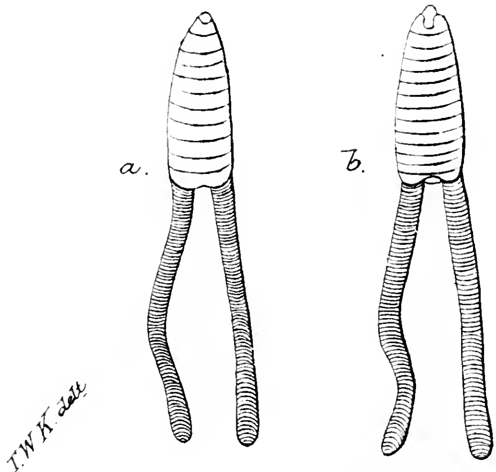
Art. VI.—*Note on a curious Double Worm.*

By T. W. Kirk (Geological Survey Department).

[Read before the Wellington Philosophical Society, 19th January, 1886.]

Plate VIB.

Some time ago, Mr. W. Marshall informed my father that there were some curious double worms in the Rangitikei, and promised to send him one. This promise he fulfilled a few weeks ago, the specimen now on the table being the one sent. It was placed in my hands for determination. I am not aware of any record of an Annelid of similar appearance. The anterior portion is about 1 inch in length and $\frac{1}{4}$th of an inch in diameter, and presents nothing peculiar so far; but from the posterior end of this



—PLATE VI.^{B} A DOUBLE WORM.—

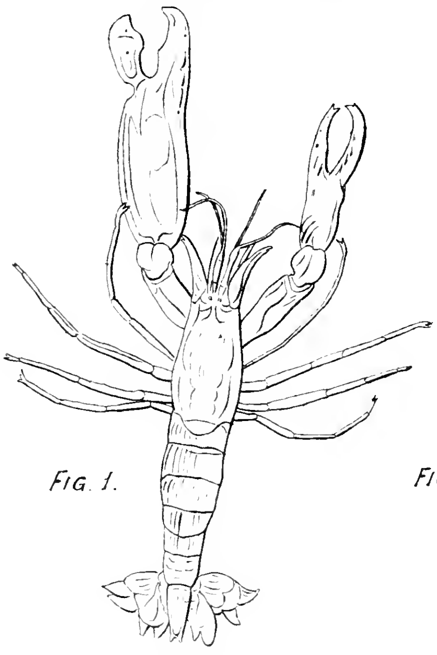


FIG. 1.

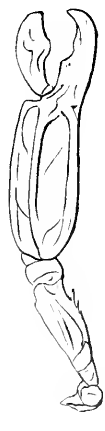


FIG. 2.

—PLATE VI.^{D} ALPHEUS HALESII.—

From a Photograph.

To illustrate Papers by T. W. Kirk.

thick part, which terminates abruptly, spring two limbs, each $2\frac{1}{2}$ inches in length, and of an average diameter of $\frac{1}{8}$th inch. These appendages make the animal look most grotesque. At first sight, these limbs look as though two worms of smaller circumference were grafted on to an abnormally short and thick individual. At times they trail behind like two tails, or are gathered up, sometimes together, sometimes one is moved first, the body pushed slightly forward with that, then the other is used, and so on alternately. The anal aperture is situate immediately at the posterior end of the thick portion, and between these two limbs or tails. There is no aperture in the end of either limb, though there is a spot which at first sight gives the impression that an opening is present.

I have not yet examined it very critically, lest it should sustain damage and die before I was able to exhibit it to this meeting.

It is a species of *Acanthodrilis*; but the question arises: Is it only an abnormal form, or are they tolerably common? Probably they are far from rare, as Mr. Marshall, in forwarding it, says: "I send you one of those two-tailed bush-worms I spoke to you about;" thus implying that he had seen others. He has been asked to endeavour to procure more specimens, and to send any information in his possession regarding their habits, abundance, etc. Till this information is received I prefer to suspend further decision as to its specific value.

This note was written for a meeting called in October, and which lapsed for want of a quorum. The worm has since died; but, as no other specimens have yet been received, I hesitate to dissect this one, and until that is done I feel that the examination is necessarily incomplete.

DESCRIPTION OF PLATE VIb.

Fig. *a*. Double worm (*Acanthodrilis*), seen from above.
Fig. *b*. ,, ,, seen from below.

Art. VII.—*On* Ixodes maskellii, *a Parasite of the Albatross* (Diomedea exulans).

By T. W. Kirk.

[*Read before the Wellington Philosophical Society*, 19*th January*, 1886.]

I had intended in this short paper to include a number of species of parasitic insects lately obtained from young specimens of the Pencilled Albatross; but as I have been unable yet to identify several specimens, in consequence of th difficulty experienced in obtaining works of reference, they will be retained for a future occasion, and your attention directed to a very large tick, two specimens of which were found with their claws so firmly imbedded in the neck of the bird as to render it impossible to remove them without the loss of some of their legs.

The genus to which this belongs is a very interesting one, for Mr. Murray tells us that their habits are at first herbivorous, that from the vegetation they find their way to the creatures on which they fix, and that when mature they avail themselves of every opportunity of fixing upon vertebrate animals, whose blood they suck instead of sap. It is very remarkable that these creatures should be at one time phytophagous and at another carnivorous. And it would seem that the usual special adaptation of structure to kind of food is absent; but Mr. Murray says that the anomaly is only apparent, and goes on to say that "carnivorous mammals are provided with different apparatus for obtaining their food from that of vegetable feeders; not on account of the different chemical constituents of their food, but on account of the different form in which it is presented to them for consumption and assimilation. If, for example, the food of both were presented to them in a liquid state, in the one case blood, and in the other juice of plants, we may be sure that the carnivorous canines in one case, and the vegetarian molars in the other, would be alike dispensed with, and both would be furnished with a sucking-up or pumping apparatus, which might be identical, if no speciality in the mode in which the liquid presented itself called for a difference. There might be a difference in the structure of their viscera, adapted to the character of the liquid food, but there is no reason why the external and oral structure should not be the same in both. This is what we find in all suctorial insects, bugs, gnats, Acari, etc. All are provided with a sucking apparatus constructed on a similar plan, which some use upon animals and others upon plants." I read recently that some insects—for instance, the London house-bug—feed indiscriminately upon the juice of plants and the blood of animals. The impossibility of the immense numbers of mosquitos that we meet with in the forests ever obtaining food if restricted to the blood of mammals has probably struck most of you. Is it not likely that they also are capable of living on a vegetarian diet, when no nice juicy specimen of humanity is forthcoming.

The insect to be noticed—viz., *Ixodes maskellii* (which I have ventured to name after Mr. Maskell, who described the only other species yet recorded from New Zealand)—is probably one of the largest of the genus, being, when alive, just under half an inch in length, excluding the rostrum; it is elliptical, but with a pronounced lateral compression on the anterior third of the body, then gradually expanding again, the hinder third being slightly wider than the anterior. On the dorsal aspect two crescent-shaped shallow grooves rise from the posterior angles of the shield, and extend backwards for about one-third the length of the body, terminating in deep pits immediately opposite the lateral constrictions; from these pits two deep crescent-shaped grooves extend backwards, ceasing abruptly a short distance from the posterior margin. A straight medial depression, not so pronounced as the crescents, runs between them from the posterior margin for rather more than a third the length of the body. The pits are connected by a transverse line.

On the under-side, a deep and wide central groove starts at the posterior margin and runs for about one-fourth the length of the animal. Two equally deep and wide grooves commence in a line with the insertion of the third pair of legs, and run backwards, gradually widening till they reach the centre of the mesial groove, when they turn in rapidly, giving the inclosed space (from the third pair of legs to the posterior margin,) much the outline of a Florence flask. The rostrum, in addition to the spines possessed by all the members of the genus, appears to be armed on its under side with five lines of hard-pointed tubercles.

The body of the animal when alive is of a delicate French-grey colour; the shield on the head pale-brown; legs red, with white at the joints; rostrum same colour as the body.

It is generally supposed that a separate species of tick is appropriated to a particular species of animal. Although this appears to be usually the case it is not always so, as proved by the fact that in England the common species *I. erinaces* is found on rough herbage, in forests; and on dogs, cattle, foxes, and hedgehogs. A short time since I found on a large gull a tick exactly similar to the one from the Crested Penguin described about two years ago by Mr. Maskell.

Art. VIII.—*On the Occurrence of the English Scaly Lizard* (Zootoca vivipara) *in New Zealand.*

By T. W. Kirk.

[*Read before the Wellington Philosophical Society, 30th June,* 1886.]

In August of 1883 I had the pleasure of bringing under the notice of the Society two English butterflies—viz., the Red Admiral, or Alderman, and the Small Tortoiseshell, both of which were captured in the Wellington Botanic Gardens—and drew attention to the fact that the importation of plants and seeds from various countries had become so extensive that it was almost certain much foreign animal life, some useful and some destructive, would be brought into the colony. It was also pointed out that, in order that the noxious forms might be more speedily detected, and to prevent confusion in future publications, it was advisable that the occurrence of unknown or uncommon species in a district should be promptly recorded.

The importation which I have now to notice is much higher in the scale than those already mentioned. It is the English Scaly Lizard (probably familiar to many persons present who in their young days rambled about the English country districts). As its food consists exclusively of insects, it is not likely to prove an unwelcome visitor.

Several specimens were captured about a year ago, on the Tinakori Hills, and one on the road, as it was crossing from the Botanic Gardens towards the shelter of the opposite bank. Being certain that it was quite distinct from any described New Zealand species, I took it to be a new form, and it was not until recently, when working up the specimens, that I became convinced it was a true British species.

As I have only found it in the localities mentioned, I conclude some specimens must have been brought to the Botanic Gardens in cases of plants. The following is the technical description :—

Zootoca.

Nostril on one side of the nose, in the lower hinder angle of the nasal shield, with one small posterior nasal. Lower eyelid opaque, scaly. Throat with a narrow cross-fold under the ears. Abdominal shields square. Temple scales small, with a larger central one. Pre-anal shield single, surrounded by smaller ones.

Z. vivipara.

(Gray, Cat. Liz. Brit. Mus., p. 27.)

Ventral shields, 8-rowed ; the temple covered with many-sided shields, with a larger central shield ; olive, back with a white-edged blackish streak on each side, and a central black streak ; belly orange, black spotted.

According to Wood, many of the habits of this pretty little creature resemble those of our common brown lizard, or Mokomoko, so abundant on the hills and beaches around Wellington.

In England, it is found plentifully upon the banks and commons ; it is extremely lively, and progresses by means of a series of sharp twists and springs. It captures flies and other insects with great dexterity. So quick are its movements, and so sharp its sight, that capture is far from easy. The colour is extremely variable, but generally the upper parts are olive-brown, with a dark brown line often interrupted along the middle of the back, and a broader band along each side, with black spots and blotches interspersed; the under-parts are orange, spotted with black in the male, and olive-grey in the female. The length is about 6 inches.

It is one of the reptiles that produce living young, the eggs being hatched just before the young lizards are born. The usual plan adopted by reptiles is to lay the eggs in some spot where the sun's rays are able to warm them. But the Scaly Lizard is in the habit of lying on a sunny bank before the young ones are born, apparently for the purpose of gaining sufficient heat to hatch the eggs, a process which is much aided by the extreme thinness of the membrane covering them.

ART. IX.—*Description of a New Species of Moth* (Pasiphila lichenodes). By ALEX. PURDIE, M.A.

[*Read before the Wellington Philosophical Society, 8th September*, 1886.]

THE genus *Pasiphila* is a very distinct genus of the New Zealand *Geometrina*, containing some of the smallest moths in that division. In his monograph of the New Zealand *Geometrina*,* Mr. Meyrick maintains that there is but one species of this genus in New Zealand, and to this opinion I have already made objection in a paper in the "New Zealand Journal of Science" for July, 1884, in which it was urged that at least two species had been included under the name *Pasiphila bilineolata*. Since then I have bred out a third form from the caterpillar state; so that, besides the species to be described to-night, there are at least three other species of *Pasiphila* in New Zealand. I have also, besides these, several doubtful forms; but Mr. Meyrick has admitted to me that he had wrongly included four, if not five, distinct species under the one name. As, however, he intends shortly to write upon this subject, it will be well to leave to him the disentanglement of the synonomy, as it is a matter upon which, perhaps, he alone is qualified to speak with authority. Here I take the opportunity of acknowledging Mr. Meyrick's kindness and readiness in furnishing information regarding insects sent to him.

Those that are acquainted with English moths may easily recognize the New Zealand species of *Pasiphila* by their likeness in size and appearance to the various species of *Eupithecia*, to which the New Zealand genus is closely allied. The members of this genus are small moths, usually less than an inch across

* "Trans. N.Z. Inst.," vol. xvi., p. 49; xvii., p. 62; xviii., p. 184.

the wings, and they rest on tree-trunks or rock-faces with their wings flatly spread out, the inner half of the hindwings not being covered by the forewings, and sharing the colouring and markings of the forewings. The neuration of the forewings also serves readily to distinguish this genus, for usually in the forewings of our *Geometrina* twelve veins can be counted along the margin; but in this genus, and in the next to it,—namely, *Elvia*—the eleventh vein coalesces with the twelfth and appears only as a short bar from the upper side of the small cell to the twelfth vein, so that only eleven veins appear on the margin.

Pasiphila lichenodes.

Expanse, 16–19 mm. General description: Ground colour glaucous-green, with finely crenulated black lines, and two conspicuous, irregular, transverse bands of light brownish-red or chocolate colour, one near the base, the other near the hindmargin.

Detailed description: Forewings with slightly arched costa, hindmargin with a slight swelling or convexity about the middle, not crenulate; ground colour glaucous-green, becoming paler with exposure. Basal area very pale pinkish or reddish-brown, bordered by a black line sharply angulated at the middle, and followed by a broad pinkish or reddish-brown band, also bordered on the outer side by a black line. This band is contracted about the lower side of the cell, so as to be nearly divided into two unequal blotches. The centre of the wing is occupied with a broad belt of the glaucous-green ground colour, boldly angulated about the middle of the outer side. This central belt is occupied with three finely crenulated black lines, which are so closely placed that they seem almost to divide the central belt into imbricating green scales edged with black. The central belt is also bordered along the outer edge by a black line. Between the central belt and the sub-marginal line is another broad belt, of a chocolate or reddish-brown colour, sometimes divided into two unequal blotches by the angulation of the outer side of the central belt. This reddish-brown band is crenulated on the outer side and edged with a pale sub-marginal line which follows the crenulations. Between this and the margin the ground colour appears without any distinct markings. The black lines of the forewing are sometimes edged with paler lines. The hindmargin is edged with an interrupted black line. Fringe fuscous and pale alternately. Hindwings with a distinct convexity, rather below the middle of the hindmargin. Inner half with colour and markings similar to those of the forewings. Outer half paler, greyish or whitish, markings not so distinct. Below, the forewings are fuscous, with a few of the black lines showing along the costal edge, while the hindwings are greyish white, with a black discal dot and a few faint lines.

This species has received its specific name because its colourings and markings seem to me to have a protective likeness to those of the *thallus* and *thecæ* of some lichens. It occurs not uncommonly in the forest about the river-bed in the upper part of the Leith Valley, Dunedin. I have collected specimens in the latter part of January; and it is not known to Mr. Fereday or to Mr. Meyrick, except from my specimens; hence its range must be somewhat limited.

I stated that I had bred out three species of *Pasiphila* from the larval state, and the descriptions of the larvæ are here subjoined. Specimens of the perfect insects have been sent to Mr. Meyrick for identification. There seem to be differences between these caterpillars quite unusual in the case of closely-allied species. The first and second descriptions are reprinted from the "N.Z. Journal of Science" for July, 1884:—

No. 1. *Pasiphila*, sp.?

"Larva smooth, green, about 10 mm. long; an indistinct dorsal and sub-dorsal stripe of darker green; underside green, with a light ventral stripe; head yellowish. Formed small rough earthen cocoons on the surface of the earth. The food-plant is *Myoporum lætum*. Larvæ in March. (See 'N.Z. Journ. Sc.,' March, 1882, p. 95.)"

No. 2. *Pasiphila*, sp.?

"Larva about 12 mm. long. Colour brownish; surface very rugged; body tapering somewhat towards the head. Two pair of small dorsal tubercles about the middle, the posterior pair being larger. Oblique lateral dark markings faintly seen on the dark ground colour; below lighter. I have beaten this larva from *Aristotelia*, from *Leptospermum ericoides*, and from a mixed growth of bramble (*Rubus*) and *Muhlenbeckia*. Larva in December and January."

No. 3. *Pasiphila*, sp.?

Larva loopers from 13 to 17 mm. long, with a black median dorsal line, and on each side of it a black sub-dorsal line. The whole dorsal area between the sub-dorsal lines is brown, or brownish-black, while the rest of the back is greenish-white; below greenish-white; lateral line and median ventral line, white; there are sometimes dark blotches above the lateral line, while below it the ground colour is suffused with purplish-black. The median dorsal line is often bordered with greenish-white.

The larvæ were found about full-grown, feeding on *Veronica salicifolia*, in the Leith Valley, Dunedin, in the beginning of April. Two of the moths were reared, one of which had the ground-colour greenish, while the other was brownish. At the same time, and on the same plants, a considerable number of larvæ, resembling the above in shape and size, were collected. Some of these had the ground-colour green, with very faint dorsal and sub-dorsal lines, the dorsal area being green, or only faintly clouded with black. Others had the ground-colour green, while the dorsal and sub-dorsal lines were distinct and black, and the dorsal area between the sub-dorsal lines was filled with alternate light and reddish-brown blotches. The two last forms had their other characters as in the first-described form, and they may be immature stages, or the larva may be a variable one.

Art. X.—*On New Species of* Araneidea.

By A. T. Urquhart.

[*Read before the Otago Institute, 17th November,* 1886.]

Plates VII., VIII.

Fam. EPEIRIDÆ.

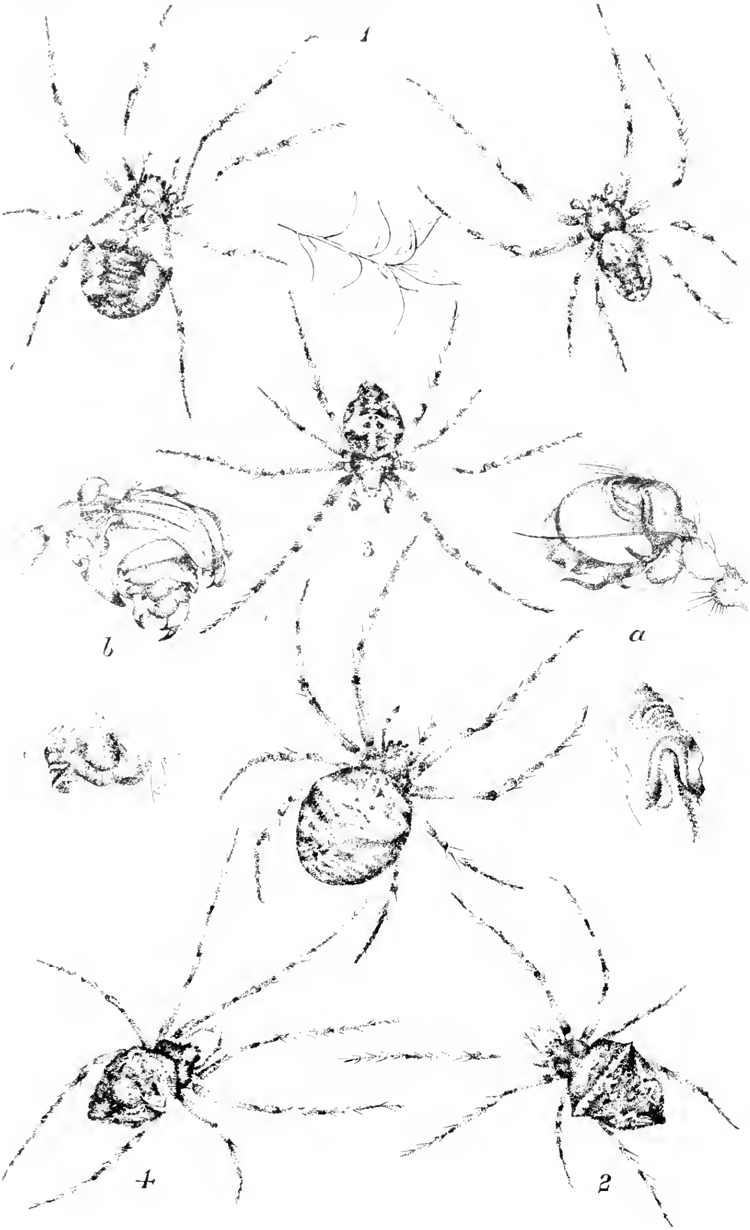
Genus **Epeira,** Walck.

Epeira corrugatum, sp. nov. Plate VII., fig. 1.

Female.—Ceph. th., long, 4; broad, 4; facial index, 2. Abd., long, 8; broad, 7. Legs, 1, 2, 4, 3 = 17, 16, 14, 9 mm.

Cephalothorax chocolate-black; short, adpressed, yellowish hairs; in length equal to genua and tibiæ of a leg of 4th pair; depressed, sides rounded, moderately constricted forwards; ocular eminence not very prominent, mammiform prominences on caput slightly developed, lateral index (*i.e.*, length of caput from striæ to fore-angle) nearly equals space between a posterior lateral eye and the hind-central next to it; median indentation on thorax transverse, radial and caput striæ rather faint; contour of profile forms an undulating curve, rising at occiput, which slopes abruptly forwards; height of *clypeus* nearly equals facial space.

Fore and hind rows of *eyes* moderately recurved; posterior centrals separated by an interval equal to about twice their diameter, nearly twice their space from hind-laterals; anterior centrals about one-fourth larger than posterior, placed rather further from each other—nearly their diameter and a-half—than each is from the hind-central next to it; lateral eyes seated moderately obliquely on low tubercles, nearly their diameter apart.



A.T.U. delt.

NEW ZEALAND SPIDERS.

Legs rather slender, femora dark lake-colour, suffused with brown, convex above, spines; genua and tibiæ grooved, these joints, with metatarsi and tarsi, have a dark lake-brown hue, faintly annulated with chocolate-brown, rings of white and black hairs; besides irregular spines above, tibiæ have a double row of 6, metatarsi two rows of 4 yellowish spines beneath. Superior tarsal claws—1st pair, 9 comb-teeth, increasing in length and strength; inferior claw, 2 close teeth.

Palpi slender, dark chocolate-brown, short yellowish bristles, palpal claw moderately curved, 9 teeth, directed forwards.

Falces conical, vertical, convex, project forwards in front, not equal to femora of first pair in stoutness, bright lake-brown.

Maxillæ nearly as broad as long, obliquely truncated, inclined towards *labium*, which is somewhat triangular, more than half length of maxillæ; organs chocolate-brown, light apices.

Sternum cordate, eminences opposite coxæ brown-black, light hairs.

Fore part of *abdomen* somewhat pointed, carinate, moderately convex, projects over base of thorax; posterior half broad, semi-oval, depressed, transversely corrugated, incurvate; marginal zone directed inwards, longitudinally corrugated; anterior tubercles applanate, apex rounded, directed outwards; posterior tubercles, which project from transverse wrinkles, are broad, rounded, applanate, directed backwards; in first row are three of about equal size, beneath central tubercle there is another rather larger, beneath latter a small one; integument black-brown, base and lateral margins more or less spotted with dull creamy-buff coloured flecks; on dorsal surface is a large, slightly flecked black-brown, acute-crenate, leaf-like mark, the black, buff-margined, carinate eminence forming the petiole; sparsely clothed with very short, close, and erect hairs. On ventral surface is a large greenish-brown, transversely wrinkled, cordate mark, with two large buff spots beneath branchial opercula, and two above spinners. Fore part of *epigyne* represents a yellowish, transversely-wrinkled, semicircular, cucullate membrane, centrally produced into a large, transversely wrinkled lip with tumid incurved margins, its greatest diameter is across centre, from whence it forms a moderately acute angle, apex produced into a clear yellow vermiform process, equal to three-fourths of lip in length; lateral margins of hood, on posterior side, involute within dark spotted concavity.

Male.—Ceph. th., long, 4; broad, 3·5. Abd., long, 4·5; broad, 3. Legs, 1, 2, 4, 3 = 15, 14, 11, 8 mm.

Cephalothorax mahogany-colour, hairs sparse, yellowish; sides prominently rounded, laterally constricted at caput, which is rather depressed, ocular eminence prominent; median indentation longitudinal, oval, deep; normal grooves slight.

Posterior central *eyes* separated by a space equal to their diameter and a half; anterior centrals rather more than that interval from each other, and about their diameter from hind-median eyes, separated from fore-laterals by about their space and a quarter; laterals on dark tubercles, about their radius apart.

Legs yellowish, moderately defined brown annulations; 1–2 pair rather stout; strong curved process on outer side of coxæ of 1st pair; armature sparse light hairs, spines numerous, yellowish, base dark, cluster of 8 short curved spines near apex of tibiæ of 2; 3–4 rather slender; long spines on inferior surface of femora, especially of 4th pair. Superior tarsal claws—1st pair, 9 teeth, 4 terminal strong; inferior claw, 2 close teeth.

Palpi yellowish, humeral joint stout, tuft of bristles project from tumid eminence on inferior surface near apex of article; cubital joint broad, somewhat spathulate, projects at apex a long strong bristle; radial joint shortest, articulated to inferior surface of cubital, produced on outer side into a large linear-oval yellowish process; digital joint broad-oval, convex and moderately hairy externally, convexities directed towards each other, base of convexity produced on outer side into a rather long, stout, curved apophysis of a dark-reddish colour; bulb, viewed from somewhat beneath, represents a series of bright red-brown dark - margined folds; terminates with several large tumid, introflexed, somewhat lip-shaped dark lobes; near apex, directed forwards, is a horizontal, dark, curved membranous apophysis, a prolongation of an upper fold, behind this apophysis there is a short process, curved backwards.

Falces slender, vertical, yellowish.

Abdomen somewhat oviform, specific pattern and coloration does not differ essentially from female.

Pairs about November. Cocoon sub-globose, composed of dark-green silk of a loose texture, about two metres in diameter; eggs pinkish, spherical, 350–645 in number.

Te Karaka, Auckland, *A.T.U.* Otago, *F. Goyen.*

Epeira pocillator, sp. nov.

Female.—Ceph. th., long, 5; broad, 4; facial index, 2·2. Abd., long, 10; broad, 8. Legs, 1, 2, 4, 3 = 17, 15, 13·5, 9·5 mm.

Cephalothorax lake-chocolate colour, hairs adpressed, sparse, yellowish; rather depressed, sides not prominently rounded, moderately constricted at caput, sides of which are not very abrupt, lateral index equals space between a hind-lateral eye and the hind-central next to it, ocular eminence fairly prominent, mammiform eminences moderately developed; median indentation transverse, normal grooves not strongly marked; contour of profile horizontal above, dips moderately posteriorly and anteriorly, rising at occiput. Height of *clypeus* rather exceeds space between fore-central eyes.

Fore and hind row of *eyes* moderately recurved; four centrals of equal size; posterior pair separated by a space equal to a diameter and a half, rather less than that interval from anterior centrals, which are rather further from one another than are the former pair, nearly twice their space from fore-laterals; side-eyes seated obliquely on small tubercles at angle of caput, about radius of an anterior eye apart, latter exceeds posterior eye in size by about one-third.

Legs rather slender, femora of 1–2 lake-coloured; 3–4 suffused with brown, convex above, few spines; genua and tibiæ double-groove above, latter joints, metatarsi and tarsi have a yellowish tinge, brownish annulations; armature sparse yellowish hairs, spine at apex of genual joint, double row of 6 beneath tibiæ, and of 5 beneath metatarsi. Superior tarsal claws—1st pair, 10 comb-teeth, increasing in length and strength; inferior claw, 2 close teeth.

Palpi moderately slender, yellow-brown, yellowish hairs and slender spines; palpal claw 10 comb-teeth, 2 basal small.

Falces conical, vertical, convex, prominent at base in front, nearly as thick as base of femora of 1st pair of legs, brownish-lake, few yellowish hairs.

Maxillæ nearly as broad as long, obtusely pointed, inclined towards *labium*, which is triangular, about as long as broad; organs chocolate-brown, pale apices.

Sternum cordate, eminences opposite coxæ; black-brown.

Abdomen oviform, projects over base of cephalothorax, depressed above, sensibly convex; lateral margins rather deep, convex; fore-tubercles moderately prominent, apices rounded, directed outwards; posterior tubercles prominent; central tubercle of first row twice size of laterals, tubercle of second row exceeds first central in size, tubercle of third row nearly equals it. Sparsely clothed with short fine light hairs; integument yellowish-brown, spotted with brown; dorsal mark brownish-buff, brown flecks, from apices of fore-tubercles it tapers off, margins incurvate, round base of abdomen, brown centre of narrow band bifurcates to base of fore-tubercles; from latter, dorsal mark extends with slightly undulating margins to posterior tubercles, which have the same pale hue; in centre of specific mark is a brown, somewhat lugeniform mark, with rather slight oblique streaks beneath; almost entire length and breadth of lateral margins covered by creamy-white, lake-tinted, somewhat oval marks, with brown dentate margins on dorsal side, and series of nearly vertical streaks of similar hue. Ventral surface brown, dark-green, orange-yellow margined, shield-shaped mark in centre, large flecks of latter colour beneath branchial opercula, and close to spinners, which are short. *Epigyne* represents a yellowish, transversely wrinkled, cucullate membranous projection, depressed above, sides abrupt, margins beaded, centrally produced above into a semi-oval dark-margined lip, whose apex is prolonged into a segmented vermiform process, nearly equal to lip in length.

Male.—Ceph. th., long, 5; broad, 3·5. Abd., long, 4·5; broad, 3·2. Legs, 1, 2, 4, 3 = 17, 15, 13, 9 mm.

Cephalothorax light mahogany colour; hairs sparse, yellowish; moderately depressed, constricted at caput, which projects over falces; ocular eminence prominent, somewhat oblique; angular depression in centre of caput; median indentation longitudinal, dark colour, normal grooves rather faint; profile line forms a slight curve from thoracic junction to occiput.

Posterior central *eyes* separated from anterior centrals by a space about equal to their diameter, rather closer to one another than are the latter pair; lateral eyes placed within a slight concavity at angle of caput, fore-eye rather larger than posterior, separated by an interval equal to radius of anterior eye.

Legs yellowish, reddish-brown annulations; armature sparse light hairs, numerous strong spines, yellowish, base brown; coxæ of 1st pair projects a short curved process; 1–2 much the stoutest, femora clouded with chocolate-brown; tibiæ of 2nd pair tumid, 7 stout dark spines at extremity; superior tarsal claws—1st pair, 10 comb-teeth; inferior claw, 2 short close teeth.

Palpi yellowish, humeral joint short, stout, strong tuft of long yellowish bristles project from near centre of inferior surface; cubital joint about half length of humeral, somewhat spathulate, broad, projects from apex a long, strong bristle; radial joint short, produced on outer side into a large, yellowish, linear-oval process; digital joint large, oval, at apex of hairy convexities—which are directed towards each other—there are prominent, somewhat conical tubercles, base of convexities produced on outer side into a long, stout, black-brown apophysis, sharply bent inwards at extremity; bulb has rich red and yellow-brown tints; on crown of bulb is a black tumid crescent-shaped eminence, centrally constricted into acute points; beneath the convex transversely striated upper fold are a series of dark lobes, mostly pointed, concave above, apices directed forwards; near apex is a dark pointed apophysis, which projects forwards; about centre of bulb, on lower side, is a short, stout apophysis, curved backwards.

Falces vertical, conical, yellowish.

Maxillæ somewhat spathulate, about as broad as long, brownish, pale apices, inclined towards *lip*, which is somewhat triangular, everted, dark-brown; apex light.

Sternum cordate, dark-brown.

Abdomen oviform, tubercles moderately developed; integument light-brown, thickly mottled with creamy-coloured flecks, specific mark yellowish-brown; margins between anterior and posterior tubercles acute-crenate; series of brown marks on median line, impressed spots well marked.

Pairs about November. Cocoon somewhat globose, composed of dark-green silk; comprised within are 350 or more pinkish eggs.

Auckland, *A.T.U.*

Epeira oblitera, sp. nov.

Female.—Ceph. th., long, 6; broad, 5; facial index, 2·5. Abd., long, 8; broad, 6·5. Legs, 1, 2, 4, 3 = 21, 19, 17, 10·5 mm.

Cephalothorax yellowish, faintly suffused with brown, moderately clothed with coarse light hairs; rather depressed, sides rounded, constricted forwards; caput squarely truncated, sides low, convex, lateral index nearly equals interval between a hind-lateral eye and the hind-central next to it; mammiform eminences well-developed; caput and radial striæ rather faint; semicircular indentation on thoracic slope. Contour of profile rises at an angle of 40°, moderately arched across caput, synclinal dip behind occiput. Height of *clypeus* nearly equals depth of facial space.

Fore and hind rows of *eyes* sensibly recurved; ocular eminence prominent; eyes small, anterior centrals separated by a space equal to twice their diameter, rather less than that interval from hind-pair, which are further from each other than they are from anterior centrals; laterals seated obliquely on very low tubercles, encircled by black rings, nearly their breadth apart.

Legs moderately strong, yellowish, sparsely furnished with light hairs; femora convex above, few spines; genua of 1–2 two-thirds length of tibiæ, two grooves on former and latter articles, spines yellowish. Superior tarsal claws—1st pair, strong, 10 open comb-teeth; inferior claw, 2 teeth.

Palpi as long as cephalothorax, yellowish, light hairs, palpal claw straighter than tarsal, 10 similar teeth.

Falces yellow-amber colour; as long as genua, and as broad as femora of 1st pair of legs; somewhat conical, vertical, project at base in front.

Maxillæ broad, obtusely pointed, inclined towards *labium*, which is triangular; organs chestnut-brown, yellowish margins.

Sternum cordate, eminences opposite coxæ; chestnut-brown colour.

Abdomen oviform, depressed above, sides abrupt, convex; anterior tubercles very small, conical; posterior rather small, central tubercle of first row shortest of three. Yellow stone-colour, faintly mottled with brown; specific mark almost obliterated, leaf-like, mottled with creamy-coloured flecks, margins brown, faint, three somewhat angular brown marks on median line, impressed spots, well-defined, form a trapezoid. On ventral surface is a large dark-green shield-like mark, margins buff, double row of four foveola. *Epigyne* represents a cucullate, transversely wrinkled, membranous eminence, depressed above, sides abrupt, centrally produced into a broad, transversely wrinkled, yellowish lip, margins tumid, apex forms an obtuse angle, terminates in a clear yellowish, segmented, vermiform process, as long as lip.

Whangarei Harbour, *T. Broun.*

Epeira tri-tuberculata, sp. nov. Plate VII., fig. 2. Plate VIII., fig. 1.

Female.—Ceph. th., long, 3; broad, 2·5; facial index, 1. Abd., long, 5·5; broad, 5. Legs, 1, 2–4, 3 = 11, 10, 6·5 mm.

Cephalothorax reddish-amber colour, few small blackish spots, hairs short, sparse, whitish; rather depressed, sides rounded, laterally constricted forwards; caput squarely truncated, lateral index equal to interval between a fore-lateral eye and the hind-central furthest from it; sides nearly vertical, slight constriction behind posterior row of eyes; median indentation longitudinal, radial and caput striæ moderately marked; contour of profile rises at an angle of 45°, slightly curved across caput, rising a little at occiput. *Clypeus* in height equals two-thirds diameter of a fore-central eye.

Posterior row of *eyes* sensibly recurved, median pair rather more than their breadth apart, their space and an eye's diameter from hind-laterals; anterior row recurved, centrals rather larger than hind-pair, separated by their diameter and a half, less than that interval from posterior pair; lateral eyes separated by a space equal to their radius, placed obliquely on tubercles; anterior tubercles prominent.

Legs moderately slender, yellow-amber colour, faint reddish-lake annuli, clouded with similar hue; sparsely furnished with short light hairs; femora convex above, numerous short spines; genual joint of 1st pair more than half length of tibial, two grooves, continued on latter joint; besides upper spines, tibiæ has double row of 6, metatarsi two rows of 4. Superior tarsal claws—1st pair long, free end rather sharply bent, 13 teeth, 5 basal, small, terminal strong, somewhat form of free end; inferior claw sharply bent, 2 points.

Palpi resemble legs in colour and armature; palpal claw, partially broken, apparently like tarsal claw.

Falces vertical, conical, moderately strong, yellowish.

Maxillæ somewhat spathulate, inclined towards *lip*, which is pointed, nearly twice as broad as long; organs reddish-brown, light margins.

Sternum cordate, broad as long, eminences opposite coxæ, yellowish, shaded with reddish-brown.

Abdomen somewhat obtusely pointed, from anterior tubercles, which are mammiform with yellow nipple-like apices, abdomen tapers moderately off to small posterior tubercle; depressed above, sides convex; from apex of fore-tubercle profile line forms a rather sharp angle; hairs light, short, sparse; dorsal mark leaf-like, coarsely acute-crenate, mottled with creamy-brown, spotted with lake-coloured, white-margined flecks, with blue-black vein-like streaks between; dark impressed spot in each acute projection; creamy-white transverse band, with lake-coloured margins, connects anterior tubercles, directed obliquely backwards from centre of band are two short bars of similar hue; petiole of leaf-like mark curves round base, is creamy-white, lake margins; lateral margins mottled, flecked and veined with normal tints. On ventral surface is a shield-like mark with white flecks. *Epigyne* represents a broad, yellowish, transversely segmented, napiform lobe; above apex of lobe, which is directed forwards, is a brown membrane produced into central and lateral acute projections; margins of lobe on posterior side incurvate, divided by a short, petiole-like projection from lobe.

Colorations of some examples have rich lake, chocolate, and orange tints. Taken amongst low, moist vegetation.

Te Karaka, *A.T.U.*

Epeira orientalis, sp. nov. Plate VII., fig. 3.

Female.—Ceph. th., long, 5; broad, 4; facial index, 2. Abd., long, 10; broad, 9. Legs, 1, 2, 4, 3 = 19, 18, 16, 12 mm.

Min.—Abd., long, 9; broad, 8. *Max.*—Abd., long, 12; broad, 9. Leg of first pair, 24·5 mm.

Cephalothorax lake-black, lake-coloured about dorsal surface, hairs sparse, light, short, adpressed; length of cephalothorax equal to tibiæ of a leg of first pair, sides rounded, moderately compressed forwards; lateral index of caput nearly equal to facial; luniform transverse depression in centre of caput; thoracic indentation transverse, radial and caput striæ fairly marked; contour of profile rises from thoracic junction at angle of 40°, slopes forwards with a slightly undulating line, rising at ocular eminence, which is moderately developed, slopes abruptly forwards, widest in front. *Clypeus* in height equal to about half facial space.

Posterior row of *eyes* nearly straight, median pair their diameter apart, twice their space from hind-laterals; anterior row recurved, central pair largest of eight, separated from one another by their diameter and a-half, rather less than that interval from hind-centrals; lateral eyes seated obliquely on moderate tubercles, their radius apart.

Legs moderately stout, femora brownish-lake, clouded with brown, few short yellow spines; double groove on genua and tibiæ, latter articles, metatarsi, and tarsi yellowish-brown, blackish annuli; armature black and white hairs, yellowish spines, tibial spines less than diameter of article in length. Superior tarsal claws—1st pair, 9 teeth, increasing in length and strength; inferior claw, 2 teeth.

Palpi brown-black, few white hairs, spines numerous; palpal claw 9 teeth, directed forwards.

Falces rather slender, conical, vertical, brown-black.

Maxillæ broad as long, obtusely pointed, inclined towards *labium*, which is rather pointed; organs chocolate-brown, pale apices.

Sternum cordate, eminences opposite coxæ, brown-black.

Abdomen somewhat diamond-shape, or broad oval, projects over base of cephalothorax, depressed above, sides convex; integument has a soft black velvety appearance, petiole of leaf-like serrated dorsal mark, dark, with orange-red and yellow sinuated margins, numerous flecks of similar hue on base of abdomen on either side of petiole; tubercles prominent, directed outwards; dorsal mark extends to apices of tubercles, is sharply constricted at central pair of impressed spots, tapers towards spinners, throwing off a few transverse bars, has orange-red tints, with dull-yellowish shading, few black marks in centre; lateral margins longitudinally wrinkled, large irregular-shaped mark of normal tints; sparsely clothed with very fine short hairs, few black erect hairs. Ventral surface dull-black, bright orange-red and yellow marks above spinners, which are short, brown-black. *Epigyne* represents a somewhat oval, greenish-black, eminence, anterior portion transversely wrinkled, projects moderately forwards, centrally produced into a pendulous, oval, fleshy process, directed backwards; lateral margins form a series of three curved folds.

Male.—Ceph. th., long, 4·5; broad, 4. Abd., long, 6; broad, 5. Legs, 1, 2, 4, 3 = 20, 18, 15, 9 mm.

Cephalothorax light-brown, fore-lateral margins and median indentation dark-olive; fairly clothed with glossy pale stone-coloured hairs; depressed, sides rounded, compressed forwards; median indentation longitudinal, deep, striæ faint; caput narrow, depressed, ocular eminence prominent; fore and hind row of *eyes* much recurved, posterior centrals less than their diameter apart.

Legs same tint as cephalothorax, light-brown annuli on tibiæ and metatarsi, whitish hairs; spines short, yellow-brown, base dark, numerous, especially on tibial joints; femoral joints of 1–2 rather stout; superior tarsal claws—1st pair, 8 teeth, inferior claw, 2 short teeth.

Palpi, humeral and cubital joints yellowish, latter applanate, broad, base constricted, projects from apex two long strong bristles, radial joint short, pitchy-red, produced above into a stout upright process, from curved apex there projects forwards a somewhat semi-oval, truncated membrane, finely toothed along truncated end; in centre of article, on outer side, is a rather large mammiform eminence, beneath which is a black curved apophysis, convave above, directed forwards; digital joint large, broad-oval, convex and hairy externally, convexities directed towards each other; palpal organs complex, most remarkable are, at base of bulb, a large black apophysis, concave above, directed forwards; projecting upright from its base is a long, stout, black process, curved forwards at apex; between former projection and apex of bulb is a dark, somewhat membranous, pointed apophysis, projecting from a ring-like base; bulb terminates with several membranous projections, concave beneath, acuminate.

Abdomen, base somewhat rounded, tapers posteriorly from lateral angles; tubercles conical, well-developed; specific pattern on fore-part bears some resemblance to female's, but has duller tints—which also obtain in some female examples; from the broad transverse band which connects tubercles, a tapering mark, with few acute projections, extends to spinners.

This handsome *Epeira* is rather uncommon, but mature examples may be met with throughout the winter months—frequents branchlets of manuka (*Leptospermum scoparium*); the snare, apparently, only consists of a few irregular lines; the cocoon, which she fabricates amongst the slender branches, is sub-globose, composed of coarse dark-green silk of loose texture, about two metres in diameter; comprised within are about 70 or more oval eggs of a pale-brown colour, agglutinated together in a lenticular form. Male rare.

Te Karaka, Auckland, *A.T.U.*

Epeira bi-albimacula, sp. nov.

Female.—Ceph. th., long, 3; broad, 2·3. Abd., long, 4; broad, 2·5. Legs, 1, 2, 4, 3 = 11, 10, 9·5, 6 mm.

Cephalothorax pellucid stone-brown, caput clouded with olive-brown; moderately clothed with light hairs; broad-oval, compressed forwards; median fovea somewhat circular, normal grooves moderately marked; caput convex, projects forwards, lateral index equals space between a fore-lateral eye and the hind-central furthest from it; contour of profile rises from thoracic junction at an angle of 30°, forms a very low arch across caput. *Clypeus* in height equals diameter of a fore-central eye.

Four central *eyes* large, seated on a prominent eminence, form a trapezoid, whose anterior side is widest; hind-centrals, which are separated by nearly their diameter, and rather more than that space from fore-centrals, exceed latter a little in size; lateral eyes nearly contiguous, placed obliquely on moderate tubercles, are further from anterior median eyes than those eyes are from each other.

Legs and cephalothorax concolorous, black-brown, olive-tinged annulations, armature pale hairs, numerous black spines; 1–2 equal in strength; superior tarsal claws—1st pair, strong, slightly sinuated, free end curved, 9 open comb-teeth, increasing in length and strength; inferior claw long, sharply bent, 2 teeth.

Palpi long, colour of legs, olive-green annuli; palpal claw long, 12 open teeth.

Falces vertical, somewhat conical, divergent, clear stone-brown, clouded with olive-green.

Maxillæ quadrate, strong, greenish-stone, dark centre. *Labium* oval, pointed, rather broader than long, resembles maxillæ in colour.

Sternum cordate, glossy black-brown, yellow median line.

Abdomen broad-oviform, slightly convex, projects over base of cephalothorax, clothed with light hairs, and bristle-like black hairs; ground colour brown, mottled with a pale hue; between the rounded tubercular eminences are two remarkable large creamy-yellow spots; tapering posteriorly as far as spinners is a wide acute-crenate red-chestnut and brown mark. Ventral surface light dull-yellow, broad T-shaped black-brown mark. *Epigyne* large, conical, pendulous, segmented, clear dark-green process, apex directed backwards, tinged with yellow, on either side of process are glossy-black planiform spiral lobes.

Te Karaka, *A.T.U.*

Epeira saxitalis, sp. nov.

Female, immature.—Ceph. th., long, 2·5; broad, 2·5; facial index, 1. Abd., long, 5·3; broad, 5. Legs, 1, 2, 4, 3 = 11·5, 10, 9, 7 mm.

Cephalothorax yellowish, sparsely clothed with light hairs; broad oval, laterally constricted forwards; caput moderately convex, roundly truncated; median indentation somewhat diamond-shaped; caput and radial striæ moderately marked; contour rises from thoracic junction at an angle of 45°, slightly arched across caput. *Clypeus* sensibly directed inwards, in height equal to half facial space.

Eyes on black rings, posterior row sensibly recurved, hind-centrals rather further from anterior pair than they are from each other, an interval slightly exceeding their diameter, their space and a half from hind-laterals; anterior centrals dark, on low eminences, interval between them rather exceeds the space between posterior pair; lateral eyes smallest of eight, seated obliquely on low tubercles, less than their radius apart.

Legs straw-colour, almost devoid of hairs, numerous irregular, erect, light-yellowish spines, dark base, rather less than diameter of tibiæ in length; superior tarsal claws—1st pair fine, moderately curved, free end long, tip bent, 10 close teeth directed forwards, two terminal teeth exceed third by one-half; inferior claw long, fine, 2 small points.

Palpi resemble legs in colour, light hairs, erect bristles, palpal claw form of tarsal, 8 teeth.

Falces glossy, yellowish, conical, project sensibly forwards.

Maxillæ nearly as broad as long, obliquely truncated, yellowish.

Labium rather broader than long, somewhat pointed, nearly half length of maxillæ, greenish tinge.

Sternum cordate, yellow-brown.

Abdomen somewhat diamond-shaped, depressed, projects over base of cephalothorax, short obtuse tubercles at lateral angles; greyish stone-colour, thickly flecked with brown, fine brown streak along median line—in some examples almost obliterated—throwing off series of oblique bars.

This species is common about the cliffs at Waiwera, its stone-colour assimilating with its environment; several immature males, 4 mm. in length, were taken. Resembles female in form and coloration.

Epeira sub-compta, sp. nov. Plate VII., fig. 4.

Female.—Ceph. th. long, 3·2; broad, 3; facial index, 1. Abd. long, 5; broad, 4·7. Legs, 1, 2, 4, 3 = 14·5, 13·3, 12, 9 mm.

Cephalothorax yellowish-amber colour, clothed with few light hairs, spine-like bristles on caput, striæ of latter and median indentation chocolate-brown; thorax moderately depressed, broad, sides rounded, curvature directed somewhat backwards; normal grooves well-marked; caput applanate (viewed from above), somewhat conical, sides compressed, lateral index about equal to space between a hind-lateral eye and the hind-central next to it; profile line rises at an angle o 30°, runs with a faint slope to posterior central eyes, dips abruptly across facial space. Height of *clypeus* equals space between fore-median eyes.

Posterior row of *eyes* recurved, interval between median pair equals their diameter; anterior row recurved, centrals slightly largest of eight, rather more than their breadth from each other, separated by latter space from hind-pair; lateral eyes placed obliquely on separate tubercles, their diameter apart, fore-tubercle prominent.

Legs moderately strong, concolorous to cephalothorax, broad chocolate-brown annulations; light and dark stiff hairs; femora convex above, few short spines; genual joint half-length of tibial, both articles have two well-marked longitudinal grooves; tibiæ and metatarsi have few irregular yellowish spines above, former double-row of 4 beneath, latter two rows of 6. Superior tarsal claws—1st pair moderately curved, 9 open comb-teeth, points curving slightly backwards; inferior claw, 2 points.

Palpi moderately stout, rather longer than cephalothorax, resemble legs in colour and armature; palpal claw long, moderately curved, 10 comb-teeth, increasing in length and strength, directed forwards.

Falces strong, vertical, somewhat conical, project at base in front, divergent, yellowish, suffused with chocolate-brown.

Maxillæ nearly as broad as long, obtusely pointed, inclined towards *labium*, which is broader than long, pointed; organs yellowish, base dark.

Sternum cordate, eminences opposite coxæ, yellowish-brown, suffused with darker hue.

Abdomen somewhat oviform, posterior end transversely wrinkled, base broad, projects over thorax, slightly convex above, sides rounded, longitudinally wrinkled; sparsely clothed with short light hairs, few bristles; a broad, coarsely runcinate, median band tapers to spinners, mottled brown, inner marginal streak black-brown, outer creamy-yellow, in centre of dorsal band is a — not clearly defined — acute-crenate chocolate mark, few creamy-yellow marginal lines; lateral margin yellow stone-colour, series of somewhat sinuated, brown-black, oblique lines converge towards spinners. On ventral surface there is a large, somewhat quadrate, shield-shaped dark olivaceous mark, with two large creamy-yellow spots near spinners. *Epigyne* transverse oval, encircled by two broad projecting membranes, outer yellowish, inner shades off to chocolate-brown on posterior side, is confluent with outer anterior side, from whence they are produced into a broad tapering central keel, connected at its truncated apex with outer membrane; dark inner membrane incurvate within concavities, on either side of keel; projecting over labia is a broad, pendulous, segmented, contorted, yellowish process, applanate and incurved at apex.

a. Annulations on tibiæ and metatarsi faint. Superior surface of abdomen creamy-yellow; specific pattern resembles type form, more defined; apices of runcinate band black-brown, between teeth are a series of three acute black-brown marks.

Two specimens, Whangarei Harbour, *T. Broun.*

Epeira viriditas, sp. nov.

Female.—Ceph. th., long, 4; broad, 3·5; facial index, 1·4. Abd., long, 5; broad, 4. Legs, 1, 2, 4, 3 = 15, 14, 13, 8 mm.

Cephalothorax greenish straw-colour, suffused with bright pea-green; hairs very sparse and fine; sides rounded, laterally constricted at caput, which is depressed, lateral index equals space between a fore-lateral eye and the hind-central furthest from it; ocular eminence moderately prominent; median indentation transverse, radial and caput striæ fairly marked; contour of profile rises at an angle of 30°, slopes, with slight curve, to ocular area. Height of *clypeus* equals radius of a fore-central eye.

Eyes on lake-coloured rings; posterior row straight, interval between median pair slightly exceeds their diameter, nearly twice their space from hind-laterals; anterior row recurved; median pair, which are slightly larger than hind pair, about their breadth and a half apart, rather less than interval from posterior centrals, their space from fore-laterals; side eyes placed on low separate tubercles, about their radius from one another.

Legs concolorous to cephalothorax; rather stout, armature sparse, short, whitish hairs, lake-tinged spines numerous on tibiæ and metatarsi, 10–12 on inferior surface, latter article and tarsi tinged with lake-colour; superior tarsal claws—1st pair 9 teeth, 5 basal close, terminal strong; inferior claw sharply bent, 2 teeth.

Palpi resemble legs in colour and armature; palpal claw 8 teeth.

Falces moderately stout, conical, directed somewhat inwards, pea-green; fangs, dark lake-colour.

Maxillæ nearly as broad as long, obtusely truncated, inclined towards *labium*, which is rather broader than long, roundly pointed, everted; organs pea-green, yellowish margins.

Sternum cordate, eminences opposite coxæ, yellowish, clouded with pea-green.

Abdomen oviform, base somewhat pointed; very sparsely clothed with short light hairs; dorsal surface covered by a bright, deep pea-green, yellow margined, oviform mark; lateral margins greenish-black. On ventral surface is a green, yellow-margined, shield-shaped mark. *Epigyne* represents a yellowish, transversely wrinkled, cucullate eminence; projecting outwards from beneath hood-like membrane, is a broad, long, clear greenish-yellow, linear process; about 12 well-defined segments, concave above, apex cupuliform; integument at base of process produced, at right angles to it, into large, somewhat conchiform projections, with brown margins, curving inwards beneath process.

Frequents *Leptospermum*; Te Karaka, *A.T.U.*

Epeira discolora, sp. nov.

Female.—Ceph. th. long, 3; broad, 2·2; facial index, 1. Abd., long, 5; broad, 4. Legs, 1, 2, 4, 3 = 12, 11, 9·2, 5 mm.

Cephalothorax yellow amber-colour, suffused with reddish-amber, hairs sparse, whitish; oval, rather depressed, moderately constricted forwards; caput roundly truncated, ocular eminence moderately prominent, lateral index equals space between fore-lateral eyes; median fovea somewhat circular, deep, radial and caput striæ fairly marked; contour of profile rises from thoracic junction at an angle of 60°, dips slightly across caput. *Clypeus* vertical, in height equal to diameter of a fore-central eye.

Posterior row of *eyes* sensibly recurved; centrals separated by an interval that slightly exceeds their diameter, little more than their space from hind-laterals; anterior row recurved, median pair rather smaller, and further apart than are posterior pair; interval between fore and hind-centrals rather exceeds space between latter pair; lateral eyes seated obliquely on black tubercles, less than their radius from each other.

Legs rather slender, yellow-amber colour, reddish annuli, femora of first pair clouded with olive-green; sparsely furnished with short hairs, erect black spines; tibial and metatarsal spines exceed diameter of those articles in length. Superior tarsal claws—1st pair, 11 comb-teeth, increasing in length and strength; inferior claw, 2 teeth.

Palpi moderately slender, about length of cephalothorax, yellowish, spines numerous; palpal claw like tarsal, 8 teeth.

Falces strong, conical, vertical, red-amber colour.

Maxillæ broad, rounded, inclined towards *labium*, which is nearly twice as broad as long, everted; organs yellowish, base chocolate-brown.

Sternum cordate, eminences opposite coxæ, brown, yellowish streaks in centre.

Abdomen oviform, convex above, projects over base of cephalothorax; dorsal surface covered by an oviform pea-green mark, margins brown, sinuated; on its fore-part there is a creamy-white angular line, vertex directed forward, base extends back to central pair of impressed spots, between latter and spinners are two or more whitish spots; upper portion of lateral margins rich maroon, lower greenish-brown oval patch, with creamy margins. Ventral surface brown, two longitudinal whitish streaks and spots. *Epigyne* yellowish, moderately convex, somewhat triangular, transversely wrinkled, cucullate membrane, centrally produced into a short involute lip; dark margins of hood-like membrane project a little forwards, from base of lip curve backwards, forming large lateral loops, confluent beneath lip.

Male.—Ceph. th., long, 3; broad, 2·4. Abd., long, 3·2; broad, 2. Legs, 1, 2, 4, 3 = 14, 12, 10, 7 mm.

Cephalothorax yellowish-amber, slightly suffused with darker hue; broad oval, fore-part of caput more depressed than female's, contour of profile low arch; median indentation and striæ well marked.

Legs concolorous to female's; femoral spines exceed diameter of article in length, numerous on 1–2; margin of coxæ, 1st pair, produced on inner side into a short curved apophysis.

Palpi yellowish, few pale hairs, humeral joint short, small curved spine on fore-end; cubital short, complanate, fore-angles produced into cylindrical tubercles, from which project remarkably long, strong bristles, outer angle produced into a stout conical apophysis; radial joint cyathiform, length about equal to diameter of cubital, attached to inferior surface of latter joint; digital joint large, somewhat globose, reddish tints, convexities hairy, directed towards each other; palpal organs complex, superior surface, large, brownish, convex disc, dark margins of which are produced into a curved, tapering apophysis, directed backwards; most remarkable, projecting from inferior surface of bulb are two broad curved apophyses near articulation of joints, terminating in several black points; between these and the terminal, long, tapering, black process, which is directed downwards and somewhat backwards, are two large, broad-conical eminences directed downwards.

Abdomen small, oviform, pea-green, varies somewhat in coloration.

This species varies in colour, lateral margins in some examples being brown or green, in others the abdomen has a yellowish tinge.

Not uncommon; usually frequents manuka (*Leptospermum*); forms a moderate-sized web; pairs in November.

Te Karaka, *A.T.U.*

Epeira verutum, sp, nov.

Female.—Ceph. th., long, 3·5; broad, 2·5. Abd., long, 6; broad, 4·7. Legs 1, 2, 4, 3 = 11, 9, 8, 6·5 mm.

Cephalothorax yellow-brown, suffused with red-chestnut; hairs greyish, sparse; broad-oval, constricted laterally forwards, depressed; caput roundly truncated, lateral index nearly equals space between fore-lateral eyes; ocular eminence low; median indentation transverse, normal grooves well-marked. *Clypeus* vertical, height exceeds diameter of a fore-central eye.

Posterior row of *eyes* moderately recurved, median pair about their diameter apart, rather more than their breadth from anterior centrals, which are separated by about their diameter and a half, and rather more than that interval from the side-eyes next to them; laterals seated obliquely on dark tubercles, about their radius from each other.

Legs moderately strong, concolorous to cephalothorax, more or less defined greenish annulations; armature darkish hairs and spines; length of tibial spines about equal to diameter of article; superior tarsal claws—1st pair evenly curved, 11 teeth, 4 outer open, curved backwards; inferior claw long, sharply bent, teeth small.

Palpi moderately slender, armature and colour of legs; palpal claw moderately curved, 6 teeth, increasing much in length and strength.

Falces vertical, conical, tumid at base in front, strong teeth; similar to legs in colour.

Maxillæ broad, inclined towards *labium*, which is nearly as long as broad, somewhat pointed, everted; yellowish-green, base dark.

Sternum cordate, eminences opposite coxæ, chocolate-brown colour.

Abdomen ovoid, projects over base of cephalothorax, on dorsal surface is a broad, pale pea-green, yellow-margined lance-like mark, basal angles obtuse, shaft tapers posteriorly; the four central, well-marked, impressed spots on lance-head form a trapezoid; lateral margins dark velvety - brown. *Epigyne* represents a yellowish-green, transversely wrinkled, moderately prominent, semicircular eminence, centrally produced into a broad, transversely wrinkled process, directed backwards, concave above, apex somewhat calceolate; projecting laterally from base of lip are large processes, terminating with somewhat planiform spiral lobes.

Female.—Var. *cervina*, var. nov.

Cephalothorax, *legs*, and *palpi* do not differ essentially in coloration from type form. *Abdomen* light brown, shading off on lateral margins to a soft dark brown, specific mark pale chalky-green edged with buff, sharply constricted at posterior pair of central impressed spots, giving it the form of an arrow, with a well-defined shaft: on posterior half of abdomen is a brownish band, with sinuated margins.

Var. *hastatum*, var. nov. Plate VIII., fig. 2.

Female.—*Cephalothorax* and *legs* resemble type form. *Abdomen* light-brown above, graduating to a darker shade on lateral margins; dorsal surface covered by a more or less defined somewhat oviform brown mark, with sinuated margins; specific mark differs in form from that of var. *veruina*, constriction defining arrow-head being in line with anterior pair of central impressed spots; in line with posterior pair is an obtuse-angled transverse bar, shaft tapers off to spinners.

Male.—Ceph. th., long, 3; broad, 2. Abd. long, 3·6; broad, 2·7. Legs, 1, 2, 4, 3 = 11, 9, 8, 6 mm.

Cephalothorax yellowish-brown, greenish-tinge; caput slightly more compressed than female's.

Legs yellow-brown, olivaceous annulations; coxæ of first pair produced, on outer side, into a short curved apophysis; femoral spines of latter pair strong, tibial exceed diameter of article in length.

Palpi yellowish, humeral joint slender, short; cubital, broad, somewhat oval, complanate, truncated at apex, projecting from short cylindroid tubercles, at each angle are long bristles; radial joint articulated to inferior surface of cubital, nearly twice diameter of latter joint, umbraculiform; digital joint large, somewhat oval, convexities moderately hairy, directed towards each other, base of convexity produced on outer side into a reddish-brown curved apophysis, concave on superior surface; beneath it is a large, conical, yellowish process, directed downwards and outwards; superior surface of bulb semi-globose, transversely striated, crumpled on inner side into a hippocrepiform eminence, lobe beneath terminates in a short beak-like process, concave within, directed downwards; remaining most remarkable projections are, a short, broad, pale, rugose membrane, curving upwards towards point of beak, and a large yellowish and black claw-like apophysis projecting from apex of joint, curved backwards.

Abdomen oviform, coloration and markings resemble female.

Var. *lineola*, var. nov.

Abdomen brown, oviform mark nearly obliterated, specific pattern reduced to a narrow longitudinal line, with similar tints; in some examples faint trace of arrow-like mark.

Examples of this interesting species, and the more or less clearly defined varieties, were numerous on low shrubs, about the summit of Arthur's Pass; I also captured them at Lake Alexandra, Mackenzie Plains, Canterbury. Examples of var. *hastatum* have been sent to me by F. Goyen, Esq., Dunedin.

Epeira linea-acuta, sp. nov.

Female.—Ceph. th., long, 3; broad, 2·8; facial index, 1. Abd., long, 5; broad, 4. Legs, 1, 2, 4, 3 = 10·5, 9·5, 9·5, 6·5 mm.

Cephalothorax greenish, hairs sparse, grey; depressed, sides rounded, laterally constricted forwards; caput roundly truncated, ocular eminence low, lateral index equal to space between a fore-lateral eye and the hind-central nearest to it; median fovea deep, striæ fairly marked; profile line rises from thoracic junction at an angle of 30°, forms slight arch across caput. Height of *clypeus* about equal to diameter of an anterior central eye.

Eyes on dark rings; posterior row sensibly recurved; median pair rather more than their diameter apart, their space and a quarter from hind-laterals; anterior row recurved, centrals nearly twice their breadth from each other, rather less than that interval from hind-centrals, nearly their space from side-eyes next to them; laterals seated obliquely on low tubercles, separated by about their diameter.

Legs moderately stout; clear yellowish-green, brownish annulations; short grey hairs, spines rather numerous, yellowish, double row of five beneath tibiæ and metatarsi; superior tarsal claws—1st pair, 9 teeth; inferior claw, 2 strong teeth.

Palpi rather slight, yellowish-green; palpal claw straighter than tarsal, 9 teeth.

Falces conical, directed somewhat inwards, greenish-yellow.

Maxillæ nearly as broad as long, obtusely pointed, inclined towards *labium*, which is triangular, almost twice as broad as long; organs yellowish, base greenish.

Sternum cordate, eminences opposite coxæ, yellowish, olive tinge.

Abdomen somewhat oviform, broad, sensibly convex above, sides rounded, projects moderately over base of cephalothorax; sparsely clothed with short fine hairs; dorsal surface covered by a large, mottled, greenish-yellow oviform mark, margined by two streaks, inner white, outer brown, graduating off to green; four central impressed spots form a trapezoid, 1st pair placed close to apex at base; on either side, and directed towards 2nd pair, are two fine brown lines forming an acute angle; extending outwards from spinners to 3rd pair are a series of four brown lines—outer streaks in most examples form a curve connected with narrow dorsal line. On ventral surface there is a wide green band, white and brown margins. *Epigyne* represents a broad, transversely wrinkled, yellowish eminence, centrally produced into a short, pendulous, cupuliform, wrinkled process, directed backwards; projecting at right angles from base of process are two smaller, somewhat vermiform, short thick processes, base of which consists of two well-defined segments; apices conical, smooth.

Male.—Ceph. th., long, 3; broad, 3·4. Abd., long, 3·5; broad, 3. Legs, 1, 2, 4, 3 = 12, 11, 10, 6 mm.

Cephalothorax deeper green, caput more compressed laterally, ocular eminence projects more over clypeus, and tubercles of anterior lateral eyes more prominent than female's.

Legs strong, yellowish-green; annuli well marked.

Palpi short, greenish; cubital joint about half length of humeral, applanate, projecting from truncated apex are two long bristles; radial joint articulated to inferior surface of cubital; projecting outwards and downwards is a large, yellowish, conoid process; above is a broad, spiral apophysis; apex dark-lake, directed outwards, curving inwards; digital joint large, somewhat oval, convexities hairy, directed towards each other; palpal organs complex, superior surface of bulb striated, apex partially cleft through, exposing inner dark lobe: lower, smooth portion of bulb terminates in a remarkable claw-like process; projecting downwards are two wide, darkish, semi-pellucid, membranous processes.

Abdomen resembles female's in coloration and pattern.

Numerous examples. Lake Tekapo, Canterbury, *A.T.U.*

Epeira purpura, sp. nov.

Female.—Ceph. th., long, 3·2; broad, 2·8; facial index, 1·2. Abd., long, 7; broad, 6. Legs, 1, 2, 4, 3 = 12·5, 11·5, 10, 6 mm.

Cephalothorax yellowish-amber, suffused with red-lake; hairs sparse, light; rather depressed, sides rounded, constricted at caput, which is roundly truncated, ocular eminence low, lateral index less than interval between a fore-lateral and the hind-median eye furthest from it; normal grooves not well-marked; contour of profile rises at an angle of 45°, slopes forwards with a slight curve to occiput; *clypeus* in height equals diameter of a fore-central eye.

Posterior row of *eyes* slightly recurved, median pair rather more than their breadth apart, their space and a quarter from hind-laterals; anterior row moderately recurved, centrals separated by an interval equal to nearly twice their diameter, rather more than their breadth from hind-pair, nearly their space from fore-laterals; side-eyes seated obliquely on separated tubercles, nearly contiguous.

Legs rather slight, yellowish-amber colour, suffused with red-lake; armature few light hairs, spines numerous, double row of 5 on inferior surface of tibiæ, about equal number under metatarsi; superior tarsal claws—1st pair, 9 comb-teeth; inferior claw strong, 2 teeth.

Palpi resemble legs in colour and armature; palpal claw somewhat like tarsal, 8 teeth.

Falces vertical, conical, moderately stout, yellowish.

Maxillæ longer than broad, somewhat spathulate, inclined towards *labium*, which is pointed, rather broader than long; organs brownish, pale apices.

Sternum cordate, nearly as broad as long, eminences opposite coxæ; chocolate-brown.

Abdomen large, base obtusely pointed, lateral angles prominent, pointed posteriorly; sensibly convex above, sides slope inwards; creamy-white transverse band connects angles, thickly marked with large irregularly-shaped creamy-white flecks, which are intersected by lake-purple vein-like lines; very sparsely clothed with short, fine hairs. Dark-green yellow-margined shield-shaped mark on ventral surface; *epigyne* yellowish, broad, somewhat vermiform process, segments well-developed, apex calceolate: three-fourths of pendulous process is attached to a wide membrane, beaded margins of which are involute on posterior side.

Single specimen. Te Karaka, *A.T.U.*

Genus **Nephila**, Leech.

Nephila argentatum, sp. nov. Plate VIII., fig. 3.

Female.—Ceph. th., long, 2·8; broad, 2. Abd., long, 7; broad, 4. Legs, 1, 2, 4, 3 = 20, 18, 15, 8 mm.

Cephalothorax dark straw-colour, translucid, marginal zone and V-shaped mark on caput olive-green; broad oval, depressed, moderately constricted forwards; caput convex, roundly truncated; median fovea deep, olivaceous tint, somewhat diamond-shaped, placed rather forwards; caput and radial striæ well-marked; contour of profile represents a double-arch, thoracic curve indented; *clypeus* vertical, in height rather exceeds space between anterior central eyes.

Eyes on dark spots, four centrals nearly form a quadrilateral figure, longer than broad; posterior row sensibly procurved, median pair separated by rather more than their diameter, nearly twice that space from hind-lateral eyes; anterior row recurved, centrals dark, placed on blackish-green moderate eminences, nearly their diameter apart, and about twice that interval from hind-centrals; lateral eyes seated on black tubercles, rather less than their radius from each other.

Legs long, slender, femora clear green, remaining joints yellowish, brownish annulations; armature long, fine hairs, long slender spines on femoral, tibial, and metatarsal joints; latter article about equal in length to genua and tibiæ; superior tarsal claws—1st pair long, moderately curved, 13 short somewhat even comb-teeth; inferior claw sharply curved, apex directed outwards, 2 small teeth.

Palpi slender, resemble legs in colour and armature; palpal claw long, rather straight, 6 teeth.

Falces vertical, somewhat conical, project at base in front, as stout as femora of first pair of legs, divergent at apex, double row of about 5 strong teeth; yellowish, olive-green, yellow-mottled oval streak on fore-part.

Maxillæ rather longer than broad, spathulate, divergent, yellow-brown. *Labium* oval, about as broad as long, less than half length of maxillæ; dark-brown, apex yellowish.

Sternum mahogany-brown, longer than broad, roundly truncated in front, pointed posteriorly, eminences opposite coxæ.

Abdomen large, oblong-oval, dorsal surface and sides somewhat deplanate, base projects forwards, slope abrupt, projects rather beyond spinners; dorsal surface dull silver, specific pattern varies in accuracy of outline in different examples; brown-black cruciate figure on fore-part intersects four rounded mammiform eminences, two black dots in front, four behind transverse bar, four anterior dots on eminences, base of cross extends nearly to spinners, throwing off two oblique lines, which are directed backwards; from dark bands along lateral margins two blackish streaks converge towards spinners; two subulate marks extend from near spinners to posterior pair of dots, apices directed forwards. Ventral surface, brown and blackish streaks, two longitudinal golden lines or spots extend from branchial opercula to spinners. *Epigyne* simple, semicircular, brownish-black eminence, slightly concave within.

Male.—Ceph. th., long, 2·8; broad, 2. Abd., long, 3·8; broad, 2. Legs, 1, 2, 4, 3 = 26, 19, 15, 9·5 mm.

Male does not differ essentially from female in coloration or form, except that the legs are longer, abdomen shorter and slimmer.

Palpi, humeral joint slender, clear straw-colour, few black hairs, and slender bristles; nearly twice as long as cubital and radial joints together; former article short, radial rather the longest, base slender, projects a long bristle on fore-part; two latter joints clouded with olive-green; digital joint nearly equal in length to three former articles; yellowish-brown; oval, convexities hairy, directed towards each other; palpal organs simple, bulb large, glossy light orange-brown, on outer face are two brownish curved lines, integument of bulb hexagonally veined, projecting from apex are two somewhat beak-like membranous apophyses; curving over bulb, at basal end, is a short, stout, dark process.

Species common, pairs in November; web oblique or horizontal, constructed amidst green vegetation, spider rests in centre, beneath the web, exposing the dull-coloured ventral surface. Mature examples are apparently not to be met with during the winter months, but the young may be found on fine webs about grass, etc.

Tairoa, *T. Broun*. Te Karaka, Waiwera, *A.T.U.*

Fam. THLAOSOMIDÆ.

Genus **Thlaosoma**, Cambr.

Thlaosoma pennum, sp. nov. Plate VIII., fig. 4.

Ceph. th., long, 2·5; broad, 2·3. Abd., long, 3; broad, 6·5. Legs, 1, 2, 4, 3 = 8, 7·8, 6·5, 5·5 mm.

Cephalothorax creamy-white, few brownish streaks and spots; sparsely clothed with whitish hairs, chiefly in lines; sides rounded sharply, laterally constricted at caput, which has the characteristic upturned form of the genus; bifurcation at conjunction of caput striæ and median indentation not so prominent as in *T. olivacea*; contour of profile rises somewhat abruptly from thoracic junction, forms a prominent rounded hump sloping off with slight arch to upturned apex. Height of *clypeus* slightly exceeds facial space.

Falces placed in usual position, four central divided by a yellowish cross-like figure.

Legs concolorous to cephalothorax, faintly clouded and annulated with brown; sparsely furnished with light hairs and bristles; 1–2 hardly differ in length or strength; femoral joints strong; two rows of minute spinous tubercles with numerous small irregular spines between on outer side; similar but smaller spines extend along genual and tibial joints, two or three at base of metatarsi; 4th pair slightly exceeds 3rd in length and strength; femora of latter pair armed with short irregular row of spines, nearly absent and weak on 4th pair. Superior tarsal claws—1st pair, outer strong, long, sharply bent, 2 short curved teeth at base; inner claw less than one-third size of outer, 5 comb-teeth, increasing in length and strength; inferior claw nearly equals inner in strength; auxiliary claws.

Palpi creamy-white, brown annuli, whitish hairs; palpal claws strong, sharply bent, no teeth.

Falces long, conical, directed slightly inwards, divergent at apex, few strong teeth; pale stone-colour, clouded with brown.

Maxillæ directed towards each other, somewhat pointed on inner side; *labium* triangular, broader than long; organs chocolate-brown, light apices.

Sternum cordate, bifurcates at base, light-brown, clouded with a darker hue.

Abdomen creamy-white, faintly clouded on fore-part with brown; sparsely clothed with whitish hairs, bristle-like hairs at posterior end, few black tufts; broader than long, sides prolong, outwards, into sharp conical prominences, 2 mm. in length; base of abdomen rounded, semicircular indentation over thorax, with brown mark in centre; transverse row of humps faintly developed; posteriorly it forms an obtuse angle, contour slightly rounded; four impressed spots form a trapezoid. Ventral surface deeper hue, bronchial opercula brownish. *Epigyne* greenish-black, prominent, lip-like, somewhat pointed.

This species was described from a single example taken at Waiwera.

Thlaosoma olivacea.

Male.—Ceph. th., long, 0·6. Abd., long, 1·2; broad, 1·2. Legs, 1, 2, 4, 3 = 1st pair, 2·1 mm.

Cephalothorax areolate; chocolate-brown; two yellowish, half-circular lines extend along caput grooves, conjoined in centre of thorax, curving outwards near base; clothed with a few stout white lanceolate hairs, long erect black one at base of caput; oval, laterally compressed at caput, which is upturned, sub-conical, reddish-chocolate colour; four central *eyes*, which are comparatively larger than female's, intersected by a less defined yellow cross; lateral eyes seated obliquely on strong tubercles, rather less than diameter apart. *Clypeus* in height equal to about twice diameter and a half of an anterior central eye.

Legs moderately stout; 1–2 and 4–3 nearly equal in length and strength; brownish-yellow, fore-half of femora, genua, and basal half of tibiæ black; chocolate annuli at apices of tibial and metatarsal joints; sparsely furnished with light hairs, few spines, long erect bristles; double row of short, black, tubercular spines along outer side of femora of 1–2. Superior tarsal claws differ in size; inferior claw sharply bent, free end fine.

Palpi short, tints of cephalothorax; humeral joint rather exceeds cubital and radial in length; cubital joint somewhat applanate, broad, and rounded in front, projects a strong bristle; radial joint calycoidal; digital oval, convex, and hairy externally, convexities directed towards each other; superior and inferior lobes of bulb large, reddish-brown; projecting at apex is a stout yellowish conical process; springing from base of article on outer side is a reddish, rather flat, but convex apophysis, curved inwards at apex.

Falces long, vertical, somewhat linear; yellowish, clouded on inner side with brown-black.

Maxillæ spathulate, much inclined towards *labium*, which is rounded, more than twice as broad as long; former organs greenish, latter brownish-yellow, dark bases.

Sternum broad-cordate, areolated, chocolate-brown.

Abdomen rounded in front, slightly curved indentation, pointed posteriorly; tubercles strong, project moderately backwards and outwards; brownish-yellow, dark, oblong mark at basal indentation; brownish marks between tubercles; strong black and white lanceolate serrated hairs.

This little spider may possibly not prove to be the male of *T. olivacea*, but I have taken it on two occasions, at Te Karaka and Waiwera, in the vicinity of females of that species; the first mature male was taken on November 1st. Females fabricate cocoons as late as April 17th; they are spherical, 5 mm. in diameter, echinulate, of a hard, brown, parchmenty nature, four or five in number, suspended by a short pedicel; comprised within are about 80 spherical, unagglutinated, dark straw-coloured eggs. The web is small, resembles that of the *Theridiidæ*, the lines intersecting one another at different angles and planes; web and cocoons may be met with about hakea fences and low shrubs. The female probably obtains some protection from her remarkable form and pale coloration; in the early part of summer examples may be met with resting on the upper surface of broad leaves—*e.g.*, apple; when in such positions their irregular forms, tinted with a pale greenish-blue and creamy-white, bear a strong resemblance to the excreta of birds.

Fam. THERIDIIDÆ.

Genus **Ariamnes**, Th.

Ariamnes conifera, sp. nov. Plate VIII., fig. 5.

Female.—Ceph. th., long, 1; broad, 0·8. Abd., long, 2; broad, 1; high, 1. Legs, 1, 4, 2, 3. 1st = 4·5 mm.

Cephalothorax oval, nearly as broad as long, slightly compressed forwards, depressed, caput roundly, thorax squarely truncated, areolate, normal grooves faint yellow-brown, shaded on lateral margins with olive-green, two bands of similar hue converge from hind eyes to base of thorax; contour of profile rises rather abruptly, runs nearly horizontally, rising slightly at occiput; *clypeus* nearly as long as depth of ocular area, projects forwards.

Eyes of equal size, seated on lake-coloured spots; four centrals nearly form a square; posterior row sensibly procurved, median eyes separated by rather more than their breadth, their diameter and a half from side eyes of same row; anterior row recurved, nearly equidistant; laterals placed on moderate tubercles, their radius apart.

Legs slender, 1–4 nearly equal in length; pale stone-colour, dark olivaceous annuli at articulations; metatarsal joint exceeds tibial in length, tarsal joint very short; armature few black hairs, long slender bristles; superior tarsal claws—1st pair slender, outer claw 1 tooth, inner (?); inferior claw sharply bent.

Palpi rather short, resemble legs in colour and armature, palpal claw about four teeth.

Falces conical, project slightly forwards, yellowish.

Maxillæ greenish-yellow, somewhat spathulate, moderately inclined towards *labium*, which is dark, pointed, about as long as broad.

Sternum oval, slightly angular at coxæ of second pair, rugulose, centre greenish-yellow, margins dark.

Abdomen oblong-oval, base cleft in centre, forming short obtuse tubercles, apices directed forwards, posterior quarter compressed into a stout tail-like projection; at base of compression dorsal surface is produced into a conical nearly upright tubercle, about equal in length but slighter than posterior end of abdomen; very sparsely furnished with light hairs; dorsal surface mottled with stone-coloured brown, dark median band extends to apex of cone. Ventral surface darkest, spinners at apex. *Epigyne* simple, red-brown, circular orifice, labia black-brown, moderately prominent.

Chiefly frequents *Leptospermum*. Waiwera, Te Karaka, *A.T.U.*

Ariamnes triangulatus, sp. nov. Plate VIII., fig. 6.

Female.—Ceph. th., long, 0·8. Abd., long, 1·7; deep, 1. Legs, 1, 4, 2, 3, = 6·2, 6, 3·7, 2·2, mm.

Cephalothorax yellow-brown, suffused about thorax with brown, rugulose, almost glabrous; oval, about twice as long as broad, slightly compressed forwards, transverse indentation on thorax deep; fovea oval, striæ fairly marked; contour of profile rises from thoracic junction with a moderate curve, forms nearly even line across caput, slopes forwards at ocular area, which projects a little in front. *Clypeus* projects forwards, length about equals depth of facial space.

Posterior row of *eyes* moderately procurved, median pair on lake-coloured rings, have with side eyes a pearly lustre, separated by an interval equal to more than twice their diameter, less than their breadth from hind-laterals, they form with anterior-centrals a nearly quadrilateral figure, broader than long; anterior row recurved, centrals dark, seated on black eminences, rather closer to each other than are posterior pair, close to fore-laterals; side eyes nearly contiguous, seated obliquely on small lake-coloured tubercles.

Legs slender, yellowish, clouded with reddish-brown, armature light hairs and bristles; superior claws—1st pair slightly curved, weak, few teeth ; inferior claw bent, free end fine, curved outwards.

Palpi rather stout, short, resemble legs in colour and armature, palpal claw form of tarsal.

Falces long, nearly linear, directed forwards, yellowish.

Maxillæ long, spathulate, inclined towards *labium*, which is broad-conical, more than half length of maxillæ; organs yellowish.

Sternum shield-shaped, yellowish, mottled with lake-brown.

Abdomen somewhat oval, base squarely truncated, centre grooved, prolonged beyond spinners into a stout tubercle, nearly twice length of abdomen proper ; profile somewhat triangular, spinners at apex ; sparsely clothed with light hairs ; integument mottled with various tints of yellowish-brown, brown dorsal band converges round apex at tubercle, which has faint transverse rings. *Epigyne* simple.

Male, immature.—Ceph. th., long, 0·6.—Abd., long, 1·2. Legs 1, 4, 2, 3 = 6, 4·5, 3·3, 2 mm.

Cephalothorax yellowish, lateral margins suffused with brown ; sides nearly parallel, twice as long as broad, transverse indentation on thorax, small oval fovea ; contour on profile rises at occiput. *Clypeus* projects forwards, slightly exceeds in length depth at ocular area. *Eyes* resemble female's in position.

Legs long, slender, yellowish, suffused and annulated with red-chestnut ; armature sparse light hairs, few slender bristles.

Palpi yellowish, humeral joint long, slender ; cubital short.

Falces long, somewhat linear, directed slightly forwards, yellowish.

Maxillæ long, spathulate, moderately inclined towards *lip*.

Sternum shield-shaped, chocolate-brown, yellow spots.

Abdomen does not differ essentially from female in form or coloration.

Frequents *Leptospermum*, Te Karaka, *A.T.U.*

Ariamnes attenuatus, sp. nov.

Female.—Ceph. th., long, 1·3; broad, 0·8. Abd., long, 4 ; broad, 1·5. Legs, 1, 4, 2, 3,=11, 9·2, 6·8, 3 mm.

Cephalothorax mottled, brown-black, light median band ; areolate ; elongated, sides nearly parallel, strong transverse indentation, caput roundly truncated ; contour at profile forms a moderate arch from thoracic junction, notched at indentation, slopes slightly, rising somewhat abruptly at occiput. *Clypeus* nearly horizontal, about equal to depth of ocular area.

Eyes disposed in two semicircles, forming an oval space, four centrals form a quadrilateral figure, separated by about their radius from laterals, which are contiguous, seated on very low tubercles, have pearly lustre at hind-median eyes ; anterior centrals dark, placed somewhat obliquely on prominences.

Legs long, slender, yellowish, spotted and annulated with dark-brown and chestnut-brown; armature few fine erect hairs and slender bristles; superior tarsal claws moderately curved, weak; inferior long, fine.

Palpi stout, nearly as long as cephalothorax, radial joint broadest at apex, red-chestnut; palpal claw fine, moderately curved, about 4 small teeth.

Falces narrow, conical, project moderately forwards, yellowish-chestnut, base dark.

Maxillæ yellowish, long, obliquely truncated on outer side, slightly inclined towards *labium*, which is broader than long, slightly pointed, two-thirds length of maxillæ, dark, light apex.

Sternum long-obovate, brown, spotted and suffused with brassy metallic lustre.

Forepart of *abdomen* somewhat oviform, prolonged beyond spinners into a long cylindrical tubercle, curving slightly downwards, about half-length of abdomen, transversely rugulose; brown-black, mottled with stone-colour, glabrous. *Epigyne*, concavity oval, reddish, labia dark, protuberent, broad, introflexed.

Male.—Ceph. th., long, 1. Abd., long, 3. Legs, 1, 4, 2, 3 = 9·6, 6, 4·5, 2·3 mm.

Cephalothorax similar in form and coloration to female; anterior median *eyes* rather further apart.

Legs slender, yellowish, clouded or spotted, and annulated with dark chestnut-brown; armature fine hairs, few slender bristles.

Palpi long (2 mm.), slender, resemble legs in colour and armature; humeral joint rather less than one-half length of palpus; cubital joint short; radial twice length of former article, stoutest at articulation with digital joint, which is convex, rugulose, and hairy externally; palpal organs small, on outer side is a sinuate process, apex black, curved, toothed beneath, directed forwards; at basal end is a yellow acuminate apophysis, directed downwards.

Abdomen does not differ essentially from female.

Frequents manuka. Te Karaka, *A.T.U.*

Genus **Linyphia**, Latr.

Linyphia blattifer, sp. nov. Plate VIII., fig. 7.

Female.—Ceph. th., long, 1. Abd., long, 1·8. Legs, 1, 2, 4, 3.

Cephalothorax light mahogany-brown, median line and margins darker hue, rugulose; oval, moderately compressed forwards, caput roundly truncated; median fovea transverse oval, caput and radial striæ moderately marked; profile line rises, not very abruptly, from thoracic junction, forms a low arch across caput. *Clypeus* projects forwards, indentation below eyes, in height equals depth of facial space.

Eyes on black spots, posterior row procurved, median eyes rather less than their diameter apart, more than their breadth from hind-laterals; anterior row strongly recurved, central pair black, rather smallest of eight, separated by a space equal to their radius, more than their diameter from side eyes; laterals nearly contiguous, seated obliquely on strong black tubercles.

Legs slender, bright yellow-amber colour; armature erect dark hairs, erect spines on femoral, genual, and tibial joints, circle of weak spines round metatarsi of 3–4; superior tarsal claws—1st pair, fine, slightly curved, about 10 somewhat even teeth; inferior claw, free end fine, one point.

Palpi resemble legs in colour and armature, palpal claw slender, apparently no teeth.

Falces long, linear, vertical, rugulose, reddish-amber colour.

Maxillæ broadest at apex, inferior angle obtuse, base chocolate-brown, apices yellow.

Labium oval, everted, about half length of maxillæ, dark.

Sternum broad-cordate, dark chocolate-brown.

Abdomen oviform, convex above, rises abruptly from petiolum; a not very clearly defined leaf-like mark on dorsal surface, marks and shading, various tints of purple. *Epigyne* represents a remarkably large yellowish-brown appendage, convex above, few hairs, apex directed backwards.

Male.—Ceph. th., long, 1·3; broad, 1. Abd., long, 1·3. Legs, 1, 2, 4, 3. Leg of first pair, 4·5 mm.

Cephalothorax olive-brown, glossy; oval.

Legs 1–2 do not differ much in length; resemble female's in colour and armature.

Palpi, humeral joint about twice length of cubital and radial together, latter articles of about equal length, cubital somewhat globose, projects a long black bristle; radial broad cup-shaped, black bristle; articles yellowish; digital joint large, somewhat oviform, convex and moderately hairy externally, convexities directed towards each other, palpal organs complex, bright reddish-brown; series of, more or less, semi-transparent membranous folds—viewed in front, article appears almost transversely disconnected in centre; close to base of article, on outer side, is a large, reddish-brown, membranous apophysis, curved forwards, concave on outer side, apex truncated.

Abdomen rather narrower than cephalothorax, resembles female's in pattern and coloration.

Taken on shrubs, three examples. Waiwera, *A.T.U.*

Linyphia melanopygia, Cambr.

Female.—Ceph. th., long, 1. Abd., long, 1·4. Legs, 1–4, 2, 3 = 3·9, 3·5, 2·5 mm.

Cephalothorax yellow-brown, suffused with olive-green, few bristly hairs on forepart of caput; oval, slightly compressed forwards; median fovea rounded in front, somewhat pointed behind, normal grooves moderate; contour of profile moderately arched backwards from ocular area; *clypeus* projects forwards, in height nearly equals depth of facial space.

Hind-centrals and lateral *eyes* have a pearly lustre, large, of nearly equal size; posterior row slightly procurved, hind-centrals rather more than their diameter from posterior laterals, more than that distance from anterior-centrals, rather less than their breadth from each other; fore-centrals smallest of eight, dark, rather less than their diameter from one another, and from fore-laterals; side eyes largest of eight, placed obliquely on low tubercles, nearly contiguous.

Legs moderately slender, 1–4 about equal in length; brownish-yellow; armature stiff black hairs, few fine spines, except on metatarsi; superior tarsal claws—1st pair slight, but somewhat even curve from base, about 8 close fine teeth; inferior claw long, fine, curved, free, and projects outwards, 1 tooth.

Palpi have an olivaceous hue, armed with hairs, few strong spines, digital joint terminates with a rather stout point.

Falces stronger than femoral joint of 1st pair of legs, prominent at base in front, somewhat attenuated at extremities, which are divergent, strong teeth; cocolorous to cephalothorax.

Maxillæ stout, obtusely pointed, inclined towards labium, do not possess characteristic conical eminences of male, strong bristles project from usual slight eminences, colour of falces.

Labium broader than long, brown-black.

Sternum broad-cordate, dark-brown.

Abdomen oval, base squarely truncated, moderately notched; dark orange-red, sparsely clothed with coarse dark hairs, broad black ring round spinners, which are yellowish. *Epigyne* represents a prominent blackish hood, concave within, centrally produced into a semicircular band, attached to integument on posterior side.

The *male* is described by the Rev. O. P. Cambridge in the "Proc. Zool. Society," 1879, from an imperfect example in Mr. A. S. Atkinson's collection, probably from Nelson. Relative length of *legs* 1, 4, 2, 3; 1–4 nearly equal in length. Both in form and coloration it resembles the female. Specimens may be found about loose debris, under old bags, etc.; the female constructs a fair sized horizontal web, with a fine close mesh. Mature examples are to be found throughout the year.

Te Karaka, Auckland, *A.T.U.*

Genus **Erigone**, Sav.

Erigone atriventer, sp. nov.

Female.—Ceph. th., long, 0·9. Abd., long, 1·5. Legs, 1-4, 2-3 = 4; 3·3 mm.

Cephalothorax areolate, glossy, yellowish-brown; three rows of black bristle-like hairs converge from base at caput to ocular area; oval, compressed forwards, caput convex, lateral margins deep; median fovea transverse oval, radial and caput striæ fairly marked; contour of profile rises somewhat abruptly from thoracic junction, represents a double arch; *clypeus* directed moderately forwards, projects laterally, indentation below eyes, in height nearly equal to depth of facial space.

Posterior row of *eyes* slightly procurved, about equidistant, median pair separated by rather less than their diameter, rather more than that interval from anterior centrals; hind-centrals and laterals—which are contiguous, and placed obliquely on strong tubercles—are large, pearl-grey lustre; anterior row recurved, central pair small, dark, rather less than their breadth from each other, and from fore-laterals.

Legs long, moderately slender, 1–3, 2–3, about equal in length, bright yellow-brown; armature stiff black hairs, few long bristle-like spines, none on metatarsi; superior tarsal claws—1st pair, long, fine, form an even curve from base, about 6 fine teeth, increasing in length; inferior claw long, moderately bent.

Palpi rather long, olivaceous tinge, black hairs, strong bristles, digital joint terminates with a short point.

Falces gibbous at base, taper towards apex, directed inwards, fang and teeth strong; yellowish, suffused with brown.

Maxillæ strong, dilated towards extremity, pointed, curving towards *labium*, which is somewhat oval; organs greenish-black, apices pale.

Sternum large, cordate, areolate, brown-black.

Abdomen oviform, convex, projects moderately over base of cephalothorax, brown-black, sparsely clothed with stiff black hairs, spinners greenish-yellow. *Epigyne* represents a triangular, transversely wrinkled, membranous eminence, about as broad as long, apex directed forwards, margins curve within the concavity, and are produced into a short, rather thick, apophysis, curved downwards, directed backwards.

Taken in July, amongst grass. Te Karaka, *A.T.U.*

Genus **Theridium**, Walck.

Theridium melanozantha, sp. nov. Plate VIII., fig. 8.

Male.—Ceph. th., long, 1·8; broad, 1·4. Abd., long, 3; broad, 1·5. Legs, 1, 4, 2, 3 = 10, 9·5, 7, 5 mm.

Cephalothorax glossy light-brown, marginal zone and median band wide, dark olive; broad oval, compressed forwards, caput roundly truncated; median indentation deep, transverse oval, caput and radial striæ moderately marked; contour of profile represents a low double arch; *clypeus* projects forwards, height equals depth of facial space.

Anterior row of *eyes* recurved; posterior row sensibly recurved, equidistant, interval between them rather more than their diameter; four centrals form a square, about one eye's breadth apart, anterior pair dark; latter pair closer to fore-laterals than they are to each other; side eyes separated by a space nearly equal to their radius, seated slightly obliquely on separate dark tubercles.

Legs long, slender, dark straw-colour, chocolate-brown annuli at articulation of joints; fine erect black hairs; superior tarsal claws—1st pair curved, 4 strong open teeth, increasing in length and strength, terminal tooth nearly equals free end in strength; inferior claw long, fine, sharply bent, 1 strong curved tooth, directed forwards.

Palpi resemble legs in colour, humeral joint long; cubital short, cup-shaped; radial applanate; digital joint large, somewhat cupuliform, convex and hairy externally, convexities directed towards each other, prolonged and tapering beyond bulb, projecting at apex is a greenish, membranous, pointed process; palpal organs complex, bulb large, convoluted, bright reddish-brown, attached to extremity is a remarkable long, broad, ribbed, spiral, tapering, black process, which, after making four revolutions in contact with bulb—truncating apex of article—fine end sometimes springs off laterally into an independent curl.

Falces vertical, conical, divergent at apex, glossy, yellow-amber colour.

Maxillæ spathulate, inclined towards *labium*, which is a broad-oval; organs yellowish, base chocolate-brown.

Sternum cordate, rugulose, chocolate-brown, broad light mark in centre.

Abdomen ovoid, projects over base of cephalothorax; creamy-white, two brownish bands—in some examples consisting of continuous, rather broad rings, in other series of more or less disconnected spots, of a lighter hue—converge from base to spinners; similar bands encircle lateral margins. Ventral surface black-brown; shield-like creamy-coloured mark in centre.

Female (immature) resembles male in form and coloration.

Palpi yellowish, few black hairs and fine bristles; palpal claw short, free end more than half length of claw, 4 strong teeth, resembling free end in form, 2 apical teeth nearly equal in strength.

Six examples were captured at Waiwera, *A.T.U.*

Theridium tuberculum, sp. nov.

Female.—Ceph. th., long, 1. Abd., long, 2·8; broad, 2. Legs, 1, 4, 2, 3 = 5·6, 4·2, 4, 2·9 mm.

Cephalothorax glossy brown-black, few strong bristles on caput; oval, about as broad as long, compressed forwards, caput convex, projects in front, lateral index equals twice diameter of a side eye; median fovea large transverse oval, radial striæ broad; contour of profile rises rather abruptly from thoracic junction, slopes across caput; *clypeus* projects forwards, in height about equal to depth of facial space.

Eyes large, posterior row sensibly procurved, median pair separated by nearly their diameter, their radius from hind-laterals; anterior row recurved, centrals black, seated obliquely—rather more than their breadth apart—on eminences, rather further from hind-centrals than they are from each other, close to fore-laterals; side eyes rather smaller than posterior centrals, have their pearly lustre, are placed obliquely on strong lake-coloured tubercles, nearly contiguous.

Legs moderately slender, 2–4 nearly equal in length; semi-pellucid stone-colour, dark-brown annuli; dark stiff hairs, few erect strong bristles; superior tarsal claws—1st pair, 6 open comb-teeth; inferior claw fine, 1 point.

Palpi resemble legs in colour and armature, base of palpal claw straight, free end sharply curved, 6 open comb-teeth.

Falces long, somewhat linear, convex, vertical, glossy mahogany-brown.

Maxillæ long, spathulate, inclined towards *lip*, which is nearly as long as broad; organs dark-brown, pale margins.

Sternum cordate, areolate, chocolate-brown.

Abdomen oval, yellowish olive-green, thickly mottled with creamy-white lobate spots, suffused with reddish-chocolate; on fore-part there is a black median band, with three cross bars, partially obliterated in centre where it throws off, round lateral margins, oblique creamy-coloured, sinuated lines, which have black patches on anterior side; on posterior curve of abdomen is a remarkable large, low, pointed tubercle, apex pale-yellow, nearly encircled by lemon-coloured, brown-lake, and black rings, posteriorly the pale-yellow flows over the darker colours, and apparently forms a series of creamy-coloured lobate flecks as far as spinners, which are prominent, placed about centre of ventral surface; abdomen sparsely clothed with bristle-like dark hairs. *Epigyne* glossy-black, conoid, orifice at apex, which is directed towards base of abdomen, attached to integument along its inner side.

Single specimen. Te Karaka, Auckland, *A.T.U.*

Theridium maculopes, sp. nov.

Female.—Ceph. th., long, 1·7; broad, 1·5. Abd., long, 3; broad, 2·2. Legs, 1, 2, 4, 3. = 10, 8, 6, 4·5 mm.

Cephalothorax areolate, yellow-brown, broad, brown median band extends from occiput to base, marginal zone similar hue, few bristles on occiput; oval, compressed forwards; median fovea nearly circular, deep, normal grooves moderately marked; caput convex, roundly truncated, lateral index rather less than space between an anterior lateral eye and the fore-central furthest from it; contour at profile rises with an abrupt curve, arched across caput; *clypeus* projects forwards, height rather exceeds depth of facial space.

Anterior row of *eyes* recurved, posterior row slightly procurved; centrals nearly form a square, hind-median pair separated by their diameter, rather more than that interval from side eyes next to them and anterior-centrals, which are prominent, their breadth and a quarter apart, close to fore-laterals; side eyes nearly contiguous, seated obliquely on strong dark tubercles.

Legs slender, yellowish, first pair brown annulations at articulation of joints, marked—especially femora—with brown spots; lake-chocolate spots and annuli on hind pairs; armature black hairs, few bristle-like spines, strong curved hairs on metatarsi and tarsi of two hind pairs; superior tarsal claws—1st pair, 8 teeth, 7 basal close, fine, terminal tooth strong, resembles free end; inferior claw fine, 1 long point.

Palpi short, yellowish, brown spots, stiff hairs on digital joint; palpal claw moderately curved, 5 teeth, increasing greatly in length and strength, small point at base.

Falces vertical, conical, rather divergent at apex, yellowish, clouded with brown.

Maxillæ long-oval, somewhat pointed, inclined towards lip, yellowish-reddish apices; *labium* oval, strongly convex, nearly half length of maxillæ, greenish-yellow, dark-red apex.

Sternum broad-cordate, greenish-yellow, mottled with olive-brown.

Abdomen oval, base truncated, hairs sparse, integument mottled with chocolate-brown and creamy colour; extending from base for about one-fourth along dorsal surface, is a narrow-oval creamy band with black margins, which project at right angles at either end; this part forms the petiole to the brown, black-margined, runcinate, leaf-like dorsal mark, in centre of which are a series of more or less defined somewhat triangular creamy-coloured marks. In centre of a greenish-yellow transverse eminence is the *epigyne*, which is brownish, reniform, concave; labia on posterior side moderately deep, and produced into a short, narrow, lip-like process, with incurved margins.

Several specimens. Canterbury, *A.T.U.*

Theridium viridana, sp. nov.

Female.—Ceph. th., long, 1. Abd., long, 2. Legs, 1, 2, 4, 3; leg of 1st pair, 4 mm.

Cephalothorax pea-green, glabrous; sides rounded, moderately compressed forwards, fovea and normal grooves faint; caput comparatively long, broad, convex; contour of profile rises somewhat abruptly from thoracic junction, forms low arch across caput; *clypeus* vertical, height equals depth of facial space.

Posterior row of *eyes* sensibly procurved, separated by an interval equal to about twice their diameter, median pair on dark lake-coloured rings, have, with side eyes, a pearly lustre; anterior row recurved, nearly equidistant, rather closer to one another than are eyes of hind row; median pair dark, on black spots, as far from each other as they are from hind-centrals; laterals seated obliquely, nearly their radius apart, on separate dark tubercles.

Legs long, slender, yellowish-green; armature black hairs; 1 exceeds 2 a little in length, 3–4 nearly equal; superior tarsal claws—1st pair rather short, about 5 comb-teeth; inferior claw moderately long.

Palpi resemble legs in colour and armature; palpal claw fine, curved, about 6 teeth.

Falces strong, vertical, somewhat linear, greenish-straw-colour.

Maxillæ rather broad at extremity, inferior angle obtuse, projects over *labium*, which is conical, three-fourths length of maxillæ, darker yellowish hue.

Sternum cordate, glossy, deep straw-colour.

Abdomen narrow-ovate, bright pea-green, series of irregular shaped marks of a lighter hue, largest on fore-part and lateral margins; posterior end in most examples crimson. *Epigyne* prominent, red-chestnut, somewhat quadrilateral lip, sides incurved, apex rounded.

Frequents *Leptospermum*. Waiwera, *A.T.U.*

Theridium flabellifera, sp. nov.

Female.—Ceph. th., long, 1·8; broad, 1·4. Abd., long, 2·5; broad, 1·8. Legs, 1, 2, 4, 3=9, 5·5, 4·5, 3·5 mm.

Cephalothorax glossy, yellow-amber colour; oval, moderately compressed forwards; lateral index of caput nearly equals depth of facial space; median fovea small, oval, striæ irregular, but well-marked; contour of profile rises from thoracic junction at an angle of about 65°, very slight arch across caput. *Clypeus* convex, projects forwards, in height nearly equals depth of ocular area.

Eyes on black rings, form two evenly curved rows, enclosing a narrow oval space, four centrals nearly form a square; posterior median eyes rather less than their diameter apart, more than that space from hind-laterals; anterior centrals dark, separated from each other by a space equal to their diameter, less than that interval from fore-laterals; side eyes nearly contiguous, placed obliquely on moderate tubercles.

Legs bright deep straw-colour; armature black erect hairs, few slender spines; first pair of legs longest and strongest; superior tarsal claws — 1st pair, 7 open teeth, not differing greatly in length or strength; inferior claw, free and directed outwards, 1 tooth.

Palpi resemble legs in colour and armature; palpal claw somewhat form of tarsal claw; teeth broken.

Falces conical, project sensibly forwards; yellowish.

Maxillæ straw-colour, somewhat spathulate, inclined towards *labium*, which is oval, nearly as long as broad, half length of maxillæ, deep yellow.

Sternum cordate, colour of lip.

Abdomen oviform, yellowish-olive, thickly marked with creamy-coloured flecks, fan-shaped mark on dorsal surface, fore-half heart-shaped, apex directed forwards, black-brown, margined and marked with reddish tints, posterior half narrow, linear, pale-yellow, irregular line of light-brown down centre. *Epigyne* transversely wrinkled eminence, orifice semicircular.

Taken on *Leptospermum;* Waiwera, *A.T.U.*

Theridium venustulum, sp. nov.

Female.—Ceph. th., long, 1. Abd., long, 1·9; broad, 1·3. Legs, 1, 2, 4, 3. First pair, 6·4 mm.

Cephalothorax glossy, yellow-amber colour; broad-oval, moderately constricted at caput, which is roundly truncated; median indentation and normal grooves moderately marked; profile line rounded posteriorly, rises to occiput; *clypeus* projects forwards, in height rather more than half depth of facial space.

Eyes about equal in size, represent two curved rows, enclosing a narrow oval space, four centrals form a square, are separated by a space equal to rather more than their diameter, anterior pair dark; lateral eyes nearly contiguous, seated obliquely on small black tubercles.

Legs slender, yellow-amber colour, 1–4, reddish annuli at articulation of tibial and metatarsal joints; 1 exceeds 2–4 a little in length, two latter nearly equal; armature long hairs, few fine erect bristles; superior tarsal claws—1st pair, 5 comb-teeth; inferior claw 1 short tooth, point behind.

Palpi like legs in colour and armature; palpal claw 6 comb-teeth.

Falces pale stone-colour, somewhat linear, project sensibly forwards, strong teeth.

Maxillæ somewhat linear, rounded on outer side, yellowish; *labium* oval, rather broader than long, nearly half length of maxillæ, reddish-amber colour.

Sternum cordate, yellow-amber, glossy.

Abdomen oviform, projects over base of cephalothorax; light fine hairs, pale stone-colour, tinged with pink; median band broad, tapers off at either end, reddish-lake, pale margins. Ventral surface colour of dorsal, spinners small. *Epigyne* represents a moderate-sized, slightly concave space, encircled by a very narrow dark-brown membrane, the slightly tumid pale-brown margins curve towards each other on anterior side, but are disconnected by a narrow space.

Taken on *Leptospermum;* Waiwera, *A.T.U.*

Theridium albo-gullatum, sp. nov. Plate VIII., fig 11.

Male.—Ceph. th., long, 1. Abd., long, 1·1. Legs 1, 2, 4, 3 = 6·2, 4, 3·3, 2·3 mm.

Cephalothorax areolate, glossy, yellowish-brown, small olivaceous flecks, chiefly along grooves and about caput, on forepart of which are few bristle-like hairs; broad-oval, compressed forwards, caput projects forwards, projection blackish; median fovea dark, large oval, striæ well-defined; contour of profile rises rather abruptly from thoracic junction, forms a faint curve across caput; *clypeus* projects forwards, height about equal to depth of ocular area.

Eyes large, posterior row sensibly recurved, median pair encircled by lake-coloured rings, have pearly lustre of laterals, nearly their diameter apart, about that interval from side eyes next to them; anterior row strongly recurved, centrals dark, largest of eight, three-fourths their diameter from each other, closer to fore-laterals, more than their breadth from posterior centrals; lateral eyes seated obliquely on somewhat triangular lake-coloured tubercle, nearly contiguous.

Legs long, moderately stout, yellowish, chocolate-brown annulations; femora of 1 darkest, 3–4 greenish tinge; armature long, stiff black hairs, few long fine spines, none on metatarsi; superior tarsal claws—1st pair, 7 teeth; inferior, 2 small teeth.

Palpi rather short, humeral and cubital joints yellowish; radial somewhat crateriform, about equal to cubital in length; digital joint oviform, convexities hairy, directed towards each other, project beyond bulb; latter yellowish-brown, viewed from beneath it represents a smooth, convex, oval eminence; on fore-half is a somewhat circular, narrow, brown membrane terminating at apex in a short black spiral process.

Falces vertical, somewhat linear, glossy amber-colour.

Maxillæ long, somewhat tapering, curved towards *labium*, which is broader than long, everted; organs yellowish.

Sternum broad-cordate, yellowish.

Abdomen oval, black-margined indentation at base; olive-brown; a series of oblique bands, formed of wreath-like clusters of large creamy-white flecks, with pinkish centres, extend from base to spinners, converging round lateral margins, leaving a long open space on forepart of median line, dark spot towards posterior end; sparsely clothed with long black hairs, few bristles; ventral surface brownish-yellow.

Two specimens, taken on webs formed of a few irregular lines, amongst long grass; June–July. Te Karaka, *A.T.U.*

Fam. DRASSIDÆ.

Genus **Drassus,** Walck.

Drassus formicarius, sp. nov.

Male, immature.—Ceph. th., long, 3; broad, 2. Abd., long, 6; broad, 2. Legs, 4, 1, 2, 3=8·5, 7·8, 7, 5·5 mm.

Cephalothorax chocolate-brown, sparsely clothed with short fine yellowish hairs; oval, convex above, compressed forwards, somewhat squarely truncated posteriorly; median striæ rather faint; contour of profile represents a nearly horizontal line dipping moderately at base; *clypeus* in height equals diameter of a fore-central eye.

Posterior row of *eyes* procurved, median pair oval, closer to one another than they are to hind-laterals a space equal to diameter of latter eyes, which rather exceed former in size; anterior row procurved, centrals largest of eight, about twice size of fore-laterals, separated from each other by an interval equal to rather more than their radius, closer to side eyes next to them; space between laterals nearly equal to that between centrals.

Legs moderately strong, yellow-brown, broad olive-brown annulations at articulation of joints, faint or absent on terminal articles; armature fine hairs (on both specimens), only 1 spine at extremity of tibiæ and metatarsi of 4 pair; genual joints of 1–2 about equal in length, tarsi about one-fourth shorter than metatarsi; tarsal claws—1st pair, base straight, 4 open somewhat crooked teeth, point at base; claw of fourth pair, 8 teeth increasing in length and strength; hairs of claw-tuft dilated towards extremity, flattened, extend beneath nearly entire length of tarsi of 1–2, and along sides of metatarsi.

Palpi yellowish, humeral joint rather longer than cubital and radial together, latter articles about equal in length.

Falces rather short, conical, convex, divergent, project moderately forwards, greenish-brown.

Maxillæ long, dilated and rounded at extremity, slightly curved round *lip*, which is conical, large, nearly equal to maxillæ in length, chocolate-brown.

Sternum long-oval, somewhat pointed at both ends, rugulose, chocolate-brown, white hairs.

Abdomen linear-oval, moderately convex above; greenish-slate colour, two broad, transverse, pale-yellow stone-coloured bands, disconnected on median line, about equidistant from each other and base of abdomen, a trilobate mark of similar hue above spinners, which have the same yellowish tint; sparsely clothed with short fine hairs; ventral surface light-brown.

I am indebted for the first specimen to Mrs. Nathan, who captured it on the walls of the Waiwera Hotel; the second example was amongst Mr. Joseph Mayo's collection, from Drury.

Female.—Ceph. th., long, 5; broad, 3. Abd., long, 7; broad, 4. Legs, 4, 1, 2, 3 = 13, 12, 11, 10 mm.

Cephalothorax in colour and form resembles male, median indentation longitudinal, moderately marked.

Legs moderately stout, yellow-brown, faint annuli.

Palpi resemble legs in colour, short, dense hairs at apex of digital joint; palpal claw short, free end projects beyond hairs, teeth (?).

Abdomen does not differ essentially in form or coloration from males; *epigyne* lake-black, large oval, rugose, a somewhat hippocrepiform low eminence at anterior end.

Waiwera, *A.T.U.*

Fam. THOMISIDÆ.

Sub-Fam. PHILODROMINÆ.

Genus **Hemiclæa**, Thorell,

Hemiclæa plautus. Plate VIII., fig. 9.

Male.—Ceph. th., long, 6; broad, 4·2. Abd., long, 7·5; broad, 3. Legs, 2, 4, 1–3. = 24, 22, 17 mm.

Cephalothorax glossy, red-mahogany colour, sparsely clothed with light pubescence, strong black hairs about margins; oval, much depressed, moderately constricted forwards; caput squarely truncated, lateral index about equal to space between lateral eyes, two somewhat cuniform indentations on median line; thorax squarely truncated, median indentation longitudinal, caput and radial striæ moderately marked; *clypeus* in height nearly equal to diameter of an anterior central eye.

Posterior row of *eyes* sensibly recurved, median pair smallest of eight, closer to one another than each is to the hind-lateral next to it; anterior row straight, central eyes largest of eight, separated by nearly their diameter, about same space from hind-centrals, with which they form a trapezoid, more than their breadth from fore-laterals, latter eyes equidistant from hind-laterals and hind-centrals.

Legs moderately strong; yellow-brown, terminal articles red-mahogany; armature light pubescence, long, fine, erect black hairs; femora, on superior surface, 2 slender spines; tibiæ, about 3 on inferior side; metatarsi, 2 at base of article; on 1–2 scopula extends nearly entire length of penultimate joints; tarsal claws—1st pair, coarse, moderately curved; inner claw 15 teeth, 12 basal somewhat even comb-teeth, 3 terminal, coarse, curved backwards; outer claw, 4 coarse sparse teeth; claw-tuft linear, equals claw in length.

Palpi yellow-brown, long, slender; humeral joint long, group of 3 spines, dark hairs; cubital and radial comparatively short, latter reddish, produced above into a broad-subulate process; digital joint oviform, convex and hairy externally; bulb, reddish, large, directed backwards; viewed in front, somewhat hippocrepiform, face concave, concavity shallow, margins wide introflexed; on fore-part of bulb is a short, curved, black apophysis.

Falces short, somewhat conical, project forwards at base, reddish-black, two rows short teeth.

Maxillæ reddish-black, broadest at articulation of palpi, terminal half nearly linear, rounded, divergent; *lip* conical, apex rounded, about half length of maxillæ, blackish.

Sternum oval, yellow-brown, light pubescence.

Abdomen stone-brown, shading off to slate-colour on lateral margins, elliptical, base squarely truncated, much depressed.

Male bears a marked resemblance to the female,* differing chiefly in the actual and relative length of the legs, and slenderness of abdomen.

Te Karaka, *A.T.U.* Otago, *P. Goyen.*

Genus **Philodromus**, Walck.

Philodromus sphæroides, sp. nov. Plate VIII., fig. 10.

Male.—Ceph. th., long, 2·6; broad, 2. Abd., long, 3·9; broad, 1·9. Legs, 1, 2, 4, 3=10, 9·9, 5·1, 5 mm.

Cephalothorax deep pea-green, in some examples lake-coloured about frontal region; broad-oval, slightly compressed forwards, caput index equals space between anterior lateral and posterior median eye furthest from it; median indentation and striæ not well-marked; contour of profile rises from thoracic junction at an angle of about 45°, slight slope across caput; *clypeus* nearly vertical, in height equal to three-fourths depth of ocular area.

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* *Vide* description "Trans. N.Z., Inst.," vol. xiii., p. 199.

Legs pea-green, yellow tinge, metatarsi and tarsi red-lake; 1–2, and 4–3, about equal in length and strength, sparsely furnished with hairs, except at extremities, slight spines on femoral, tibial, and metatarsal joints; tarsal claws—1st pair, slightly sinuated, moderately long and curved; inner claw 12 teeth, 8 rather fine comb-teeth increasing in length, 4 coarse terminal teeth; outer claw 8 open teeth increasing much in strength, claw-tuft linear, equals claw in length.

Palpi shorter than cephalothorax, yellowish-green; humeral joint rather exceeds cubital and radial together in length; former projects a strong bristle, is widest at its articulation with radial joint, which is about equal in length, latter article produced, on outer side, into a broad curved apophysis, apex lobed; below it, margin is produced into a broad, curved apophysis, concave, apex directed inwards, lake-coloured; digital joint red-chestnut, oviform, convex and hairy externally, bulb moderately prominent; a spiral brown beading—in contact with face of bulb—starts from centre, follows margin of convexity, terminates at base.

Falces vertical, strong, rugose, greenish, clouded with lake-colour, more or less dark beading on outer side.

Abdomen cylindric-oval, bright pea-green, spinners usually lake-coloured.

Common on *Leptospermum*, male-female; many of the females taken at Waiwera were larger (*max.*, 8 mm.; *min.*, 5 mm.) than the single example captured at Lake Tekapo, Canterbury.* All had the coloration of the male. *Clypeus* of female in height equals three-fourths depth of ocular area. Palpal claw resembles tarsal in form, 5 rather coarse teeth.

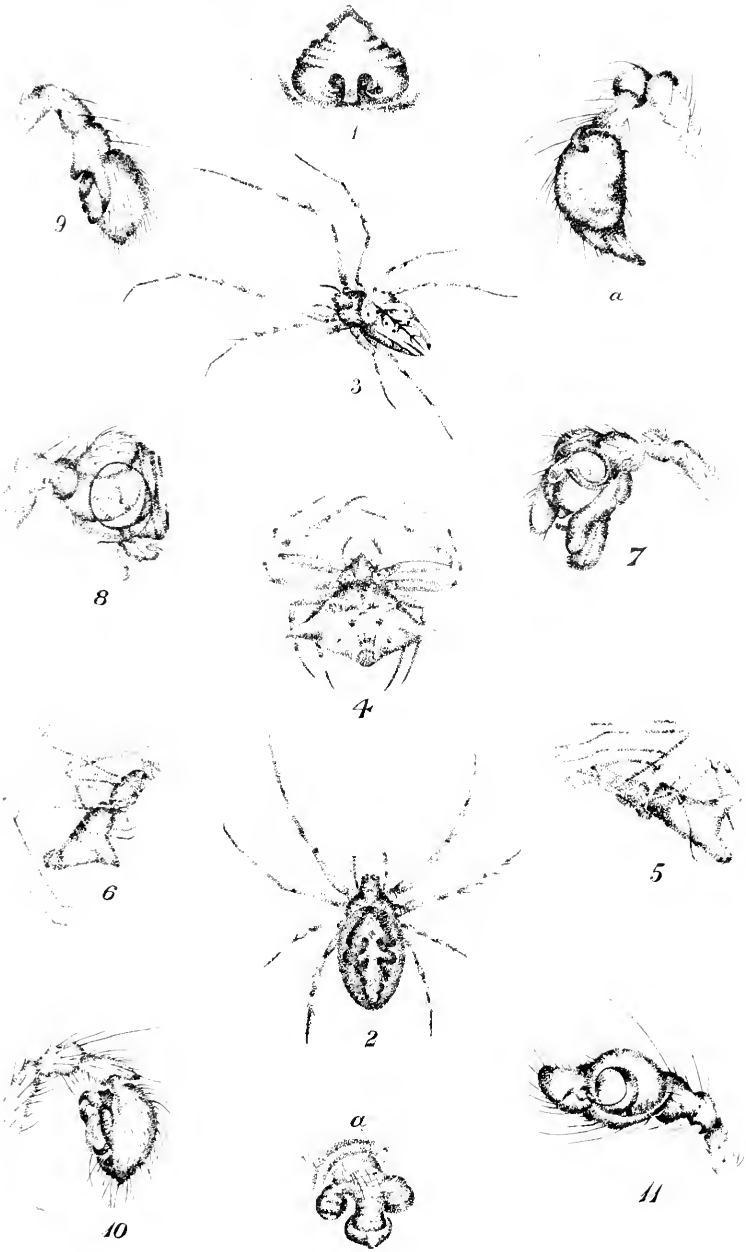
Philodromus anbarus, sp. nov.

Male.—Ceph. th., long, 1·9; broad, 1·9. Abd., long, 2·5; broad, 1·5. Legs, 1, 2, 4, 3 = 8, 7·5, 4, 3·5 mm.

Cephalothorax as broad as long, sides rounded, slightly compressed forwards; dark pea-green, two broad lake-coloured bands converge from ocular area, which has same hue, along caput striæ as far as shallow median fovea, normal grooves faint; profile line rises at an angle of 40°, curves slightly across caput; height of *clypeus* rather exceeds space between anterior median eyes.

Legs slender, 1–2, 4–3, about equal in length and strength, brownish-yellow, suffused and annulated with dark-brown, hind-pairs greenish; armature few fine hairs, short spines on femora, genua, tibiæ, and metatarsi; tarsal claws—1st pair rather thick, curved, tip bent, 5 strong open teeth, form of free

* *Vide* description, "Trans. N.Z. Inst.," vol. xiii., p. 44.



A.T.U. delt

NEW ZEALAND SPIDERS.

end, 1 short basal tooth; claw-tuft sparse, long, slender plumose hairs.

Palpi humeral and cubital joints green, former exceeds cubital and radial in length, latter articles equal; base of cubital slender; radial, yellowish-brown, somewhat linear, short bi-cornute apophysis on outer side; digital joint same tints, small, oviform, tapering, convex and sparsely haired externally; oval concavity on inferior surface, margins glossy-brown, reddish bulb in centre.

Falces broad at base, tapering, vertical, rugose; reddish-black.

Maxillæ inferior angle somewhat pointed, superior rounded, inclined towards *labium*, which is oval, more than half length of maxillæ; these organs have a rich chestnut hue.

Sternum cordate, green.

Abdomen cylindric-oval, resembles female's in pattern and coloration.

Numerous specimens; frequents *Leptospermum*. Waiwera.*

Philodromus ovatus, sp. nov.

Female.—Ceph. th., long, 2.8; broad, 2·4. Abd., long, 3·5; broad, 2·2. Legs, 1–2, 4, 3 = 9·5, 5·5, 5 mm.

Cephalothorax pea-green, lake-colour about ocular area; broad-oval, slightly compressed forwards; caput roundly truncated, lateral index equals rather more than space of side eyes; median fovea shallow oval, normal grooves faint; profile line rises at an angle of 45°, slight arch across caput; height of *clypeus* nearly equals space between anterior median eyes.

Four central *eyes* nearly form a quadrilateral figure, posterior side slightly broadest; lateral eyes placed on prominent tubercles, nearly as far from one another as each is from the posterior lateral eye next to it; fore-lateral largest of eight.

Legs pea-green, faintly shaded with lake on anterior surface of femora and tarsi; 1–2 about equal length, former slightly stouter; slender spines on femora, double row under tibiæ and metatarsi; few, somewhat irregular spines on 3–4; black hairs, numerous at extremities; tarsal claws—1st pair, 8 teeth, 7 coarse divergent teeth, 1 short tooth at base; inner claw 12, except 2 basal, open, somewhat coarse teeth; claw-tuft longer than claw, hairs linear; scopula hairs on tarsi.

Palpi like legs in colour, about twice length of falces, black hairs, few strong bristles; palpal claw form of tarsal; 5 strong, open, somewhat even teeth.

Falces vertical, conical, broad at base, greenish.

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* The female was described ("Trans. N.Z., Inst.," vol. xiii., p. 44.) from two examples in Capt. T. Broun's collection; owing to the action of spirit, the cephalothorax and legs were erroneously described as amber-colour, instead of pea-green.

Maxillæ broadest at extremity, obliquely truncated, inclined towards *lip*, which is triangular, more than half length of maxillæ, greenish-yellow.

Sternum cordate, greenish-yellow.

Abdomen oblong-ovate, moderately convex above; pea-green, white oval mark runs through six impressed spots; marginal zone corrugated, shaded with lake; ventral surface greenish; *epigyne* greenish-yellow; fore-part represents a well-defined circular band, labia on posterior side, confluent carinate, dividing organ into concave circular depressions.

Taken on *Leptospermum*, single specimen; Waiwera, *A.T.U.*

Fam. LYCOSIDÆ.

Genus **Lycosa**, Latr.

Lycosa adumbrata, sp. nov.

Female.—Ceph. th., long, 4; broad, 2·7. Abd., long, 4; broad, 3. Legs, 4, 1–2–3 = 12·5, 9 mm.

Cephalothorax oval, moderately compressed forwards; yellow-brown, marginal zone dark-brown, from ocular area, which is brown-black, a large oval brown mark extends to base of thorax, posterior portion of caput yellow-brown, striæ dark, well-marked, median-line on thorax, and radial striæ yellow-brown; a narrow, oval, grooved eminence occupies crown of thorax; lighter parts and facial space clothed with short adpressed whitish hairs, erect black hairs on caput; contour of profile rises at an angle of 70°, slopes forwards with an even curve, dipping abruptly at second row of eyes; *clypeus* vertical, in height equals space between first and second row of eyes.

Anterior row of *eyes* small, sensibly procurved, laterals slightly the largest, rather closer to median pair than the latter are to each other, a space about equal to their diameter and a quarter; eyes of second row large, about one-third larger than dorsal eyes, less than their radius from laterals of anterior row, separated from each other by an interval which slightly exceeds their diameter; eyes of third row placed obliquely, rather further from one another than they are from eyes of second row.

Legs long, moderately strong; one pair rather stoutish, 1–2–3 about equal in length; yellow-brown, narrow well-defined brown annuli, 4 on femora, 3 on tibiæ and metatarsi; armature fine erect hairs, 2 or 3 short spines on femoral joints, 6 or 7 long slender spines on tibial and metatarsal joints; superior tarsal claws—4th pair, strong, evenly curved, 8 somewhat coarse open teeth; inferior claw thick, no teeth.

Palpi yellowish, fine hairs, long slender bristles, few spines; palpal claw short, thick, 4 coarse open teeth.

Falces somewhat conical, vertical, sharply convex, red-mahogany colour, few longitudinal dark streaks, white hairs.

Maxillæ spathulate, brownish-red, inclined towards *labium*, which is somewhat oval, more than half length of maxillæ, dark-brown, numerous short white hairs.

Sternum broad-cordate, dark-chocolate colour.

Abdomen oval, yellow-brown, clouded with black-brown; lighter tints clothed with white hairs—with the exception of an acuminate mark, which extends from base for two-thirds along dorsal line; four broad, irregular, somewhat acute-crenate transverse bands; dark patches clothed with dark hairs. Ventral surface lighter than dorsal, whitish hairs; spinners yellowish, short. *Epigyne* brownish, moderately prominent, oval, centrally produced, on anterior side, into a tapering projection; labia tumid, obliquely truncated on posterior side, concavities at truncation lake-coloured.

Single specimen. Te Karaka, *A.T.U.*

Fam. ATTIDÆ.

Genus **Attus**, Walck.

Attus aquilus, sp. nov.

Female.—Ceph. th., long, 1·5. Abd., long, 1·8. Legs, 4, 1, 2–3.

Cephalothorax rugulose, elevated; thorax less than one-fourth longer than caput, latter slightly compressed forwards; chocolate-black, moderately clothed with orange and white papillæform hairs; contour of profile rises from thoracic junction at an angle of about 60°, slopes forwards across ocular area; *clypeus* very narrow.

Anterior row of *eyes* slightly recurved, close to one another, irides chiefly whitish hairs; posterior eyes not prominent, slightly further from each other than they are from anterior laterals; small intermediate pair closer to fore-laterals; ocular area one-third broader than long.

Legs: 4 slightly exceeds 1 (2 mm.) in length; 2–3 about equal in length; femoral joints brown, sparsely furnished with white and orange papillæform hairs; other joints yellowish, brown annuli at articulations; three curved fine spines on superior surface of femora, latter joints of 1–2 stout; metatarsal spines stronger than tibial; tarsal claws—1st pair, outer, 1 strong tooth; inner claw about 13, 12 close teeth, 1 strong terminal tooth; claw-tuft linear, equals claw in length.

Palpi yellow-brown, radial and digital joints yellowish, white hairs.

Falces short, applanate, in length rather more than diameter of an anterior central eye ; transversely wrinkled, yellow-brown, base dark.

Maxillæ somewhat quadrate, slightly rounded. *Labium* oval, broader than long; organs yellowish, base dark, lips darkest.

Sternum somewhat ovate, chocolate-brown.

Abdomen oviform, projects over base at cephalothorax ; moderately convex above, rugose, black, sparsely-clothed with orange and white papillæform hairs; spinners long, bright - brown. *Epigyne* moderately prominent, large, transverse oval, centrally divided by a broadish keel, fluted margins, within concavities, terminate on anterior side in dark spiral processes.

Male.—Ceph. th., long, 1·5. Abd., long, 1·2.

Cephalothorax of male does not differ essentially from female's in form—slightly broader—or colour.

Legs 1–2 strong, femoral joints applanate; 1 pair stoutest, genua and tibiæ strong, former article nearly equals latter in length ; metatarsi and tarsi about equal.

Palpi brownish, few white hairs; humeral joint strong, three-fourths length of palpus; cubital short, broadest at its articulation with radial joint, which is somewhat cupuliform, projects on outer side, a fine-pointed, curved, black apophysis ; digital joint large, oviform, yellowish, convex and hairy externally, bulb large, somewhat conical, apex directed backwards, dull orange-red, short black spine-like apophysis projects downwards and outwards from fore-part.

Abdomen projects rather over cephalothorax, and is more pointed at either end than female's; red mahogany hue, clouded with dark-brown, sparsely clothed with papillæform hairs.

The cephalothorax in some female specimens has a red-mahogany hue, clouded with black-brown; abdomen mottled with yellowish-brown and dark-brown.

Captured on rocks about road-cuttings ; Waiwera, *A.T.U.*

Attus bimaculosus, sp. nov.

Female.—Ceph. th., long, 2; broad, 1·5. Abd., long, 2·5; broad, 1·3. Legs, 4, 1, 2, 3.

Cephalothorax yellow-amber colour, two black spots on caput, rarely absent; few erect hairs; median fovea circular, shallow, contour at profile rises from thoracic junction at an angle of 45°, slight indentation at fovea, slope across caput, which projects forwards; *clypeus* in height is equal to rather more than radius of a fore-lateral eye, yellowish hairs about eyes and *clypeus*, directed somewhat centrally.

Eyes on large black spots, anterior row curved, nearly half radius of lateral eye apart; dorsal eyes form with fore-laterals, which they equal in size, a quadrilateral figure, whose transverse side is greatest.

Legs clear yellow-amber, more or less distinct reddish-brown annulations, few fine hairs; first pair stoutest, nearly equals fourth in length, short curved spines on femoral joints; first pair genua nearly equal to tibiæ in length, 6 spines on latter; metatarsi slightly exceed tarsi in length, on former 4 long spines exceeding article in length; tarsal claws—1st pair evenly curved, outer claw 1 strong tooth; inner claw about 16 close even teeth, 1 strong apical tooth; hairs of claw-tuft linear, pointed.

Palpi resemble legs in colour, fine light hairs, slender bristles.

Falces vertical, short, as broad as long, length equal to diameter of an anterior central eye; rugose, yellowish.

Maxillæ rather broader than long, inferior angle obtuse, project over *labium*, which is oval, apex everted; clear yellow.

Sternum oval, yellowish, black coarse hairs.

Abdomen squarely truncated at base, which rises abruptly from petiolum, which is exposed, tapers towards spinners; creamy-yellow, two broad somewhat clouded marks of a darker hue extend along dorsal surface, ending near spinners in a series of short oblique bars; clothed with few fine hairs; on forepart of *epigyne* are two circular dark-margined fovea, centrally divided by a narrow keel, posterior projection cyathiform, about twice as long as broad, black margins.

Examples of immature males do not differ essentially from females.

Taken on shrubs and old logs.

Whangarei Harbour, *T. Broun*; Waiwera, *A.T.U.*

Attus sub-fuscus, sp. nov.

Female.—Ceph. th., long, 4; broad, 2·5. Abd., long, 4·5; broad, 2·5. Legs 4, 1, 2–3 = 8, 7, 6 mm.

Cephalothorax dark mahogany-brown, few fine yellowish hairs, widest at fore-part of caput, rounded posteriorly; median fovea large, circular, shallow; profile line rises at an angle of 45°, depressed at fovea, slopes across caput; *clypeus* narrow, less than space between central eyes, projecting hairs.

Eyes, anterior row sensibly curved, median pair nearly contiguous, laterals about half their radius from centrals, irides bright orange-red hairs; dorsal eyes are slightly smaller than anterior laterals, and the interval between them rather less.

First pair of *legs* stoutest, red-mahogany colour, hind pairs yellowish-tinge, faintly annulated; femora have short curved spines on superior surface, spines on tibiæ and matatarsi; tarsal claws well curved, outer claw 1 strong tooth; inner 15 close even and 1 strong terminal tooth; claw-tuft linear hairs.

Palpi light-brown, digital joint dark, grey hairs, bristles.

Falces short, oval, nearly as broad as long, rugose, rich red-chestnut.

Maxillæ broader than long, inferior angle projects over *labium*, which is oval, everted; red-orange, pale apices, furnished with coarse black hairs.

Sternum oval, olive-brown, black and white hairs.

Abdomen oviform, dark-brown, clothed with fine pale-yellow, orange-tinted hairs, and coarse black hairs; lateral margins longitudinally wrinkled, hairs chiefly growing in depressed lines; large conical brown mark, margins pale on ventral surface; spinners long, orange-red; *epigyne* moderately prominent reddish-brown eminence, on the face of which there are two large circular depressions, divided by a keel more than their diameter in breadth.

Some examples have a broad light-brown lanceolate mark on median line, on fore-part are two angular brown marks, apices directed forwards, above spinners are a series of small oblique angular marks.

Taken on shrubs, *Cordyline*; Waiwera, *A.T.U.*

EXPLANATION OF PLATES.

Plate VII.

Fig. 1. *Epeira corrugatum*, sp. nov., male-female, twice natural size; *a* palpus; *b*, epigyne.
Fig. 2. *Epeira tri-tuberculata*, sp. nov., female, twice natural size.
Fig. 3 *Epeira orientalis*, sp. nov., male-female, one-third larger than natural size; *a*, palpus; *b*, epigyne.
Fig. 4. *Epeira sub-compta*, sp. nov., female, twice natural size.

Plate VIII.

Fig. 1. *Epeira tri-tuberculata*, epigyne.
Fig. 2. *Epeira verutum*, sp. nov.; var. *hastatum*, nov., twice natural size *a*, epigyne.
Fig. 3. *Nephila argentatum*, sp. nov.. female, twice natural size; *a*, palpus of male.
Fig. 4. *Thlaosoma pennum*, sp. nov., female, three times natural size.
Fig. 5. *Ariamnes conifera*, sp. nov., female, eight times natural size.
Fig. 6. *Ariamnes triangulatus*, sp. nov., female, eight times natural size.
Fig. 7. *Linyphia blattifer*, sp. nov., palpus of male.
Fig. 8. *Theridium melanozantha*, sp. nov., palpus of male.
Fig. 9. *Hemiclæa plautus*, sp. nov., palpus of male.
Fig. 10. *Philodromus sphæroides*, sp. nov., palpus of male.
Fig. 11. *Theridium albo-gullatum*, sp. nov., palpus of male, viewed from beneath.

Note.—Chief errata, Vol. XVIII., p. 185, lines 15, 16 from the top, *for* "tarsi," *read* "tibiæ"; line 36, *for* "talica," *read* "labia"; p. 186, line 5 from below, *for* "tibiæ" *read* "labia"; p. 187, line 16 from below, *for* "free, and," *read* "free end" (throughout paper); p. 188, line 15 from below, *for* "pea-shaped," *read* "pear-shaped"; p. 202, line 13 from below, *for* "general," *read* "genual."

Art. XI.—*On the Work of Earth-worms in New Zealand.*

By A. T. Urquhart.

[*Read before the Auckland Institute, 14th November,* 1886.]

Although it has become generally known, since the publication of Mr. Darwin's researches, how rapidly surface débris is buried through the action of earth-worms, the result of a few observations may, nevertheless, be worth recording, as they afford means of comparison between the work done by the New Zealand and the British species. The comparative weight of their castings, and an estimate of the number of earth-worms usually found in some of the cultivated and uncultivated lands in Auckland District were given in a former paper, "On the Habits of Earth-worms in New Zealand."*

A section was described, the result of the work of worms, chiefly the common *Lumbricus campestris*, but only an approximate estimate could be arrived at as to the length of time which it had taken for the surface - charred débris to sink to an average depth of about $5\frac{3}{4}$ inches. The section when first exposed, in 1875, showed an average of $4\frac{1}{2}$ inches of black vegetable mould, free from stones, etc., and a horizontal layer, nearly 1 inch thick, of charred wood, burnt marl, fragments of jasper, and pumice, lying on the subsoil, a brownish-green arenaceous clay. In October, 1883, (*i.e.*, in eight years,) the depth of mould had increased $1\frac{1}{4}$ inches, giving an average depth of about $5\frac{3}{4}$ inches above the burnt layer; during the past three years there has been an even average increase to the superficial layer of nearly 1 inch, the total depth now being rather more than $6\frac{1}{2}$ inches.

Considering the depth of vegetable mould above the charred layer, this certainly appears to be a considerable increase for so short a period, but apparently the estimate is correct: it is in all probability to be attributed, independently of the increase of worms since the land has been in grass, to the moisture and nature of the subsoil. Worms living in lands with a moist substratum continue to work at a low level, not only during the short intervals of dry weather that occur in the spring months, but as long as there is sufficient moisture; whereas in the upper lands, during these dry intervals, the worms cease to work, retire temporarily to their chambers, coil themselves up, and remain apparently in a dormant state until rain sets in again.

On the 15th October, 1883, a layer of charred wood and broken

* "Trans. N.Z. Inst.," vol. xvi., 1883, p. 266.

brick was strewed on the surface, above the former layer, and a similar strip of débris was also scattered in a grass paddock on the upper land, ordinary light clay soil, with a moderately hard subsoil. Although the spot selected was rather favourable for earth-worms to work in, the amount of castings ejected on the surface may be taken as a fair average for the whole field. Sheep were occasionally grazed in the field; but considering how soon small fragments disappear beneath the surface, probably their treading did not much influence the result.

Owing to there being no well-defined line between the dark mould and substratum, no estimate of any value can be given as to the probable amount of subsoil that has been brought to the surface during the past three years; but a record will be kept of any marked increase in the depth of the vegetable mould, the average depth now being about $5\frac{3}{4}$ inches. At the present time the section in the trench shows, the grass being shaved off close to the surface, an average of $\frac{7}{8}$ths of an inch of brownish-black mould, free from coarse material, and a horizontal layer of charred wood and broken brick half an inch thick, forming an even line round the vertical sides. This means that in three years, or rather during the working months of that interval, through the agency of earth-worms, $\frac{7}{8}$ths inch of mould has been added to the superficial layer—mould that has been enriched with vegetable and animal matter, passed the bodies of the worms, and ejected as castings on the surface.

This annual working of the superficial mould effects a remarkable change in the character of our fern-lands in the course of time—that is, after they have been cultivated, or, more especially, if left in permanent pasture for 10–15 years, and have become fairly stocked with worms. There are, no doubt, other agencies that, under the circumstances, tend to improve the soil, but, more particularly in the case of permanent pastures, only minor agencies.

From the number of earth-worms that live in most of our old pasture-lands, it is evident—independently of the experiment given above—that, as Mr. Darwin has shown, the superficial mould must pass over and over again through their bodies, and be brought to the surface. It is hardly necessary to point out the value such work must be to the agriculturist, especially when taken in conjunction with the loosening of the subsoil by their burrows and chambers, which in time become more or less filled up with their castings and the dark viscid linings of the walls. These moist and nourishing galleries, penetrating, as a rule, to a depth of 6–15 inches beneath the surface, must tend to draw the roots of the vegetation to a depth that they would not otherwise attain.

The test in the lower land (mentioned above), a black arenaceous loam, was submitted to rather severe conditions—that is, the coarse wood-ashes and broken brick were spread over a thick sward of cocksfoot grass, from which stock is always excluded. Last September, when the strong grass was shaved off close to the surface and a trench opened up, the section in the vertical sides of the walls showed that all the débris was buried beneath an average depth of rather more than $\frac{3}{8}$ths of an inch of mould ; the layer forms a horizontal line $\frac{7}{8}$ths of an inch in thickness, but most of the débris is more or less entangled amongst the roots, consequently does not represent a compact and well-defined line ; some of the fragments of brick, about $1\frac{1}{2}$ inches square, weighing over 1oz., have sunk about $1\frac{1}{2}$ inches beneath the surface. This irregularity is to be attributed to the fragments having remained entangled amongst the grass for a more or less length of time, consequently buried at various intervals. It will be observed that there is a difference of about half an inch between the increase to the superficial layer in the upper and lower lands, which is easily accounted for : it was an oversight on my part that, when the débris was scattered over the latter, a portion of the grass was not skimmed off ; this would have given the worms a fair chance of more rapidly burying the material thrown over it ; however, this error will be remedied before next winter.

The larger of the two stones mentioned in the former paper, which was laid on the turf in May, 1876, when raised on the 15th October, 1883, left a cast 2 inches in depth; when again examined on the 26th September, 1886, it was firmly embedded, and required some force to raise it ; the most protuberant point was 3 inches beneath the level of the surface, the raised margins being removed ; the flatter portion had sunk $2\frac{6}{10}$ inches ; worm burrows were numerous beneath. The smaller stone, which was placed near the former in September, 1882, sank in thirteen months 1 inch ; on the 26th September of the present year it had attained a depth of 2 inches below the general level of the ground ; its convex margins were partially covered with worm castings and grass ; it will, if left undisturbed, soon become entirely buried beneath the surface. It is well, perhaps, to bear in mind that under favourable conditions, through the agency of earth-worms, it is possible for a stone $6\frac{1}{2}$ inches long, $3\frac{1}{2}$ inches broad, and $3\frac{3}{8}$ inches in thickness, to disappear below the surface of the ground in about seven or eight years.

The experimental stones laid on the turf on October 15th, 1883, when recently examined gave the following results :—

No. 1, triangular block of trachyte, 6 inches high, when raised left an impression 6 inches long, $4\frac{4}{10}$ inches wide, depth below general level of the ground $1\frac{2}{10}$ inches.

No. 2, 4 inches in thickness: cast, long, $6\frac{8}{10}$ inches; wide, 6 inches; slopes from surface to a depth of $1\frac{2}{10}$ inches.

No. 3, average thickness 4 inches, bottom irregular: cast, long, 8 inches; greatest width, $5\frac{5}{10}$ inches; average depth, $1\frac{4}{10}$ inches.

These stones were surrounded with the usual margin of fine vegetable mould, were rather firmly embedded, and had not been raised since they were first laid down; beneath were numerous worm-burrows.

The researches which I have carried out during the last three winters, with the rather vague hope of affording some evidence that earth-worms possessed, to a limited extent, a sense of direction (for it may be assumed that there is such a sense), have, owing chiefly to the unnatural conditions to which they had to be submitted, not been by any means conclusive.

Although it was very improbable that, when worms left their burrows and wandered about for considerable distances after more or less heavy rain, they ever returned to them, as it was possible that on ordinary nights, when they sometimes only wander for a short distance from their burrows in search of food, that they might intentionally return to them, I thought it worth while to endeavour to determine if such was the case, as earth-worms certainly appear not to be devoid of a low form of intelligence. In the centre of boxes, 2 feet square, a small hole was pierced, a shallow vessel was placed beneath the orifice, filled with moist siliceous sand, with the hope that it would be the means of compelling the worms to come to the surface in search of food. Four or five of our large *Lumbricus uliginosus* were placed within each box—the boards having been well damped. As is almost invariably the case when worms are placed in confinement, in the first instance they travelled round the margins (when placed in pots containing well-pressed earth they finally force their way down the sides, rarely towards the centre); after attempting for 15–20 minutes to burrow into the boards, or scale the walls, one or two of the more vigorous, possibly more intelligent, struck out across the centre; after a few traverses they finally, as a rule in about 30 minutes, discovered and entered the artificial burrow. About as often as not, all the worms had found out the entrance before the morning; but in some instances, part or all, after crawling for a time round the sides of the box, finally huddled up into a corner, and would have died there, had they not been removed. Although tempting baits consisting of their favourite food, onion bulb, etc., were placed close to the mouth of the burrow, the worms rarely came to the surface; when they did, and left the burrow to wander about, apparently in most instances they never returned to it, but remained alongside the walls. In hopes of affording them greater inducement to return, tufts of grass were placed in the centre; but the result was not satisfactory, as they appeared never to leave them, probably owing to there being no inducement for them to do so. Although the fact that some of the earth-worms after coming to the surface and wandering about returned to the burrow, by no means proves that the act was intentional, the fact that the majority of them never did so, hardly disproves the possibility of their possessing sufficient intelligence to do so. Considering the unfavourable conditions to which they were submitted, and that they must necessarily have been weakened through want of food, it could hardly be expected that they would under the circumstances have acted with the same freedom and intelligence as when in their natural haunts.

ART. XII.—*Notes on New Zealand Earth-worms.* By W. W. SMITH. Communicated by DR. HECTOR.

[*Read before the Wellington Philosophical Society, 4th August*, 1886.]

THE habits of New Zealand earth-worms receive the smallest share of attention from naturalists of any group of our native fauna. This is to be expected, as the study of worms requires much time and patience, and the attractions in a young country among the higher groups is greater, especially one like New Zealand where so many anomalous forms exist, that little time is given to some of the lower orders. Some notes, therefore, on earth-worms, made during eleven years of almost daily experience with them in several localities in the South Island, will contribute a little towards a knowledge of their habits.

As the habits of some of our earth-worms differ considerably from others, I propose to give notes on each species separately, of all I am acquainted with, and the locality where I have collected them. This will enable other workers who may be studying earth-worms in various parts of the country to compare their own observations. This appears to me a sound method of working out perfectly the habits and distribution of all species.

Like other groups of animals, earth-worms vary in their habits, size, and colour, according to the nature of the soil or situation they inhabit; but, so far as I have ascertained, our worms differ, distinctly in some respects, from the British species, so ably treated by Mr. Darwin, in the construction and form of their burrows. I think I will be able to show that New Zealand earth-worms, whether kept in pots in confinement or in their natural state, differ much in their economy from the British *Lumbricus;* but more especially in the peculiar semicircular and distinctly branching burrows they construct. This, however, does not apply to all species, as there are others which cannot be said to construct any particular form of burrow: those species, for instance, which live and bore, or burrow, in every direction in loose decaying vegetable matter, or rotten wood, in the bush. The habit of lining their burrows with leaves or other materials is absent with worms in Canterbury and Otago. Mr. A. T. Urquhart, in an excellent paper "On the Habits of Earth-worms in New Zealand,"* has shown that the habit obtains with worms inhabiting the Auckland District. He has also shown that they are content with drawing in leaves to the mouths of their burrows; but he thinks they are chiefly for food. The same habit prevails with worms in Canterbury and Otago; but here in the South, where they live beneath gravel-walks, they draw small stones over to conceal the mouth of the burrows, when not protected by the usual covering of viscid castings. My notes have been gathered in the country between the Rivers Rakaia and Kakanui, and I do not venture to treat of worms beyond the limits of these rivers, although no doubt they will be found to vary little.

Between the two rivers, a distance of 115 miles, worms abound in all the forests, hills, downs, and plains; in some districts they are abundant, in others they occur sparingly. Wherever a clearing is made in the forests they are very active in favourable weather, and throw up immense quantities of castings on the surface. Worms increase in numbers more rapidly in forest clearings than in open pastures; it is due to the mould containing much decayed matter, which they so much relish. They are plentiful beneath dense beds of ferns, or any undergrowth in the forest, and occur sparingly on all the diverging spurs of Mount Peel, Rangitata, up to 4,000 feet. If a prostrate log in the bush be rolled over, large numbers of worms of several species will sometimes be found secreted beneath it; the same may be said of flat stones, and slabs of wood. About farm homesteads, where old bags are left lying on the ground, worms gather beneath them in great numbers, especially during moist or wet weather. They appear to prefer the shelter of rotten bags lying on the surface; it is probably for warmth, as they do not generally burrow beneath them.

In old forests, where small streams flow through them, sections of considerable thickness are often exposed in their banks; at depths varying from 10 to 40 inches a distinct layer

* "Trans. N.Z. Inst.," vol. xvi., pp. 266-275.

of black mould is visible. These layers appear to have been once the open land inhabited by worms, before the forest spread over it. As the vegetation flourished, the decaying matter from it in the form of leaves, bark, and rotten wood, assisted by the actions of worms, made up in time the superficial mould as we find it to-day in forests. The Canterbury Plains, near the north terrace of the Rangitata River, is covered in some parts with 2½ to 4 inches of brown friable mould. It is doubtful whether worms ever existed there in any numbers, as the greater number of various-sized stones lying on the surface exhibit few signs of sinking, and must have remained on the surface for many ages. A few are slightly embedded, while others show a slight impression as if produced by their own weight; the same will be noticed by many on other parts of the Plains, in passing over in the train. These portions of the Plain are exposed to fierce north-west winds, which blow during the spring and early in the summer with terrific force, down the gorges of the Rangitata and Rakaia Rivers, carrying away the finer mould, and depositing it over the Plains along the eastern or lower side.

Worms greatly dislike wind, and, so far as I have ascertained, do not rise to the surface to change quarters, to feed or pair, during dry or cold windy nights, unless accompanied by heavy rains, when they are sometimes flooded out of their burrows. It is during the spring and summer that worms are most active; on mild nights they rise to the surface and pair, and can often be seen lying long after sunrise. I am, therefore, inclined to believe that their absence from those parts of the Plains is chiefly due to their exposure to the dry and fierce "nor'-wester." On some parts slight depressions occur. After heavy rains small lakes are formed for a time, but generally disappear in a few weeks. The mould in such places is much deeper, and worms more numerous, than on the more stony parts. Although in a few places stones are not seen on the surface, they have sunk through the action of worms, and lie only a few inches below the scanty covering of turf.

Near the banks of the River Hinds, nine miles north of the Rangitata River, where the thick tussock grass breaks —or a few years ago broke—the fury of the wind, worms begin to be more numerous, and along the sea-board for miles inland the land is deep and strong. It is also comparatively free from stones, and worms are abundant. The common *Acanthodrilus uliginosus* was a few years ago the more numerous. Another larger and undescribed species, of very sluggish habits, is found near the edges of permanent swamps. The other species occurring on the Plains are *Endrilus annulatus*, *E. campestris* and *E. levis*, the first-named of the three being the commones . Beneath the great terrace on the north side of the Rangitata, there is some excellent land, where worms exist plentifully, and at all seasons, when the weather is favourable, throw up large quantities of castings. The soil, excepting in the swampy parts, is slightly sandy, and probably has been blown on to it from the river-bed by the strong wind. I have no doubt that the great depth of rich mould along the sea-board of Canterbury has been added to considerably by the storms of fine mould blown by the "nor'-westers" from the hills and western portions of the Plains. Some of the stony parts that have been ploughed within the last eight years, and sown down in grass, show signs of worms increasing, by the greater number of castings thrown up annually. When cutting the crops of grain, farmers put little value on the straw, and set the knives of the reapers to clear the stones on the surface. When the grain is threshed out, the straw is sometimes left to rot in large heaps. When trodden down by cattle or sheep, the ground around the mass soon becomes inhabited by *Endrilus levis*.

Agriculture is favourable to the increase of worms. It is due to the land being loosened by the plough and sweetened by the atmosphere. Worms are the natural fertilizers of the soil, and in favourable weather are constantly replenishing it by the addition of fresh castings. The enormous area of land in New Zealand at present sown down in English grass, will be greatly enriched in a few years for future cropping, through the action of worms. In mild weather, and at all seasons, worms eject more castings on bare patches free from grass, sheep tracks, or well-beaten paths across fields, than on ordinary pasture land, even when many years in grass, but no more than on old lawns that are kept well-mown and rolled. I think this can be explained by the paths and lawns being firm and compact, and having no interstices where they can eject their castings. If burrowing afresh in solid ground, they are compelled to void all the mould they swallow on the surface.

During heavy rains, pools of water are sometimes formed on bare paths; as the weather becomes fine, and the water drains away, a fine sediment or "film of mud" settles on the surface; worms are then very active, and in a few days almost cover the site of the pool with dark mould. As the worms work vigourously, and appear especially to relish the mould, it is probable that many nutritious particles accumulate in the pools, and sink into the earth with the water as it drains away.

Worms throw up castings abundantly in corn-fields, between the stalks of grain, but not for some time after the land settles down; heavy rain settles the ground in a few days. While it remains loose, the worms eject their castings in any crevice. They delight in moist but not wet land, and in dull mild days throw up castings as well as during the night. I first observed this by castings appearing on a tennis lawn through the day, that had been well rolled in the morning. Some days more are thrown up than others. On those days they are ejecting mould, birds can often be seen flying on to lawns and drawing worms from their burrows.

Some curious sections can be seen on some of the low flats of some Canterbury rivers, notably at the Rakaia, Hakatere, and Tungawai. They consist of thin alternate layers of fine sand and mould. After the deposition of the thin layer of sand, the worms appear to have thrown up a few inches of mould, when another layer of sand was again and again deposited over it. Heavy rains also wash down quantities of fine silt and clay from the clay-banks or "facings" at Albury, and deposit them over the flats below. The worms in a short time throw up abundance of castings; the clay soon becomes perfectly mixed with the mould, and forms land of great depth and good quality.

The cold and wet season of 1884 was specially suited to the actions of earth-worms. Many English grass paddocks adjoining the Haketere or Ashburton River, and broken up eleven years, were daily closely covered with fresh castings. In some parts the whole surface had the appearance of having been covered with a thin covering of dark mould. Many of the castings were of considerable size, and measured in height from $\frac{1}{4}$ to $1\frac{1}{2}$ inches. Owing to the continuous wet weather, it was impossible to collect and weigh them accurately from a measured space, but the amount of mould thrown up must have been considerable, compared to other seasons. On the low undisturbed land, elevated only a few feet above the river, fresh castings were numerous, some portions covered with a fine layer of sand had also a sprinkling of them on the surface.

Worms living in gardens, in cold weather, often cluster together into any piece of rank, loose, or half-decayed manure buried in the soil. Such no doubt is warmer and more pleasant to their bodies; it is also more porous, and allows the wet to percolate through. In rich well-worked gardens, *Endrilus annulatus* and *E. campestris* attain their largest size: both species often assume a blackish hue; the former in colour, when inhabiting pastures, is whitish-pink; the latter is generally brownish-red. Both species, with *Endrilus levis*, are often found between the outer leaves of cabbages and lettuce, and consume much of the softer parts. They cling in great numbers around the stems of blanched celery, and nibble at the more tender parts, often proving very destructive. Although *A. uliginosus* is found in gardens, they prefer the shelter of large trees in the orchard, or strawberry-beds, to the more cultivated parts, and are not so numerous as the three last-named species, which certainly are the commonest garden worms. They do much injury in flower-pots, and impede the growth of plants by boring or burrowing through the mould, disturbing and consuming the tender roots, and absorbing all nutritious particles from the soil. If pots are thus infected, and the plants carefully turned out, it will be seen that they keep chiefly to the sides of the pots. The burrow or track against the side is generally open. The tender feeding-roots can be seen "pressed into the walls," and their actions choked in the viscid lining of the burrow. They deposit their castings among the drainage cracks beneath the mould, and, if not removed, will sometimes effectually choke the drainage. Worms, especially half-grown specimens of *Endrilus annulatus*, occasionally hibernate in pots, even when the conditions are favourable for their actions.

Some of our worms present some problems, which, as yet, I have not been able to solve. I have already mentioned a large undescribed species existing in a few swampy places on the Plains. Here, near Oamaru, it exists as a more diminutive species, although the conditions appear equally favourable for its development. In one particular swamp, on the south side of the Rangitata Gorge, it attains its maximum size, some specimens measuring 13 and 14 inches, and varies much in colour from each locality, from yellowish-white to dark reddish-pink.

The diseases of earth-worms are little known; yet they are subject to some of a virulent type. I have seen a few individuals of *A. uliginosus* with hard excrescences on different parts of their bodies. They appear to be painful to the animals, as the slightest touch on one of them causes the worm to shrink. The disease first appears as a small hard pimple, and increases gradually in size. It sometimes almost surrounds the worm's body. At this stage the swelling softens and opens, and the intestines protrude, tinged with blood, when the miserable creature finally rots away.

Mr. Darwin, in his "Vegetable Mould," page 14, remarks: "After heavy rain succeeding dry weather, an astonishing number of worms may sometimes be seen lying on the surface." He believed that they were "already sick," and that their deaths were "merely hastened by the ground being flooded." He thought if they had been drowned "they would have perished in their burrows." After many years experience with worms, under all circumstances, I am fully convinced that severe and protracted droughts are both distressing and destructive to them. When drought sets in they are compelled to hibernate, excepting those affecting the edges of permanent swamps. If it be severe, the mould becomes so intensely hard that they are unable to escape, and many perish with exhaustion. If the drought be succeeded by heavy rains, many survive; while some appear to have only sufficient strength to struggle to the surface and die from the same cause, probably accelerated in their weak state by a little cold or exposure. I think this is borne out by the appearance of their limp and emaciated bodies; but, whatever may be the cause of their deaths, I am of opinion that they die more from the lack of the necessary moisture in the mould they inhabit, than from actual disease.* Mr Urquhart, who has paid some attention to this subject, and who collected worms roaming about after heavy rains, says that they were certainly not all sick, as he obtained healthy as well as sickly and dead worms; but in the case of the healthy ones they were no doubt flooded out of their burrows, and searching for drier ground when picked up. However, that worms are sometimes drowned there is no doubt, as any one can observe after heavy rains. When the water sometimes forms large pools in paddocks, numbers of dead worms are seen lying on the bottom. If it occurs in the spring or summer, the little grey Tern (*Sterna antarctica*) soon detects them, and small flocks hover and circle about the pools, dipping into the water every few minutes and picking up the dead worms.

Protracted droughts do incalculable injury to the land, not only in destroying worms, but in preventing their actions from replenishing it. The summer and autumn of 1885 and 1886 have been the driest on record, and the most disastrous to earth-worms, that of 1884 the coldest and wettest, but well suited to their actions and the most beneficial to the land.

Mr. Urquhart states that the greatest enemies of worms in the district of Auckland are the *Limosa baueri* (*Var.* Red-rumped Godwit) and *Larus scopulinus* (Mackerel Gull). Here in the South, undoubtedly their strongest enemies, excepting in the more settled districts, are the Weka (*Ocydromus australis*) and Swamp Hen (*Porphyrio melanotus*). Both species, being of nocturnal habits, come in for the lion's share. Both the introduced blackbirds and thrushes consume immense numbers. The old adage, "The early bird catches the worm," is most appropriate when applied to both species. The abundance of worms in settled districts, combined with their habit of lying paired, or roaming about on the surface after daybreak, may be said to be one of the chief causes favouring the great increase of both these English songsters. They, however, do not lose their finer relish for strawberries and other fruits, as they have already gained the same ominous name in this

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* Mr. Darwin has fully discussed the effects of an English winter on earth-worms. After observing their movements on the surface, he remarks: "On these occasions, very few dead worms could *anywhere* be seen," and continues, "on January 31st, 1881, after a long-continued and unusually severe frost, with much snow, as soon as a thaw set in the walks were marked with innumerable tracks;" but no further mention is made of dead worms

respect as in England.* In the springtime, when lands are ploughed, millions of sea birds, coming inland to breed, follow the plough, and subsist for weeks and months on worms. Several species of birds come a long distance from their nesting-place to follow the plough, and obtain food for their young. When mild weather, with sunshine, succeeds heavy rain, worms often lie in loose mould near the surface. The weka is then very busy, and digs them out with its powerful bill, and consumes great quantities. I have dug up a number of worms, from time to time, minus their tails. I think that during the process of ejecting their castings they are sometimes attacked by birds, which with a quick snap of their beaks tear away a portion of the worm's body. If the tail of a worm be seized with the fingers, when protruding from its burrow, it has great power, and it would be almost impossible to extract it without injury. If only a few segments of the tail are removed, the worms apparently suffer little or no inconvenience, and, if placed in pots, continue active and throw up castings.

The burrows of New Zealand earth-worms form a curious and striking contrast to the British species, described by Mr. Darwin in his valuable work on "Vegetable Mould." He says, "they run down perpendicularly, or, more commonly, a little obliquely." He doubted if they branched in solid ground, and adds: "As far as I have seen this does not occur, except in recently-dug ground, and near the surface." Mr. Urquhart, in his paper already mentioned, states that he "met with instances in which the burrows branched in solid ground, but the branching merely consisted of two short lateral passages at the termination of the burrow, leading into two distinctly separate chambers," and adds, further, "it is not unusual for two separate burrows to terminate in the same chamber." Mr. Urquhart, however, does not name the species inhabiting these forms of burrows.

I have already stated that our worms construct semi-circular and distinctly-branching burrows. I will select those of *A. uliginosus*, as it is a common species, and its burrows large. They can be more easily examined than those worked by the smaller forms. In order to examine them perfectly, I have been in the habit of stripping off the turf or covering of

* Probably the best introduced bird is the English starling (*Sturnus vulgaris*), which is increasing at an unprecedented rate. In settled districts it can be seen in troops of many thousands, busily picking over the ground infested by the larvæ of *Odontria striata*. Besides consuming great numbers of worms, it bids well at present to exterminate the native *Locustina*, as they have almost disappeared from districts where the birds are numerous. It would, therefore, be well for collectors to secure abundance of specimens in all districts where the starling is likely to increase.

dead grass with a sharp spade until the mouths were exposed. I then pour a small quantity of a weak saturated solution of corrosive sublimate into the burrow. No sooner does it come in contact with the animal's body than it starts to the surface. Sometimes they rise 12 or 15 inches from the mouth of the burrow where the solution is poured in, but invariably at the mouth to which the worm's head is directed. I never saw one leave its burrow tail first, except when it was a new one in course of making.

Another method of testing the form of these burrows is to insert a fine pliable twig (a weeping-willow answers well) into them, passing it through from one mouth to the other. It is at times difficult to do this, unless the solution be used, as the worms will often refuse to leave the burrow, or when both mouths are close together on the surface, or branches in other directions. When the twig is passed through, it is then easy to dig away the mould or clay on one side and examine the burrow. The two or more mouths vary from 2 to 18 inches apart. When they meet close together on the surface, the worms often lie in the morning with portions of their bodies exposed, with head and tail down each mouth of the burrow, as if enjoying the sun's warmth; but the habit causes the death of many, as the keen eyes of the weka and swamp-hen detect them, and the birds snatch them from their burrows.

When they are working in a considerable depth of rich mould they do not always line their burrows, especially in mild weather. Others, again, are partially lined, being dotted over sparingly with "small globular pellets adhering to the walls." When living in clay or clayey land the walls of the burrows are thickly lined with viscid earth, and can be examined perfectly, as the dark lining of the burrow contrasts well with the clay. The latter being colder, accounts for the greater thickness of lining. In depth, the burrows vary from 4 to 20 inches; those of the young worms are generally about 3 or 4 inches. It is difficult to dig up whole burrows without fracturing them, yet I have succeeded in raising some perfect ones, which I will forward to the Colonial Museum. When frosts or droughts set in, many of them hibernate for a time; the chambers in which they hibernate are sometimes excavated on one side of the burrow, or a few inches from its walls, but commonly in the middle, and form an enlargement. The chambers are always lined with viscid earth; in addition to this they are often saturated with slime from the animal's body, this forms a cool and slimy bed; they then roll themselves up in the form of a ball, or lie coiled in a circle, with the head in the centre. I have dug them out tied in a perfect knot, or in the form of a running noose, with head and tail placed together. After hibernating for some time, especially in dry weather, many of them become pale and almost transparent; their bodies also become limp, compared to those that remain active in moister places.

Where two or more worms are found in one burrow, or in separate chambers attached to or leading from it, it can only be explained by some finding their way into them during the night, when roaming about on the surface, and when the mouths of the burrows are open. I have observed that when worms are numerous in solid ground, their burrows often enter or run into each other; they then have the appearance of branching burrows, but the difference can be detected, as a perfect one is either semicircular, or branches gradually like railway points, usually but not always at the bottom, or turn, and rises again to the surface. If worms are about to hibernate, they sometimes descend perpendicularly to a considerable depth, and turn a few inches horizontally before they excavate their chambers; the mould is generally voided in the channel leading from the main burrow, and effectually shuts off the worm from any contact with the cold or dry air.

In some of the branching burrows may often be seen quantities of fresh castings packed tightly into them. The difference between dark mould washed in from the surface, or from the broken walls of a burrow, can be distinguished from castings voided intact, as the latter retain their perfect vermiform shape for a considerable time. There is no doubt whatever that the New Zealand earth-worms "use old burrows for the purpose of voiding their castings in," as abundance of them can be found in clay, or clayey lands, perfectly packed with them, both fresh and old. The habit of voiding castings, or pairing in their burrows, must tend to the preservation of worms in districts where their enemies are numerous.

During the last summer, undoubtedly the hottest and driest on record in this province, the sun cracked the land which these worms inhabit to a great depth. In order to ascertain the depth they burrowed under the circumstances, we dug several holes, and found them chambered at from 20 to 49 inches from the surface.

Early in September of last year one of the ploughmen informed me that he was ploughing a piece of land on the banks of the Waiareka Creek which contained great numbers of large worms. I went out next day, and followed in the wake of the plough, collecting specimens and examining the burrows. The land was the same peculiar adhesive mould already mentioned, and the worms were numerous and large. Previous to this the weather had been mild, and suited to their actions. The burrows were very perfect, nearly all being of the semicircular form. The air echoed with the delighted cries of gulls, stilts, and terns, all eagerly devouring the large worms.

In regard to the number of worms living in gardens, cultivated fields, and undisturbed Native land, I have made many tests. Worms like naturally rich and even strongly-manured land, but occur plentifully in some districts in poor soils. In an old kitchen-garden on the Rangitata they averaged 7 per square foot; in a similar one at Albury they averaged 8 per square foot; and in another in North Otago, cultivated seventeen years, the average was 7 per square foot. Worms are more numerous in old pastures than in gardens; in some paddocks in the Waiareka Valley they vary from 5 to 16; at Ashburton, on the Plains, paddocks broken up ten years had an average of 8 to each square foot, but they are often found twice more numerous in some parts of the same paddock than in others. In the winter of 1884 we were planting some pines on a piece of Native land, where *A. uliginosus* was plentiful; at six different places on the slope we dug out a square yard, and counted the worms, which numbered in each as follows: 11, 8, 7, 13, 9, 6; but in some places, lower in the valley, they are more numerous.

The habit of worms rising to the surface and leaving their burrows, caused by beating the soil or other disturbance, is peculiar to two species, *Endrilus campestris* and *E. annulatus.* As far as I know, this only occurs on loose ground, particularly in gardens or swampy land that trembles when treading on it. Occasionally, though rarely, they do so in pasture, when the land is soaked after heavy rains; but no manner of beating, or treading, will drive them to the surface in fine weather, either in pastures or on lawns, when they are a few years old, and the ground solid and favourable for their actions. The reverse is the case in loose garden mould: almost any piece not dug for several months, if trod on, or beaten with a spade, will bring some to the surface. This instinct is a subject for speculation; and after experimenting with a view to ascertain the cause, I have no doubt that the sudden breaking or crushing of the burrows causes the worms to extricate themselves and rise to the surface. Both are very sensitive and timid species, and the sense of fear highly developed in both. This considered, I think that any sudden shaking of the mould, or collapse of the burrows, would cause the animals instantly to free themselves, by rising to the surface; but possibly the habit may be acquired from living in loose mould.

I have never lived long enough in one locality to experiment with the sinking of large stones or other bodies, through the actions of worms; but Mr. Urquhart, from experiments made in the Manukau District, has shown that they sink sooner in New Zealand than in England; the gravel on garden walks also sinks much earlier in this country, but the greater number of worms will account for this. There is no doubt that the accumulation of mould increases more rapidly in our climate than in countries where the winters are long and severe.

The habits of our earth-worms kept in pots differ also from the British species, and are the same highly sensitive animals. If the pots are placed in the open air, they plug the mouths of the burrows with castings, but never plug them or line the burrows with leaves or other materials. They consume fresh or tainted meat; they especially relish the small soft leaves of the common chickweed (*Stellaria media*). As many as four and five are often drawn into one burrow in a single night. They nibble at almost every variety of mixed fruits or vegetables placed on the pots, and swallow quantities of pounded glass, brick, oyster-shells, and small stones, to aid in the trituration of their food. They are greatly benefited by a change of fresh mould occasionally, and burrow vigorously through it for days after, as if searching for the more nutritious particles it contains. When worms are kept in a limited quantity of mould they become weak and sluggish in their habits. If experiments are tried with worms in penetrating hard compressed soil, or sand, specimens of the same species fresh from the pasture will penetrate it much quicker than those which have been previously kept in confinement. When the mould in pots is pressed down hard, the worms construct the most perfect semicircular and branching burrows, and line them perfectly with viscid castings. The best results are obtained by putting one worm in each pot, according to the size of the animal, but the larger the pot the better, if obtainable.

The following is some account of six species, the other two recorded species (*Megalosolex antarctica* and *M. lineatus*,) I have had no experience with:—

Acanthodrilus (?) *uliginosus.*

Lumbricus uliginosus, Hutton, "Trans. N.Z. Inst.," vol. ix., p. 351.

Acanthodrilus (?) *uliginosus*, Hutton, "N.Z. Journ. of Science," vol. i., p. 586.

Professor Hutton gives this species as 9 inches in length. This is about the average size, although it attains the length of 12 inches. It appears to be distributed over the whole length of the islands, as Mr. Urquhart mentions it occurring in the Auckland District; and I hear from a correspondent that it is plentiful at Riverton, in Southland. In some districts, in suitable soils, it is exceedingly abundant. It attains its greatest size on low-lying, moist flats, or near the margin of sluggish streams, where it is not much disturbed by the plough. It is sparingly found in poor and stony soils, but does not thrive so well as or attain the size of those living where the land is richer and moist. It is a more active species than its larger congener, and during dark damp nights in spring and summer they leave their burrows in prodigious numbers, and move about on the surface; some are in search of food; some to pair; while others seek new ground to burrow afresh. The nights they appear on the surface, the weka and swamp-hen commit great havoc among them. In some parts of the Waiareka Valley, near Oamaru, the land is intensely adhesive; if ploughed when a little wet, it adheres to the plates of the plough and causes it to stick fast in the furrow. In this particular mould this large species exists in enormous numbers, and attains a great size. From the adhesive nature of the mould, the castings they eject retain their size and form for a long time, and are not so easily defaced or washed away by heavy rains as those thrown up on friable loam. Some thrown up by the larger worms resemble the one figured by Mr. Darwin,* but not so large or perfect. I have not seen an analysis of this mould, but after experimenting with a number of the worms, by handling the animals with the bare hand, and mixing the secretions with the other soils, I am of opinion that its tenacity is chiefly owing to its being saturated with the intestinal secretions of these animals. The same result is obtained by placing a number in a large flower-pot containing friable loam; in a few months it is changed to a rich adhesive mould. The land, however, is well suited for growing wheat, a yield of 70 to 80 bushels per acre being commonly obtained on it. As winter approaches, any castings standing up are soon pulverized by frost, and form small heaps of fine mould on the surface.

Acanthodrilus, sp. nov.

This undescribed species is the largest yet discovered, and although I have stated that it varies in size and colour in different localities, individuals are met with much larger than the largest forms of *A. uliginosus*. It is found living chiefly in clay, or clayey soils, and its habits are more sluggish than the last-named species. It is limited in its range, being confined to a few places in the districts I have examined. In one spot, a few miles below the Rangitata Gorge, the largest forms are found. Its colour in this locality is reddish-pink. It also occurs in a few places on the Canterbury Plains. At Oamaru I find it in one place, a small swampy patch of Native land; but here it exists as a more diminutive species, and never attains the size of those living in the two other localities. Its burrows are peculiar, as they are more commonly found running horizontally, than perpendicularly or obliquely. They appear to burrow in this manner when inhabiting solid clay. The burrows are of no particular form, but wind in all directions, generally horizontally, and near the surface, especially if the clay be wet.

* "Vegetable Mould," p. 129.

When living in deep clayey land, as at the Rangitata Gorge, their burrows have often two distinct mouths, and frequently resemble the letter Y. They work deeper in the mould, usually preferring the clayey subsoil. The dark superficial mould is intermixed with clay, voided in old chambers by the worms. Sometimes the burrows run a few inches horizontally at the bottom. I have never observed this species hibernating, but the habit of living in damp clay may account for it not doing so.

Endrilus (?) *levis*, Hutton.

Lumbricus levis, Hutton, "Trans. N.Z. Inst.," vol. ix., p. 351.
Dygaster (?) *levis*, Hutton, "N.Z. Journ. of Science," vol. i., p. 586.

This species abounds plentifully in heaps of rotten dung, or any decayed vegetable matter. It attains its greatest size in the bush, among moist beds of dead leaves, or leaf-mould, when its colour is paler and very distinct. It is also found, as Professor Hutton states, "in gardens and fields," and is "a variable species, sometimes of a greenish hue." If seized with the fingers, or touched in any way, it secretes a yellow fluid having a fetid odour, which is most distasteful to birds. Caged birds will generally reject it if any other food is obtainable. It is common in Peel Forest, in parts where the mould is deepest and moist. It is somewhat sluggish in habit; and numbers can often be found lying paired beneath slabs of wood, or rotten logs, in which it sometimes bores between the bark and decaying wood, generally on the under surface. It delights most in wet decomposing manure. I have observed it in a matted mass, in the bottom of an open drain leading from a gentleman's kitchen, living in the slimy, soapy pulp. After much wet weather, which causes celery to rot in the trenches, they cling to and nibble at the tender or rotting parts. Where numerous, the rotten celery occasionally partakes of their offensive odour.

Endrilus (?) *annulatus*, Hutton.

Lumbricus annulatus, Hutton, "Trans. N.Z. Inst.," vol. ix., p. 352.

This species is the commonest form in all the localities where I have examined; it abounds in gardens and pastures, and is met with in almost every quality of land, from peaty soil on low flats to dry friable loam several thousand feet up the slopes of the ranges; it increases rapidly as the land becomes broken up. It is a very variable species in colour and size, being met with from pale-pink to brownish-black. When living in peaty soil they are pale, and never attain the size of some specimens living in well-manured gardens. When heavy rains fall on newly-dug ground, they often leave their burrows and move about on the surface, leaving a distinct track behind them. This species has the habit of lying closer to the mouth of its burrow than any other, and is more consumed by birds. It is about 5 to 1 more numerous than any other species. In the summer, during damp mornings, it may be seen moving about on the surface of lawns or pastures, moving its head to and fro, searching for food among the short grass. It has the habit of lying or working close beneath the surface of the mould; this occurs in fine weather after heavy rains, it then falls an easy prey to the weka, which roots them out with its strong bill, and consumes vast numbers. Hundreds can sometimes be seen dead in ditches, or in paddocks where water lodges on the land, after storms of rain.

Endrilus (?) *campestris*, Hutton.

Lumbricus campestris, Hutton, "Trans. N.Z. Inst.," vol. ix., p. 352.

Dygaster (?) *campestris*, Hutton, "N.Z. Journ. of Science," vol. i., p. 586.

This species is found plentifully in gardens; more so in old ones cultivated some years, than in gardens recently made. A very variable species: Professor Hutton gives its colour as "reddish or olivaceous-green." In good garden soil it is sometimes almost black, with the clitellum "reddish-brown" and very distinct; I have collected specimens on poor soil clear red. If held before the light of a lamp at night, it is almost transparent. It is a very sensitive and active form; it prefers medium dry to wet land; in gardens in summer it collects into strawberry-beds or under the shade of trees in the orchard: it appears to have a strong liking for both cos or cabbage lettuce, as I find it often between the inner leaves, nibbling at the tender edges. It delights to live in the rot-heap of kitchen gardens, where the refuse of all vegetables is thrown to form manure; it climbs through the heap in all directions, subsisting on the decaying matter. Common in some districts in the open land.

Megalosolex sylvestris, Hutton, "Trans. N.Z. Inst." vol. ix., p. 351.

This species is plentiful in some places in Peel Forest. It lives in the rotten centres of prostrate trunks, or in the bark. It appears to prefer the dampest parts of the forest. It occurs in the fine mould which often accumulates around the bottom of the stems of tree-ferns. Colour, "dark red-brown." The young is generally lighter in colour. If placed on level ground, it has a curious habit of wriggling or twisting itself violently about.

The actions of earth-worms on the Canterbury Plains in former times is of much interest, as a little reflection will show that the accumulation of the mantle of mould now covering them must have proceeded at an exceedingly slow rate. The enormous mass of shingle and sand which underlies the mould would, after their deposition, on account of their great power of absorbing moisture, naturally retard the action of worms for many ages. I have no doubt that worms, or their seed capsules, were transported across the plains by floods in the great rivers, and some probably lodged in the fine silt or sand often deposited on the edges of the streams, leaving them to effect a footing at many places. Some of the best land in the Colony is found on parts of the Plains. The plantations and fences now planted will in a few years serve to break the wind in the more exposed parts affected by the dry north-west gales, and naturally assist the actions of earth-worms. It is well known that some of the heaviest yields of grain are grown in New Zealand, and no one who has examined a heavy crop of wheat growing in this country could fail to observe the astonishing height and thickness of the stalks. This applies to land broken up and in crop for the first time. Mr. Darwin has said that archæologists in England "ought to be grateful" to earth-worms for the preservation of many antiquities of the Roman period. In New Zealand, naturalists are indebted to them for the preservation of many valuable bones of the moa and other extinct birds, and for ethnological relics, buried beneath their castings.

Although earth-worms are "lowly organized" forms of life, any time given to observing their habits is well spent, and only by patient observation can their fertilizing actions on the land be realized.

Note.—Since the foregoing was written, the great drought of the past season has broken up, and been succeeded by the greatest rainfall recorded in New Zealand in a short space of time, and destructive floods, equalled only by those in the memorable year 1868. To show, however, the disastrous effects of droughts on earth-worms, when followed by heavy rains and floods, I will add a few facts which will tend to strengthen my theory of accounting for the death of large numbers of worms. From the 10th to the 24th of July, rain fell sufficient to moisten the land to the depth of 2 inches, but no worms were observed moving on the surface during this time. At Christchurch, heavy rains fell almost continuously from July 28th to August 11th, and the *Canterbury Times* of August 13th had the following note on worms:—

"An extraordinary number of worms were observed on August 9th, in the side-channels in Gloucester Street. The little creatures, who had evidently been washed out of the earth at various points, seemed to have called meetings of the homeless poor at various points along the road. Just below the

Public School, there must have been a barrow-load of wrigglers in a heap — a large and excited meeting. Further on, by Latimer Square, there was a more thinly-attended meeting, at which those present seemed to have given it up as a bad job, and decided to take no action."

At Oamaru, heavy rains fell from 10th August to the 22nd. During the afternoon of the 17th, the rain abated for several hours. Large numbers of weakly and apparently healthy worms were then observed moving in all directions on the surface, while some parts of the fields and public roads were literally strewn with the dead bodies of others; but all were of the three smaller species which inhabit open lands. The intestines of nearly all I examined were quite empty. A few only contained minute quantities of clay, which showed that they had burrowed into the clayey subsoil. At the end of the month many of the lakes and pools formed by the heavy rains had subsided. The bottoms of some were covered thickly with the dead bodies of earth-worms in a putrifying state. The drift weeds clinging to wire fences and gorse hedges through which the floods had passed also contained numbers of dead worms. On the hills and downs where they rose to surface they were instantly swept down the slopes, or scoured out of the earth by the numerous small streams formed by the heavy and incessant rains. The weather during the whole period being exceedingly mild, I think their deaths were not in any way accelerated by cold, although vast numbers of both weakly and healthy worms perished by drowning.

I am not sufficiently versed in the anatomy of earth-worms to discuss the subject fully; but I think that, were a number of them collected under the circumstances I have described, and forwarded to some specialist to report on them, it would doubtless settle the question, and explain the cause of their death. Although severe droughts or excessive moisture may generate disease among some species of worms, I am of opinion that more perish from exhaustion during droughts, or from the effects of it, than any other known cause. At Dunedin and other parts of Otago the rainfall for the month of August varied from 16·12 inches to 19·52 inches, and the destruction of worms during the same period was prodigious. These facts are of great interest in illustrating the effects of extremes in seasons on the actions and mortality of earth-worms.

Art. XIII.—*A Description of the curiously-deformed Bill of a Huia,* (Heteralocha acutirostris, *Gould,*) *an endemic New Zealand Bird.*

By William Colenso, F.R.S., F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 9th August.* 1886.]

Plate IX.

A short time ago I received from a kind correspondent, a settler dwelling in the interior forest-land, the head of a Huia in a fair state of preservation, which he had then recently obtained from a Maori. This head is that of a female bird; the upper mandible of its bill being greatly and strangely deformed. From about 1 inch, or one-fourth of the normal length of the upper mandible from its base, it suddenly rises and remains at an angle of 45°, forming a regular ascending and sub-erect spiral of two large and equal curves, each being of $\frac{3}{4}$-inch open interior diameter; not unlike a gigantic corkscrew, and reminding one of the horn of the *Strepsiceros.* (See Plate IX.)

The total length of this deformed mandible, following the curves, is just 6 inches; its breadth at the widest part about the middle is 4 lines, which part is also flat above, and is devoid of nostrils; and its end or tip is sharply pointed, and vertical upwards; throughout its whole length it is much thicker, rounded, and very obtuse on the right side or edge, while the left edge is thin and sharp; the lower thin marginal base of the right edge of the mandible is also much produced and sharp, evidently larger than ordinary, arising from, I think, not having been worn away in use; while the corresponding opposite edge is much worn, being almost the only part of the upper mandible that could possibly be brought into serviceable contact with the lower mandible; its colour, too, is not that sure ivory-white of the healthy and normal bill, but more like that of common whitish horn.

The lower mandible is $2\frac{3}{4}$ inches long, being very much shorter and not so much curved as this portion of the bird's bill is in the normal state. The tip, too, is much more blunt, and is slightly worn or broken; on the left edge near the base is a tolerably large, worn depression or notch, where the upper mandible must have closed upon it in the efforts of the bird on receiving its food.

There is not the least indication of the upper mandible ever having been broken or bruised, and afterwards, in healing and using, grown out of its common natural form, and thenceforward assuming its present shape. The inference, therefore, is that this bird must have been hatched with this peculiarly aberrant upper mandible; and, while we may reasonably suppose the parent birds assiduously fed it for some considerable time beyond the usual period of their young remaining unfledged, still, how it afterwards could have managed to exist and grow up seems truly wonderful! Especially when we consider the usual native food of the Huia, which consists of the larvæ of some of our largest beetles, (*e.g.*, *Prionoplus reticularis*,) obtained by the bird industriously pecking and probing rotten logs and wood, much after the manner of the common Woodpecker. Besides, from its very strange configuration, it appears to have been far worse than merely useless, for it must have been always an obstacle in the way, and the means of keeping the bird's mouth always open.

From the general appearance, as well as from the extreme length, of this upper mandible, I should infer the bird to have been an aged one; for, according to Dr. Buller, the length of the bill of the female bird is from 4 to $4\frac{1}{4}$ inches; but this upper distorted and unused mandible is no less than 6 inches long, while the lower one, which should correspond as to length, is only $2\frac{3}{4}$ inches! So, here we have two patent facts: 1, that the upper amorphous mandible grew continually, without being worn away through use; and, 2, that the lower one, having extra and constant work to perform, was consequently worn down and made defective far beyond its normal state and its natural power of growth-producing horn.

I have said that this head had belonged to a female bird: this is known by the greater length of the bill of the female bird, which is also narrower and much more curved than that of the male. For, while the bill of the female ordinarily measures about $4\frac{1}{4}$ inches, that of the male is only $2\frac{1}{4}$ inches, and is much more stout and strong, more wedge-shaped, and, consequently, less curved. Indeed, so great is the difference existing between the male and female birds in the form and length of their bills, that formerly, and for some considerable time, owing to their rarity and the scarcity of good specimens, the two birds were by our first ornithologists at Home believed to constitute two distinct species, and were consequently published as such.

I have already remarked that it seems almost a mystery how a bird with such a strangely deformed and all but useless bill could have managed to obtain its native food, so as to subsist and grow. We may, however, obtain a little light on this somewhat dark subject from an interesting paper on the Huia, written by Dr. Buller some 15 years ago for the Wellington branch of this Institute, and published in the third volume of their "Transactions;" Dr. Buller having had the peculiar and almost unique advantage of observing for more than a year the habits of these birds while living in confinement; and from his pleasing paper I shall quote a few passages bearing more particularly on this part of my subject.

In the beginning of his paper, Dr. Buller observes:—"Their peculiar habits of feeding, which I have described from actual observation, furnish to my own mind a sufficient 'reason' for the different development of the mandibles in the two sexes, and may, I think, be accepted as a satisfactory solution of the problem. In the summer of 1864 I succeeded in getting a pair of live birds. I kept these birds for more than a year; and when the male bird was accidentally killed, the other, manifesting the utmost distress, pined for her mate and died ten days afterwards."

"The readiness with which these birds adapted themselves to a condition of captivity was remarkable. Within a few days after their capture they had become perfectly tame, and did not appear to feel in any degree the restraint of confinement; for, although the window of the apartment in which they were kept was thrown open and replaced by thin wire netting, I never saw them make any attempt to regain their liberty."

"They were fully adult birds, and were caught in the following simple manner. The Maori who had caught them attracted the birds, by an imitation of their cry, to the place where he lay concealed; then, with the aid of a long rod, he slipped a running knot over the head of the female and secured her. The male, emboldened by the loss of his mate, suffered himself to be easily caught in the same manner. On receiving these birds, I set them free in a well-lined and properly-ventilated room, measuring about 6 feet by 8 feet. After feeding freely on the *huhu* grub, a pot of which the Maori had brought with them, they retired to one of the perches I had set up for them, and cuddled together for the night."

"It was amusing to note their treatment of the *huhu*. This grub, the larva of a large nocturnal beetle (*Prionoplus reticularis*), which constitutes their principal food, infests all decayed timber, attaining at maturity the size of a man's little finger. Like all grubs of its kind, it is furnished with a hard head and horny mandibles. On offering one of these to the Huia, he would seize it in the middle, and, at once transferring it to his perch and placing one foot firmly on it, he would tear off the hard parts, then, throwing the grub upwards to secure it lengthwise in his bill, would swallow it whole. . . . I sent to the woods for a small branched tree, and placed it in the centre of the room: it was most interesting to watch these graceful birds hopping from branch to branch, displaying themselves in a variety of natural attitudes, and then meeting to caress each other with their ivory bills, uttering at the same time a low affectionate twitter."

"But what interested me most of all was the manner in which the birds assisted each other in their search for food, because it appeared to explain the use, in the economy of nature, of the differently formed bills in the two sexes. To divert the birds, I introduced a log of decayed wood infested with the *huhu* grub. They at once attacked it, carefully probing the softer parts with their bills, and then vigorously assailing them, scooping out the decayed wood till the larva or pupa was visible, when it was carefully drawn from its cell, treated in the way described above, and then swallowed. The very different development of the mandibles in the two sexes enabled them to perform separate offices. The male always attacked the more decayed portions of the wood, chiselling out his prey after the manner of some Woodpeckers, while the female probed with her long pliant bill the other cells, where the hardness of the surrounding parts resisted the chisel of her mate. Sometimes I observed the male remove the decayed portion without being able to reach the grub, when the female would at once come to his aid, and accomplish with her long slender bill what he had failed to do. I noticed, however, that the female always appropriated to her own use the morsels thus obtained. For some days they refused to eat anything but *huhu*, but by degrees they yielded to a change of food, and at length would eat cooked potatoe and raw meat minced up into small pieces."

Dr. Buller also goes on to say that "Dr. Dieffenbach, in forwarding his specimens of the Huia to Mr. Gould in 1836," [error, *lege*, 1839–41] "wrote :—'These fine birds can only be obtained with the help of a Native, who calls them with a shrill and long-continued whistle, resembling the sound of the Native name of the species. After an extensive journey in the hilly forest in search of them, I had at last the pleasure of seeing *four* alight on the lower branches of the trees near which the Native accompanying me stood. They came quick as lightning, descending from branch to branch, spreading out the tail and throwing up the wings.'" (*l.c.*). From Dr. Dieffenbach seeing *four* on that occasion, I have little doubt of their being two pairs.

Moreover, and in further confirmation of much of the foregoing, I may briefly add what have at various times in past years, while travelling, come casually under my own notice respecting this bird. In some year in the decade of 1850 (I forget the exact one), I was, as usual, returning on foot from my annual journey to Wellington by the coast line, when one morning early, on the beach by the side of a small stream near Cape Turakirae (the west head of Palliser Bay), I suddenly came upon a single Maori, who had just then taken six of these birds, three males and three females ; some were dead, killed in the capturing, and some were still alive. He told me that he had seen them there on the low-stunted *karaka* trees (*Corynocarpus lævigata*) the day before; and so, having prepared his materials, had returned thither early that morning, and had succeeded in taking them.* I am, however, not certain (now) that he had captured all. I might have bought them from him for a small sum, but I was too far away from my home in Hawke's Bay, with a long and heavy journey before me, and had no means at hand for preserving their skins. At that time (before, and for many years after,) there lived at Mataikona, near Castle Point, a very curious eccentric old Maori chief named Pipimoho—a true type of the skilled old Maori *tohunga*, or knowing-man! Pipimoho was the only one in these parts who knew how and where to capture these birds; and this for a long time was his annual occupation, once or twice in the year to go to the inland forests from the East Coast, (to Puketoi and its neighbourhood,) to snare the Huia; and this was done to supply the principal chiefs of Hawke's Bay— Puhara, Te Hapuku, and Hineipaketia, his superiors in rank. This quaint old man only died about three years ago. From him I have received many a curious and interesting relation, always wishing I had more spare time at command to obtain more.†

I have also seen this bird in captivity with the Maoris, kept in a large light cage of network for the sake of its tail-feathers (*rectrices*), which were plucked as they arrived at maturity; the Maoris fed them with cooked potatoes, and other similar soft vegetable food.

Dr. Buller, in the same paper, also mentions, and gives the figure of, a larger and more highly curved form of the bill of the female bird than is usually met with. (*Loc. cit.*, tab. iii., fig. 3.)

Further, I may also briefly state that, among the Parrots, the Maori Kaka, (*Nestor meridionalis*, Gml.,) which I have formerly seen kept in confinement by the Maoris, I have noticed a few with very deformed upper mandibles; those birds had been kept by them for several years, and were aged, and being fed only (and sparingly!) on soft vegetable food, generally cooked potatoes, their bills, from want of their regular natural attrition on the harder substances of the forest, became overgrown and deformed. Indeed, the poor prisoners had not the common chance allowed them of biting and tearing their perch, or any wood (and this from mere thoughtlessness and carelessness, or long-continued custom, on the part of their Maori owners), for they were invariably kept fastened by a bone ring or carved

* The finding of those birds here, far away from the forests and close to the sea-beach, is opposed to Dr. Buller's statement as to their narrow restricted mountain-forest habitat. (*loc. cit.*, p. 24.)

† See "Trans. N.Z. Inst.," vol. xiv., p. 54, for a pleasing anecdote concerning him.

CURIOUSLY DEFORMED BILL OF HUIA.
From a Photograph.

circlet around one leg, and thus tied securely, but loosely, with a strong short cord to a slender polished cylindrical hard-wood spear, up and down which, for the space of 2 or 3 feet, the poor bird ran and danced and flapped his wings, always without water, and frequently in the hot burning sun, without any shade. These birds, however, were of great use to their owners for decoying other parrots for food, which through their means were often at set seasons slaughtered in large numbers.

Now, from all those interesting facts and observations relative to the habits and economy of the Huia, we may, I think, gather:—1. That these birds are quiet and social. 2. That they keep together in sexual pairs, and are therefore likely to be monogamous. 3. That the cock and hen are greatly attached to each other. 4. That they naturally and mutually help in their search after their own proper food. 5. That they can and do, without difficulty, make a thorough change in their diet or food, from animal to vegetable substances. And so, I think, we may reasonably conclude that the unfortunate female bird, to whom belonged this unnaturally distorted and almost useless upper mandible of her bill, was helped throughout a long life by her kind and attentive mate.

ART. XIV.—*A Description of a large and new Species of Orthopterous Insect, of the Genus* Hemideina, *Walker*.

By W. COLENSO, F.R.S., F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 9th August*, 1886.]

FAM. LOCUSTIDÆ.

Genus **Hemideina.**

Hemideina longipes, sp. nov.

Male.—Body smooth, legs and palpi hairy; general colour dark red-brown clouded with black. *Head*, rather small elliptic-globular, slightly wider than prothorax; eyes large, sub-lunate, gibbous, broadest above, horny integument filled with minute quadrangular facets; clypeus ochraceous, transversely rugulose above; labrum large, longitudinally ridged in the centre, minutely pitted and creased, yellowish spotted with dark-brown, with a few small vibrissæ; maxillary palpi very long, about 1 inch, slender, finely pubescent, three last joints nearly equal, last the longest, tip slightly clavate, hollow (? or extreme point wanting), pale coloured; labial palpi rather short, stoutish, second and third joints of equal length, colour pubescence and hollow tips as in maxillary palpi; antennæ, etc. . . . *Thorax* shining: prothorax 5 lines wide, slightly concave, dark-brown mottled with black, and a black transverse band within each margin, edges thickened, brown; mesothorax and metathorax each $2\frac{1}{2}$ lines wide, dark-brown with blackish mottlings; sternum of thorax, coxæ, trochanters, and femora below light-chocolate brown and very glossy, coxæ slightly pubescent. *Abdomen* short, rather narrow, sub-compressed, about $\frac{1}{2}$ inch long, seven rings slightly arched, smooth above, sides minutely muricated, dark brown transversely banded with black and mottled with black above; anal appendages two, 5 lines long, slender, subulate, obtuse, curved, light-brown, very hairy almost shaggy. *Legs: posterior pair* very long; femur 2 inches long, straight, smooth, largely clavate, outer side convex, unarmed, inner side very deeply grooved, and armed with a row of spines on each edge, edges sharp, glossy, also the spines; 12 spines, distant, in the inner row, and 21 spines, smaller and closer in the outer row; upper part of thigh 4 lines wide, stout, thick, of a light dull-brown colour, smoothish, shaded with darker wavy lines that are minutely hairy (*sub lente*), the lower end dilated laterally into two thin auricled processes, with a minute black spine on each; tibia $2\frac{1}{2}$ inches long, slightly curved, slender, piceous, studded with numerous minute short hairs, giving it a semi-muricated appearance, the inner side convex, the outer deeply grooved and armed on the edges with two rows of acute spines, 16 in the outer row, the uppermost very small, increasing in size downwards, the lower 6 the largest, 12 spines in the inner row, the lower 7 very large and rather slender; at the lower end of tibia 8 spines around the joint, 2 of them small, close above, 2 on each side, one of them being very large, $\frac{1}{10}$th inch long, and 2 smaller below; tarsus 1 inch long, slender, unarmed save 2 small spines at the lower end of each joint, the upper joint longest, $4\frac{1}{2}$ lines long, the third very small, and the last 3 lines long, the inner side deeply and narrowly grooved, ending on each joint in a long ovate loop with raised margins and no pulvilli (and so the other two pairs); ungues small, curved, divergent: *middle pair*, femur and tibia each 1 inch long, slender, each having 3 pairs of lateral, small, sub-opposite distant spines, with minute intermediate denticulations or points, and 4 small spines at the lower end of tibia, and two of the same at lower end of femur; tarsus 7 lines long, unarmed, very slender, upper joint longest, 3 lines long; tarsi and tibiæ light-brown, clouded: *anterior pair*, femur and tibia each 13 lines long, grooved; femur slender, unarmed on outside save minute tubercles or blunt denticulations on the outer edge of groove, and 4 small slender spines on the inner edge with similar minute tubercles, and 1 small spine on the lower auricled end on the inside; tibia, 3 pairs small alternate distant lateral spines, and 4 small spines at the lower end of joint, the lower half pale-brown, clouded; tarsus 8 lines long, slender, unarmed, pale ochraceous-yellow with darker joints.

Hab. In trees, *totara* timber (*Podocarpus totara*, A. Cunn.,) forests, Norsewood, County of Waipawa; 1885.

Obs. This is a very remarkable species, from the comparative shortness of its body and great length of its stout posterior pair of legs, which are nearly four times the length of its body and head! being considerably longer than those of the two very large species—*H. gigantea*, Col.,* and *Deinacrida heteracantha*, White.† Unfortunately, my only specimen is imperfect, wanting the upper part of the head, antennæ, maxillæ, and prosternum; it got crushed in capturing by the workmen at the sawmill, and I only obtained the major part of the insect (that had been preserved for me) a few days after. Luckily, however, the legs and body were perfect, and so was a portion of the head, containing the clypeus, labrum, and maxillary and labial palpi. It must certainly be a rare species, as none of the workmen at the mill, nor of the villagers, (who subsequently saw it,) long-used as they have been to forest work, had seen one like it before, although they very well knew the commoner and smaller kinds: it was also quite unique to me.

I may here repeat what I remarked before, in describing another rare and allied species, *Deinacrida armiger*, Col., that this insect appears to possess characters belonging to those two closely allied genera (*Deinacrida* and *Hemideina*), and that I doubt those two genera being naturally distinct.‡

ART. XV.—*Further Notes and Observations on the Gestation, Birth, and Young of a Lizard, a Species of* Naultinus.

By WILLIAM COLENSO, F.R.S., F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 9th August,* 1886.]

IN a former paper, read here before you in the session of 1879, I gave some "Notes and observations on the animal economy and habits of one of our New Zealand Lizards, supposed to be a new species of *Naultinus*;" § that paper also contained an

* "Trans. N.Z. Inst.," vol. xiv., p. 278.

† Zool. "Ereb." and "Terror," Ins., p. 24; Hutton's Cat. N.Z. Orthopt., &c., p. 79.

‡ "Trans. N.Z. Inst.," vol. xvii., p. 156.

§ "Trans. N.Z. Inst.," vol. xii., p. 251, etc.

account of some young lizards (4,) that were brought forth in my house, two of which I succeeded in rearing. At that time, however, I knew nothing of the manner of their being brought forth or expelled by their parent (as I have pretty fully related in that paper); and now, having very recently gleaned a few more particulars respecting the same, which may prove both interesting and curious, and perhaps unique, I propose to bring the same before you in this paper.

Early in this year, 1886, I received from Mr. J. Stewart, of Takapau (a member of this Society,) a fine specimen of our green lizard, in good condition and very lively. I suspected at the time it was a female, and probably pregnant. Mr. Stewart informed me that it had been very recently captured—viz., on the 29th December, 1885. It was some time, however, before I could get it to eat, although I supplied it with flies, much as I did my former ones. In time it ate them, but sparingly; and although I often watched it, I never once detected it doing so, or seeking to capture them! in this respect so very different to those I formerly had. Yet it ate them, that was certain, without leaving a wing or a leg, for they were not to be found in its house (or glass case), out of which they could not possibly get; and the fæces of the reptile further proved it. It also differed widely from my former ones in not drinking; for, although I often tried to induce it to drink, it never once took any water, while the others were frequently lapping water, and licking wet spots on leaves, etc.; and I did not keep any water with this lizard in its house. It would, however, swim very well and strongly when I put it into a large basin of water. As the weather became colder in this present autumn—in May—it ceased taking any flies, and I had supposed it was about to hibernate, as the others did; so I set it aside, but kept looking at it occasionally. The last time that I did so, on the 8th of June, it seemed much as usual, only thinner from its long fasting, and not torpid, but rather lively. I therefore gave it a couple of flies, which, however, it would not eat. On my looking at it again on the following day, the 9th of June, I found that it had given birth to two young ones—curious-looking little things and fully formed, but both dead. The following is a description of them:—

They were both nearly alike, in size, shape, appearance, colour and weight; each one distinct, lying separate in the case, and closely enwrapped in its own proper semi-transparent chorion or secundine, which was entire around one, and slightly broken about the snout of the other below its eyes, so that the front part of its little head appeared. Each was closely doubled up—one with its tail coiled tightly around its snout, and the other with its tail bent round and downwards beneath its chin; their shape was broadly oblong, one end much rounded, and the other (containing the head) more produced; measuring, the one 8, and the other 9 lines in length, and 5 lines in width, compressed, with the surfaces smooth and flattened, but somewhat uneven owing to the prominences of the limbs, etc., and bearing a general resemblance to the smaller seed of the common garden bean (*Faba vulgaris*). Each fetus weighed 15 grains, their colour darkish-green on the back, shaded off in spots to lighter green and almost to white in some of the little knobs and slight hollows; the eyes bright and yellow, with dark pupils, as in the adult. The chorion, or enveloping membrane, was excessively thin and white, and filled with minute capillary branching flexuous veins of a bright florid red colour, a few of the main ones being tolerably large, presenting a pleasing appearance. The fetus that had its enwrapment broken at its snout, had its mouth slightly open, showing the little notch in the tip of its tongue. From their very fresh, damp, and glistening appearance, they appeared to have been very recently expelled.

From these circumstances here related, three facts in the history of these little animals seem to be established :—1. That their young are brought forth alive, and not within an egg (as is the case with many of the Saurians); this I had formerly supposed (*loc. cit.*, p. 264); 2. That their time of gestation must be at least $5\frac{1}{2}$ months; 3. That they bring forth two at a birth—this, also, I had before observed (*l.c.*, pp. 251 and 264).

A brief description of this adult lizard may also be here given, seeing it varies a little from the species described. Extreme length $6\frac{1}{2}$ inches, of which the tail is $3\frac{1}{2}$ inches; colour a uniform bright green above, (which is particularly vivid on casting its old skin or epidermis,) inclining to darkish-green as it grows older, and much paler beneath; head rather small, slightly concave between the eyes, and scales flattish; tongue darkish plum-coloured; two large blunt semi-transverse scales on the side of the base of the tail near the vent, and three similar ones on the opposite side; a patch of pre-anal pores singly on larger scales in 4–5 short rows; toes slender, long; tail cylindrical, very slender, much elongated, its scales not imbricated.

In some of its characters this lizard resembles *N. grayii*, Bell,* especially in the shape of its head with flattened scales, the few large convex scales near the base of the tail, (which, however, in that species are said to be "four on each side,") elongated toes, and uniform green colour. It has, also, a few characters in common with the species described by me—*N. pentagonalis* (*loc. cit.*)—as in its pre-anal scales with pores, elongated toes, and the colour of its tongue; still it seems different in other characters, and has certainly shown widely

* "Trans. N.Z. Inst.," vol. iii., pp. 7 and 8.

different habits. It agrees still less with the other described species of green *Naultini*. It may be a variety of *N. grayii*, Bell, but certainly not of *N. punctatus*, Gray, which species Professor Hutton has subsequently stated to be identical with *N. grayii*.*

Addendum.—Since writing the above, and very recently, I have received a letter from Mr. D. P. Balfour, of Glenross, a member of this Society, dated 16th July, 1886, informing me of a green lizard, a species of *Naultinus*, and believed by him to be of the same species as *N. pentagonalis*, Col., which he had in confinement, having produced two young ones on the 14th of July. One of them was born alive, and the other dead, and then only after some considerable difficulty, Mr. Balfour largely assisting the mother; for when he saw her on this occasion, this second young one was half expelled, tail foremost, the other having been first born. Mr. Balfour also says that the living one measured 3 inches at its birth.

This is the *third* known instance of the birth of these green lizards, and all of them happened about mid-winter,† (a strange season!) when they should be in their natural semi-torpid hibernating state. This additional circumstance, now confirmed, seems very peculiar, and is worthy of being noted. The living young lizard, mentioned by Mr Balfour, seems to be of an extraordinary large size, "3 inches long when born:" those four born here with me, in 1878, were only a little over 1 inch in length when first seen, (*loc. cit.*, p. 263,) and those described in this paper (although still uncoiled in their fetal membranes), cannot be much more.

Art. XVI.—*Remarks on* Palinurus lalandii, M. Edw., *and* P. edwardsii, Hutton.

By T. Jeffery Parker, B.Sc., C.M.Z.S., Professor of Biology in the University of Otago.

[*Read before the Otago Institute, 10th August,* 1886.]

Plate X.

In Miers's "Catalogue of the Stalk- and Sessile-eyed Crustacea of New Zealand," two species of *Palinurus* are assigned to this country—one, *P. lalandii*, M. Edw., identical with a species found in Cape Colony; and the other, *P. edwardsii*, Hutton,

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* "Trans. N.Z. Inst.," vol. iv., p. 171.

† See "Trans. N.Z. Inst.," vol. xii., p. 251, for the *first*.

peculiar to New Zealand. In his account of the latter form, Miers remarks: "The specimens from New Zealand, in the collection of the British Museum, that have been referred to *P. lalandii*, belong to this species [*P. edwardsii*]; and hence I am in doubt whether *P. lalandii* be also an inhabitant of the New Zealand seas. It was formerly considered a common New Zealand species."

This remark, and the fact that I constantly found myself unable to distinguish the supposed two species from one another by the diagnostic characters given by Hutton and by Miers, induced me to make a special study of the question, and to this end I have obtained a series of specimens of the undoubted *P. lalandii* from the Cape of Good Hope. For these, I have to thank Mr. R. Trimen, F.L.S., Curator of the South African Museum, Cape Town, who kindly sent me more than a dozen examples belonging to both sexes, and of very various sizes. With these I have carefully compared about an equal number of *Palinuri* from the Dunedin market, as well as Hutton's type specimens in the Otago University Museum, of which one is labelled *P. lalandii*, and two *P. edwardsii*.

The diagnostic characters of *P. edwardsii* relied on by Hutton are best given in his own words: "This species differs from *P. lalandii* in its much smaller size, in the shape of the beak, in having no spine on the penultimate joint of the anterior legs, and in having a small spine at the distal extremity of the third joint of the last four pairs of legs." *

a. Size.—In this respect there is a perfect gradation between the largest and the smallest crayfishes brought to the Dunedin market.

b. Characters of the rostrum.—The rostrum of *P. lalandii* is thus described by Miers: "Rostrum with the lateral spines smooth above and below, and not projecting nearly so far as the small median spine, below the base of which are two small spines." That of *P. edwardsii* is described in the same words, both by Miers and by Hutton: "Beak small, compressed, curved upwards, and with two small spines at its base." From this it would appear that it is the compression and the upward curvature of the rostrum of *P. edwardsii* which distinguishes it from that of *P. lalandii*, since the two small basal spines are common to both species.

As I have elsewhere pointed out,† the above description of the rostrum is wanting in exactness. The two small spines at its base have nothing to do with the rostrum proper, being given off from what I have called the "clasping processes" (figs. 7–11, $cl.p^1$), pedate structures arising from the præstomial plate,

* "Trans. N.Z. Inst.," vol. vii. (1874), p. 279.

† "Trans. N.Z. Inst.," vol. xvi. (1883), p. 298.

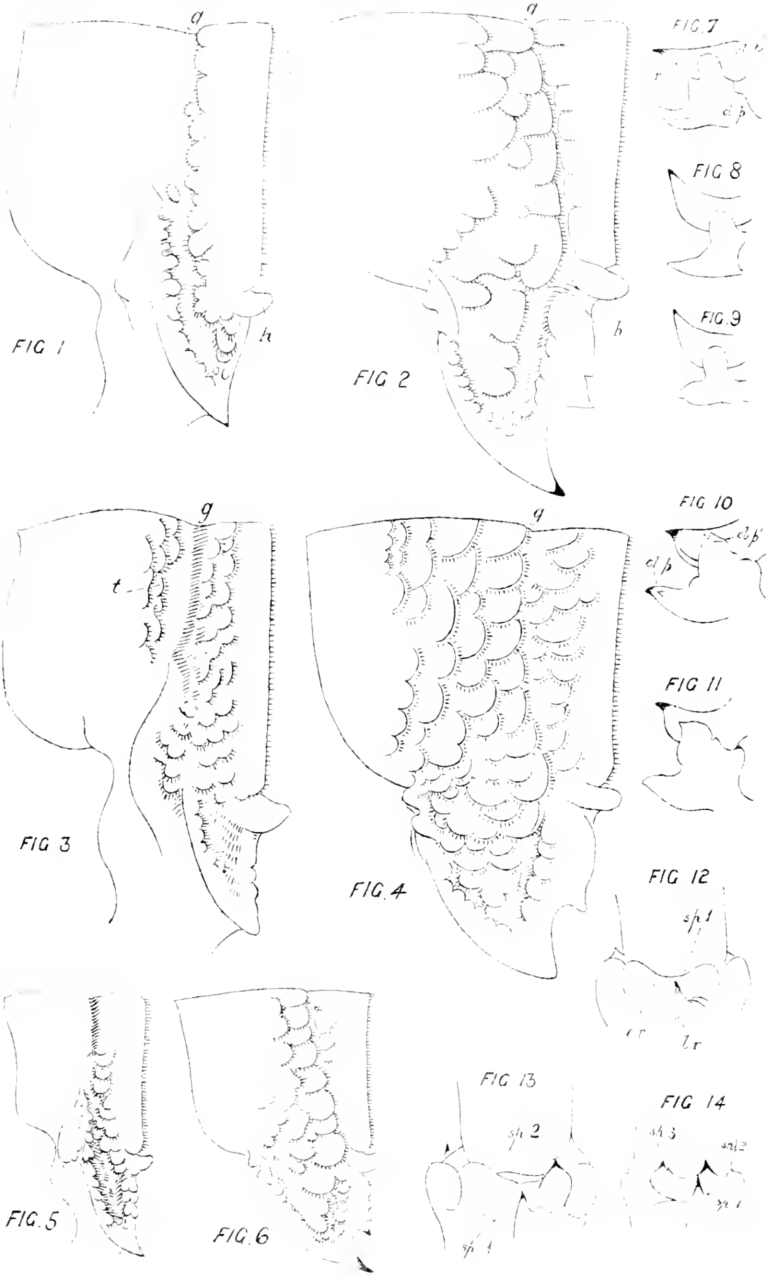
(= epimeral plate, Huxley = the area to which the eye-stalks are attached,) and ascending one on each side of the rostrum (*r*), to the base of which they are closely applied, although quite free from it. Each clasping process consists of a forwardly-directed or anterior limb (*cl.p*), and of an upwardly-directed or dorsal limb (*cl.p*[1]). The anterior limb usually terminates in a true spine—*i.e.*, is sharp, of a brownish-yellow colour, and horny appearance: more rarely it is pointed, but devoid of a true spine, and occasionally it terminates bluntly. The dorsal limb is sometimes blunt (fig. 9), sometimes bi-lobed (fig. 10), sometimes sharp (fig. 11), and occasionally terminates in a true spine. The rostrum itself may be nearly horizontal (figs. 7, 10), or slightly upturned (fig. 11), or strongly upturned (fig. 9), and usually terminates in a true spine. All these variations are found both in the South African and in the New Zealand specimens, and are therefore in no way diagnostic, but mere matters of individual variation.

c. Propoditic spine of anterior leg.—The presence or absence of this spine is a mere question of age. It is present in all the larger specimens, both from the Cape and New Zealand, absent or rudimentary in the smaller examples.

d. Meropoditic spines of legs 2–5.—The dorsal surface of the distal extremity of the meropodite, or third segment, of one of the four posterior legs of a New Zealand crayfish, is shown in fig. 12. The segment is seen to present a somewhat crescentic elevation (*cr*,) at its distal end, and proximad of this to be produced into a longitudinal ridge (*l.r*), which projects distalwards over the crescentic elevation, ending in a sharp spine (*sp. 1*): This is the spine acknowledged by Hutton and Miers to be common to the two species under discussion. The horns of the crescentic elevation, which are directed forwards, are sometimes both blunt (fig. 12), sometimes each terminates in a spine (fig. 14), while sometimes the anterior only (fig. 13,) and sometimes the posterior only is spinose. It is the presence of one, the anterior, of these small spines (*sp. 2*,) which is held to be diagnostic of *P. edwardsii*, in which species, therefore, the formula of the meropoditic spines is considered to be i.I.o., while in *P. lalandii* it is said to be o.I.o. I find, on the contrary, that the presence or absence of these small lateral spines is a matter of individual variation, the formulæ o.I.o., i.I.o., i.I.i. occurring both in African and in New Zealand specimens, and sometimes in the different legs of the same specimen.

One cannot but conclude, therefore, that, putting aside *P. tumidus*, Kirk,* which I have not examined, there is but one species of *Palinurus* hitherto discovered in New Zealand; and the question next arises, should this be called *P. lalandii* or

* "Trans. N.Z. Inst.," vol. xii, p. 313.



T.J.P. ad nat delt.

PALINURUS.

P. edwardsii: or, in other words, the diagnostic characters hitherto relied upon having broken down, are there sufficient differences from the Cape species to entitle it to retain a distinct specific name?

After a careful comparison, by means of drawings and measurements, of the series of New Zealand and African specimens, I find that there is one constant and reliable difference between the individuals from the two localities: It consists in the greater complication of the sculpturing or tuberculation of the abdominal segments in the Cape form.

The difference to which I refer will be apparent from a comparison of figs. 1 and 2, which represent the first and third abdominal segments of a New Zealand specimen, with figs. 3 and 4, which show the corresponding somites of a Cape specimen of about the same size.

In both cases, the first segment is marked by a strong transverse groove (*g*), which divides it into a larger anterior and a smaller posterior portion, the former being covered by the carapace in the extended condition of the abdomen. In all the Cape specimens which have come under my notice the segment in question shows a double row of tubercles (fig. 3, *t*) anterior to the groove; while in New Zealand specimens the anterior section of the somite is either wholly devoid of tubercles (fig. 5), or presents one or two very small detached ones (fig. 1). Further, in the Cape crayfishes, the posterior section of the same segment bears two rows of flattened squamiform tubercles; while in the New Zealand form there is only a single row of imperfectly-formed tubercles.

Similar differences are found in the remaining abdominal segments, which show the same separation into anterior and posterior areas, the groove (figs. 2 and 4) being, however, less clearly marked than in the first. In the Cape specimens (fig. 4) the tubercles on the anterior division are very numerous, only a small portion of the segment being without sculpturing; in New Zealand specimens (figs. 2 and 6), there are only two or three rows, so that fully half the tergum is left bare. In the posterior area of the 2nd–5th segments there is a close agreement with the corresponding region in the first, the Cape specimens (fig. 4) having about two rows of tubercles; the New Zealand specimens (figs. 2 and 6), a single row of imperfectly-formed tubercles.

The figures show at a glance the practical identity in these respects between the two supposed New Zealand species, ("*P. lalandii*," figs. 1 and 2; *P. edwardsii*, figs. 5 and 6,) and the marked difference of both from the true *P. lalandii*, (figs. 3 and 4,) from the Cape.

The carapace in the South African specimens is usually broader in proportion to its length than in New Zealand examples, the proportion of length to breadth being from 100–72 to 100–65 in the former, 100–65 to 100–60·5 in the latter. The pleura of the abdominal segments, measured from the hinge (figs. 1 and 2, *h*) to the terminal spine, are also, as a rule, proportionately shorter in the African than in the New Zealand specimens. But in both these characters the examination of a large series of individuals shows a complete gradation between those from the two localities.

The Cape specimens were not in a sufficiently good state of preservation to allow of a careful examination of the internal organs. But I find that there is no difference of any importance from the New Zealand form in the gills, the gastric skeleton, the mouth parts, or the microscopic structure of the branchial setæ.

In the sculpturing of the abdomen, on the other hand, the examination of about a dozen specimens of all sizes and both sexes from each locality has shown no intermediate stages.

I conclude, therefore, that there are constant though slight differences between the common New Zealand *Palinurus* and *P. lalandii* from the Cape of Good Hope, and that Hutton's name, *P. edwardsii*, should be retained for the New Zealand species, *P. lalandii* being no longer considered as an inhabitant of our coasts.

The differences relied upon are, however, so small, that but for the wide separation of the two localities one would hardly consider them as of more than varietal importance. Mr. Trimen informs me that *P. lalandii* "is confined to the western (Atlantic) shores of the Cape, and does not occur even in False Bay, immediately east of the Cape of Good Hope itself," and it would certainly be a remarkable fact to find the identical species reappear so far east as New Zealand. Haswell* states, however, that *P. edwardsii* occurs both in Tasmania and St. Paul's Island, two localities which help to bridge over the distance between South Africa and New Zealand, and it is quite possible that specimens from these places may be found to furnish intermediate steps, and thus to necessitate the merging of *P. edwardsii* in *P. lalandii*.

In any case, the existence of a single species, or group of closely-allied geographical sub-species, in South Africa, St. Paul's, Tasmania, and New Zealand, is a strong argument in favour of Hutton's theory † of an antarctic continent, from which the great Southern land-masses were stocked.

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* Cat. of Australian Stalk- and Sessile-eyed Crustacea.

† "N.Z. Journ. of Science," vol. ii., p. 1.

DESCRIPTION OF PLATE X.

Fig. 1. First abdominal somite of Hutton's type specimens of the supposed New Zealand *Palinurus lalandii*; *g*, groove; *h*, hinge.
Fig. 2. Third abdominal somite of the same.
Fig. 3. First abdominal somite of *P. lalandii* from the Cape of Good Hope; *t*, anterior group of tubercles.
Fig. 4. Third abdominal somite of the same.
Fig. 5. First abdominal somite of Hutton's type specimen of *P. edwardsii*.
Fig. 6. Third abdominal somite of the same.
Fig. 7. Rostrum and clasping process of Hutton's type specimen of the supposed New Zealand *P. lalandii*, from the left side; *r*, rostrum; *cl. p*, anterior, and *cl. p'*, dorsal limb of clasping process.
Fig. 8. Rostrum and clasping process of Hutton's type specimen of *P. edwardsii*.
Fig. 9. Rostrum and clasping process of a specimen of the supposed New Zealand *P. lalandii*.
Fig. 10. Rostrum and clasping process of *P. lalandii*, from the Cape of Good Hope.
Fig. 11. Rostrum and clasping process of another specimen of the same.
Fig. 12. Distal end of meropodite and proximal end of carpopodite of the 3rd left leg of Hutton's type specimen of the supposed New Zealand *P. lalandii*; *sp. 1*, the principal spine; *l.r*, longitudinal ridge; *cr*, crescentic elevation.
Fig. 13. Rostrum and clasping process of the corresponding leg of a large specimen of *P. lalandii* from the Cape of Good Hope; *sp. 2*, the anterior accessory spine.
Fig. 14. Rostrum and clasping process of the 4th left leg of a specimen of the supposed New Zealand *P. lalandii*; *sp. 3*, the posterior accessory spine.

All natural size except Figs. 8 and 10, which are slightly magnified.

Art. XVII.—*On a new Species of Giant Cuttlefish, stranded at Cape Campbell, June 30th, 1886* (Architeuthis kirkii).

By C. W. Robson. Communicated by Dr. Hector.

[*Read before the Wellington Philosophical Society, 19th July,* 1886.]

Cape Campbell and the adjacent coasts seem to be places of favourite resort for these great Cephalopods during the winter months, a year seldom passing without one or more of them being cast on shore, usually during the months of June and July. The greater number, however, of these, owing to the attacks of sharks, dogfish, and porpoises, are stranded in such a mutilated condition as to be of little value to the naturalist; but I am quite satisfied, from the examination of a number of imperfect and of two perfect specimens, that they are all Decapods. None of the Octopods which have come under my notice have a solid heavy body like the Decapods, and they all seem when cast on shore to be able to return to the water without difficulty. This a Decapod is unable to do; both the perfect specimens of the latter obtained by me at this place were, when first observed, alive and uninjured, and, though close to the sea, the one on a shingle beach and the other on smooth papa rock, neither was able to return to its native element. Mr. T. W. Kirk, in a paper read before this Society, October 10th, 1879, mentions an Octopus stranded at Kaimarama, in Hawke's Bay, but I am greatly disposed to believe it to have been a Decapod which had lost its tentacular arms.

About ten years ago I obtained a fine Decapod on shore in Clifford Bay, Cape Campbell, having a body 7 feet long, and a total length of 20 feet, a large and powerful creature, but not nearly so formidable a monster as that which I now desire to bring under your notice. As it lay upon the rocks it presented from a distance the appearance of a mass of raw beef, or of having been covered with dried blood. On a closer inspection this was found to be owing to a great number of minute specks of a bright red-brown colour with which the epidermis was covered. Under this the flesh was firm and white, presenting the appearance of *blanc mange* made from corn-flour. The body was slender, cylindrical, the sides nearly straight, having a small caudal fin, or fins, for they did not extend quite to the end of the tail or unite across the body, and were mere lateral expansions of the mantle. The outer edges of these fins, if produced so as to meet, would have formed a perfect oval. The head was short and thick, with large eyes furnished with a lid, the mouth being armed with a large and powerful beak. The eight sessile arms were of equal length, 6 feet 6 inches, but not of equal thickness, though all were thick and strong; two, those next the tentacular arms, were much stouter than the other six, being as large at the base as an average man's leg eight inches above the knee. All the sessile arms were furnished with stalked suckers, having a row of incurved teeth, and varying in size from those at the base, with a diameter of 1½ inches to that of a small pea at the point. The tentacular arms were long and slender, almost exactly similar to those of *Architeuthis verrilli*, as figured by Mr. T. W. Kirk.* They had also the same arrangement of small tubercles and suckers, at intervals of 2 feet from the club to the base. The club, as will best be seen from inspection of the specimen forwarded, differed from that of *A. verrilli* chiefly in having small suckers on very long stalks placed along the margins between the large ones. The internal shell was lanceolate, rather broad, transparent, and brittle when first taken from the body. It was in several pieces, owing probably to its having been broken during the animal's struggles to regain the water.

* "Trans. N.Z. Inst.," vol. xiv., p. 36.

This Decapod is not similar to any which I have previously met with, or of which I have seen descriptions; it differs chiefly in the shape of the caudal fin, in the large size of two of the sessile arms, in the arrangement of the suckers on the clubs, and in the unusual size of the beak, which, with the tongue, etc., is forwarded with the club. As it is probably a new species, provisionally I venture to dedicate it to Mr. T. W. Kirk, who has done so much good work in describing our Cephalopods.

The following measurements were taken :—

	Ft.	in.
Body, from anterior margin of mantle to end of tail	8	3
Head, from margin of mantle to base of arms	1	9
Sessile arms	6	6
Tentacular arms	18	10
Extreme length	28	10

It is to be regretted that a swiftly incoming tide prevented me from obtaining the greatest circumference, which must have been about 8 feet, or the number of suckers on the sessile arms, which I estimate at over 50.

ART. XVIII.—*On the Anatomy of the Limpet* (Patinella radians, *Quoy*).

By J. A. NEWELL, B.A.

[*Read before the Philosophical Institute of Canterbury, 7th October*, 1886.]

Plate XI.

THE following paper is an attempt to compare the structure of the New Zealand Limpet (*Patinella radians*) with that of the European *Patella vulgata*, L., as described in Cuvier's "Memoires," page 15.

Patinella was made a genus by Professor Dall. The genus was founded upon *Patinella magellanica* (Gmelin), but that definition has been slightly extended, and made to include all the *Patellas* of New Zealand.*

It will be seen that the most important differences (as they will be shown in their proper places,) between *Patinella radians* and *Patella vulgata* are—

1. That in *Patinella radians* the branchiæ do not extend all the way round the head, as they do in *Patella vulgata*, but

* "Proceedings of the Linnean Society of New South Wales, 1884," p. 374.

end at the sides of the head, in about a straight line with the disc of the mouth.

2. The convolutions of the intestine are somewhat different to those shown by Cuvier, fig. 12; but I have not been able to distinguish any expanded part of the intestine representing the stomach, further than that containing the coils of the odontophore.

3. The nervous system in *Patella vulgata* consists of a large ganglion, as shown in Cuvier, fig. 16, from which nerve-fibres go off to all parts of the body. In *Patinella radians* it will be shown that there are three separate ganglia, connected to one another by thick commissures. There are the pedal ganglia, consisting of two thick masses on the upper surface of the foot. There are two parieto-splanchnic ganglia connected by a commissure going over the back, and by two other commissures connecting them with the pedal ganglia. These ganglia give off nerves to the somatic cavity, mantle, and branchiæ. The cerebral ganglia are situated in the head, and are connected with the parieto-splanchnic ganglia by commissures, and there are small ganglia on their course where the nerves go out to the tentacles. This nervous system shows that our southern species (as most southern forms are) is a more primary and older form than the northern species. This, I think, is the distinguishing characteristic of *Patinella radians.*

The *shell* is ovate and moderately convex; the apex is situated about a third of the length of the shell from the anterior end. The ribs in it are small, slightly rounded, and radiate out from the apex to the margin of the shell. They are intersected round the margin with short ribs extending only about half-way up the shell. The ribs are of a dark-brown colour, and the interspaces are of an ash colour. In the interior of the shell, the upper part, above the circular muscle, is of a dark-brown colour; below the circular muscle it has a nacreous appearance, having small grooves corresponding to the ribs on the outside, which at the margin are slightly flattened out, giving the rim of the shell a slightly serrated appearance.

The *head* consists of a large fleshy mass (shown in fig. 2, *a*, *b*,) slightly narrowed at the neck; at the sides of the head are two well-marked tentacles, thick at their bases and tapering towards the points, very much of the shape of horns (*x*, *y*, fig. 3). I have not been able to recognise the eyes, at the bases referred to by Woodward, page 278. The mouth opens on the lower surface of the body (it is shown, *c*, fig. 1), it is simply a large oval-shaped sucking-disc.

The *foot* is a large olive-coloured oval disc, covering the lower surface of the body; by means of this muscular foot, the animal attaches itself to rocks; the free edge of the mantle hangs down round it.

The *odontophore* is armed with four tooth-like processes arranged in a series. Those of the inner series are of a brown horny colour at the apex, and transparent round the base.

The odontophore is about four times the length of the body of the animal, it is shown in position, (*d*, *e*, fig. 2,) after removing the foot. The teeth in the body of the coil are much sharper than those near the mouth, showing that they are replaced from behind as fast as they are worn out by friction in triturating the food. The muscular system round the odontophore is shown in fig. 2.

The *branchiæ* are numerous lamellar processes like ampullæ, lying between the fringe of the mantle and the foot; they do not extend all the way round the edge of the mantle, but only up to the sides of the neck; in *Patella vulgata*, figured by Cuvier, they extend round the whole body.

Nervous System.—As the nervous system seems to be the distinguishing feature between *Patinella radians* and *Patella vulgata*, I have dissected it out with great care. In *P. vulgata* the nervous system is simply a ganglionic ring, giving out nerve-fibres to the whole body. But in *P. radians* there are three different pairs of ganglia: (1.) Pedal ganglia are two ganglionic masses on the surface of the foot, connected together by a short thick commissure (*ab*, fig. 5); they are connected to the parieto-splanchnic ganglia by two very short commissures (*ca*, and *bd*, fig. 5), and to the cerebral ganglia by two long commissures (*ae*, and *bf*, fig. 5). These pedal ganglia give off two nerve-fibres to the surface of the foot (*ah*, and *bh'*, fig. 5), nearly meeting at their posterior ends. (2.) The parieto-splanchnic are not so large as the pedal ganglia; they are situated outside of and above the pedal, and connected to them by short commissures, to one another by a long commissure passing round the neck (*cd*, fig. 5), and to the cerebral ganglia by two commissures (*df*, and *ce*, fig. 5). These ganglia give off nerves (*m*, *m'*, fig. 5,) to the mantle, and nerves (*k*, *k'*, fig. 5,) to the sides of the somatic cavity, and the nerve *g*, fig. 5, to the visceral cavity. (3.) The cerebral ganglia are situated in the top of the head at *e*, *f*, fig. 5; they give off nerves to the tentacles, and one going round the top of the head (*erf*, fig. 5).

Reproductive Organs.—There is a large ovary shown in fig. 2 (*lm*), but I have not been able to trace the openings to the surface. I noticed that this ovary is much larger in summer time.

Muscular System.—The chief muscular organ is the foot; it covers the whole of the lower surface of the body, and acts like a sucker, attaching the animal to a rock. The circular muscle attaches the mantle to the upper rim of the foot. Its position is shown in fig. 2 (*pq*). From this muscle the mantle hangs free round the foot. The muscles surrounding the head, and working the odontophore, are shown in fig. 2 (*ab*); they end in two globular-ended rods.

Alimentary System.—The mouth is situated on the lower surface at the anterior end of the body; it is simply an oval-shaped sucking-disc, and has a serrated appearance. It opens into a large œsophagus, surrounded by strong muscles; in it lies the odontophore with its three coils lying on the left side of the body when examined from below (shown fig. 2, *de*). I have not been able to distinguish clearly an enlarged part, representing the stomach. The intestine has a great number of coils. I have traced them all out; they are shown in fig. 4 (*a* to *b*). The coils differ from those in the European *P. vulgata*. The rectum is slightly swollen, and the anus opens on the left side of the head, under the mantle (shown *k*, fig. 3, and *b*, fig. 4). The liver is very large, occupying nearly the whole of the body cavity; it covers the whole of the intestines (shown fig. 2, *xy*, and fig. 3, *fg*).

I have not been able to make out the salivary glands referred to by Professor Ray Lankester in the "Annals of Natural History."

EXPLANATION OF PLATE XI.

Fig. 1. Represents the animal, seen from below; *ab*, the foot; *c*, mouth; *de*, fringe of the mantle round the shell; *fg*, branchiæ.

Fig. 2. A drawing of the animal after removing the foot; *ab*, muscles round the head; *de*, odontophore (*in situ*); *f*, *g*, *h*, *k*, parts of the intestines; *pq*, circular muscle; *lm*, ovary; *st*, free fringe of the mantle; *xy*, liver, filling up the interspaces.

Fig. 3. A drawing of the animal after removing the shell and outer coverings, seen from above; *abc*, coils of the intestine; *d*, anal end; *c*, oral end; *fg*, liver; *pq*, circular muscle; *lm*, mantle; *xy*, nerve commissure.

These three figures are enlarged six times.

Fig. 4. The coils of the intestines, magnified about eight times; *a*, oral end; *b*, anal end.

Fig. 5. Represents the nervous system; *ab*, are pedal ganglia; *cd*, the parieto-splanchnic ganglia; *ef*, cerebral ganglia; *h*, *h'*, pedal nerves; *k*, *k'*, nerves of somatic cavity; *g*, nerve going to the intestines.

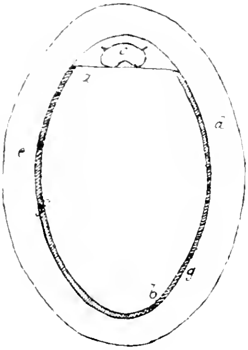

Fig 1.

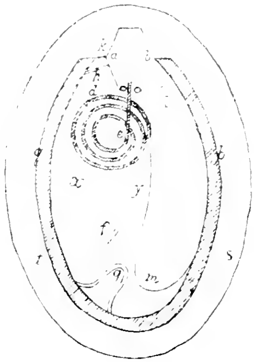

Fig 2

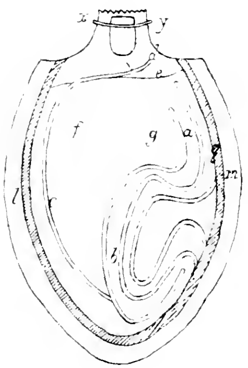

Fig 3.

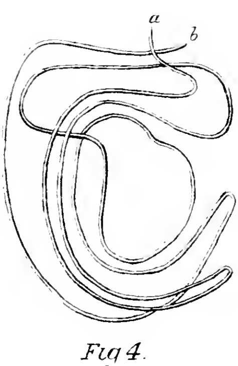

Fig 4.

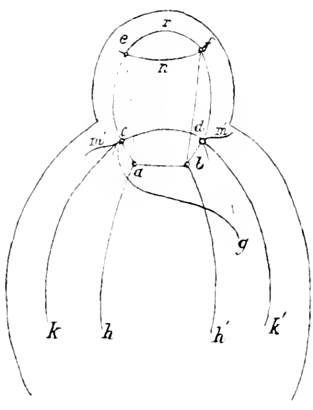

Fig 5.

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RATINELLA RADIANS.

ART. XIX.—*On the* Mollusca *of the Vicinity of Auckland.*

By T. F. CHEESEMAN, F.L.S., Curator of the Auckland Museum.

[*Read before the Auckland Institute, 20th September*, 1886.]

SOME years ago, I prepared a catalogue of the Mollusca of Auckland Harbour, which was printed in vol. viii. of the "Transactions of the N.Z. Institute."* Although as complete as the materials at my command would permit, it contained many faults, both of omission and commission. I now propose to correct these mistakes: to give a complete list of the species observed in the harbour, with notes on their habitats, etc.; and to add thereto a similar catalogue of the land and fresh-water species inhabiting the Auckland Isthmus and its vicinity. I am in hopes that the paper may be useful in two ways. First, in giving to the local collector a catalogue of the species which can be obtained near Auckland, together with some information as to where to look for them. Secondly, as a contribution to a knowledge of the distribution within the Colony of the New Zealand Mollusca, a matter which it is important should be worked out, for it will give some assistance in solving many questions connected with the geology and physical history of the country.

For the purposes of this paper, I shall consider Auckland Harbour to extend in a northerly direction as far as Lake Takapuna and Rangitoto Reef; and to the eastwards, to the Tamaki Heads and Motutapu Island. Its western boundary would be formed by a line drawn from Kauri Point to the mouth of the Whau River. By the term Auckland Isthmus and its vicinity, I mean not only the isthmus proper, extending from the Whau portage to Penrose, but also that portion of the North Shore to the south of a line drawn from the head of Lucas' Creek to a point on the sea-coast a little to the north of Lake Takapuna. The whole district would have a greatest length of about ten miles, with a greatest breadth of nine. The land area is probably over 60 square miles.

In my previous paper I have given a sketch of the chief physical features of the harbour, and some general remarks on the local distribution of the Mollusca found therein. It would be useless repeating this here; more especially as in the appended catalogue I have attempted to give some information as to the special localities and relative frequency of each species.

* "Trans. N.Z. Inst.," vol. viii., art. xxxvii.

The total number of species observed in the district is 242. Of these, 37 are land Mollusca; 12 fluviatile; and the remaining 193 marine. They fall in the following classes:—Cephalopoda, 3; Gastropoda, 177; Lamellibranchiata, 61; Brachiopoda, 1. Further search will probably add materially to the number of land-shells, for they have not been collected with the same care as the other families. Our land Mollusca are so small and inconspicuous, and so many of the species closely resemble one another, that it is no easy matter to exhaust a small district like the Auckland Isthmus. I do not anticipate that any additions of numerical importance will be made to the marine or fluviatile species, although discoveries will doubtless be made from time to time.

If the necessary material had been collected, it would have been interesting to have compared the molluscan fauna of the Auckland District with that of similar areas in other portions of the Colony, and to have worked out some general results as to the range of the species. But this cannot be done at present. Wellington is the only other locality for which a tolerably complete list has been prepared, and even there the marine species are alone catalogued. When carefully compiled lists have been published for at least a dozen stations on the coast line of both Islands, then the distribution of our Mollusca will be better understood, and some advance may be made towards determining the range and relative frequency of the species.

Catalogue of the Species of Mollusca observed in the Vicinity of Auckland.

Class I.—CEPHALOPODA.

Order I.—DEBRANCHIATA.

Octopodidæ.

1. *Octopus maorum*, Hutton. Hiding in crevices of rocks at or below low water-mark. North Shore, and Rangitoto Island.

Loliginidæ.

2. *Sepioteuthis bilineata*, Quoy et Gaim. An occasional summer visitant.

Spirulidæ.

3. *Spirula peronii*, Lam. Dead shells are occasionally cast up on the sandy beaches, although never so plentifully as on the exposed coasts.

CLASS II.—GASTROPODA.

ORDER I.—PECTINIBRANCHIATA.

Sub-Order 1. TOXOGLOSSA.

Pleurotomidæ.

4. *Pleurotoma zealandica*, E. A. Smith. Sandy bays between the North Head and Lake Takapuna, at or below low water-mark.
5. *P. albula*, Hutton. A few worn specimens, doubtfully referred to this, have been dredged in Rangitoto Channel.
6. *Drillia maorum*, E. A. Smith (*P. buchanani*, Hutton). Dredged in Rangitoto Channel.
7. *D. novæ-zealandiæ*, Reeve. Rare. Two specimens obtained on the sandy beach near Lake Takapuna.
8. *D. protensa*, Hutton. Rare. Sandy beach near Lake Takapuna.
9. *Clathurella sinclairii*, E. A. Smith. Dead shells are cast up in great abundance on all the sandy beaches in Auckland Harbour, but I have never been able to obtain a living specimen.
10. *Daphnella lymneiformis*. Living specimens are occasionally thrown up after storms.

Terebridæ.

11. *Terebra tristis*, Desh. Muddy and sandy places below half-tide, not uncommon.

Sub-Order 2. RHACHIGLOSSA.

Marginellidæ.

12. *Marginella muscaria*, Lam. Common. Living specimens can often be obtained crawling about near low water-mark in sandy places.

Volutidæ.

13. *Voluta (Alcithoe) pacifica*, Lam. Rare in Auckland Harbour, although common enough in many other places.

Fasciolaridæ.

14. *Fusus australis*, Quoy et Gaim. Rare.
15. *Taron dubius*, Hutton. An abundant shell between tide marks, in rocky places, under stones, etc.

Mitridæ.

16. *Turricula (Pusio) rubiginosa*, Hutton. Not uncommon under stones near low water-mark.

Buccinidæ.

17. *Siphonalia dilatata*, Quoy et Gaim. Not uncommon on rocky ground, usually concealing itself under ledges when the tide recedes.
18. *S. nodosa*, Martyn. Worn specimens are occasionally washed up.
19. *Pisania lineata*, Martyn. Common on rocky ground between tide-marks. A very variable shell.
20. *P. vittata*, Quoy et Gaim. Most abundant on rocky ground. The coloured bands are often quite absent, and the shell varies much in shape.
21. *Cominella maculata*, Martyn. Common between tide-marks. Appears to feed on *Paphia* and *Venus*.
22. *C. maculosa*, Martyn. Not uncommon.
23. *C. testudinea*, Chemn. Very plentiful, especially on rocky ground between tide marks.
24. *C. virgata*, Adams. The same remarks apply.
25. *C. huttoni*, Kobelt. Can be dredged plentifully in any part of the harbour, but is seldom seen in a living state above low water-mark.
26. *C. lurida*, Phil. A most plentiful shell on mud-flats, *Zostera* beds, etc.

Olividæ.

27. *Ancillaria australis*, Sow. Sandy bays near low water-mark. Covers itself with sand when the tide recedes.

Muricidæ.

28. *Murex octogonus*, Quoy. Under stones near low water-mark. Not common.
29. *Trophon ambiguus*, Phil. Dredged in Rangitoto Channel. Apparently not common.
30. *T. stangeri*, Gray. Not uncommon on rocky ground. I am not sure that Prof. Hutton is correct in referring his *T. retiaria* to this species.
31. *Kalydon plebeius*, Hutton. Most abundant.
32. *Purpura succincta*, Martyn. In crevices of rocks between tide-marks. Rare.
33. *P. textiliosa*, Lam. In crevices of rocks. Abundant.
34. *Polytropa scobina*, Quoy et Gaim. Faces of rocks between tide-marks. Abundant.
35. *P. albo-marginata*, Desh. In similar situations as the preceding, but not quite so abundant.
36. *P.* (*Lepsia*) *haustrum*, Martyn. Clefts of rocks between tide-marks. Not common in Auckland Harbour.

Columbellidæ.

37. *Columbella choava*, Reeve. Under stones and on seaweeds near low water-mark. A variety, nearly or altogether black, is almost as common as the type.

Sub-Order 3. TŒNIOGLOSSA.

Pomatiidæ.

38. *Realia egea*, Gray. Sheltering under decaying leaves of *Brachyglottis*, etc. Mt. Wellington and Mt. Eden lava streams; gullies near St. John's College; Rangitoto. Fast becoming scarce.
39. *R. turriculata*, Pfeiffer. With the preceding, but much rarer.

Cyclophoridæ.

40. *Cyclophorus cytora*, Gray. On fronds of ferns, but apparently very rare.

Rissoidæ.

41. *Rissoina annulata*, Hutton. On corallines and other seaweeds in tide-pools.
42. *Rissoa rugulosa*, Hutton. Under stones near low water-mark. Abundant.
43. *R. nana*, Hutton. With the preceding, and also on seaweeds.
44. *R. flammulata*, Hutton. Dead shells are not uncommon on the sandy beaches near Lake Takapuna.
45. *R. limbata*, Hutton. On seaweeds.

Hydrobiidæ.

46. *Potamopyrgus cumingiana*, Fischer. Lake Takapuna, Onehunga Springs, etc. Abundant.
47. *P. corolla*, Gould. With the preceding, but not quite so plentiful.
48. *P. antipodum*, Gray. Abundant in both fresh and brackish water.
49. *P. pupoides*, Hutton. Brackish water. Not uncommon, but easily overlooked.

Littorindæ.

50. *Littorina cincta*, Quoy et Gaim. Very scarce near Auckland. Faces of tidal rocks on the coast near Lake Takapuna.
51. *L. mauritiana*, Lam. Abundant everywhere on the faces of rocks and cliffs near high water-mark.

52. *Fossarina varius*, Hutton. In similar situations to the preceding, but much less abundant.

Pyramidellidæ.

53. *Turbonilla zealandica*, Hutton. Dead specimens can be occasionally picked from shell-sand near high water-mark.
54. *Odostomia lactea*, Angas. A few specimens have been dredged in Rangitoto Channel.

Cerithiidæ.

55. *Bittium terrebelloides*, Martens. Can be dredged in considerable numbers in the deeper parts of the harbour.
56. *B. exilis*, Hutton. In tide-pools, on seaweeds, etc.
57. *Cerithidea bicarinata*, Gray. On mud-flats and *Zostera* beds; plentiful.
58. *C. subcarinata*, Sow. Rocks and tide-pools; common.

Vermetidæ.

59. *Siliquaria australis*, Quoy et Gaim. At the roots of seaweeds in deep water; not common.

Turritellidæ.

60. *Turritella rosea*, Quoy et Gaim. Not uncommon on rocks near low water-mark.
61. *T. fulminata*, Hutton. With the preceding.
62. *Eglisia plicata*, Hutton. Under stones near low water-mark; rare.

Trichotropidæ.

63. *Trichotropis inornata*, Hutton. Dredged in Rangitoto Channel; and specimens are occasionally washed up after storms.

Calyptræidæ.

64. *Galerus novæ-zealandiæ*, Less. Common under loose stones between tide-marks.
65. *G. scutum*, Less. With the above, but much less plentiful.
66. *Crepidula costata*, Sow. Under stones, at and below low water-mark, near the roots of seaweeds, etc.
67. *C. monoxyla*, Less. Commonly affixed to *Turbo smaragdus*.
68. *C. unguiformis*, Lam. Affixed within the aperture of *Turbo smaragdus*; rare.

Aporrhaidæ.

69. *Struthiolaria papulosa*, Martyn. } Not common within the
70. *S. vermis*, Martyn. } harbour.

Lamellariidæ.

71. *Coriocella ophione*, Gray. Under loose stones at low water-mark; not common.

Naticidæ.

72. *Natica zealandica*, Quoy. A few worn specimens have been picked up near Lake Takapuna.
73. *N. australis*, Hutton. Dredged in Rangitoto Channel.

Tritonidæ.

74. *Triton nodiferus*, Lam. One specimen obtained on Rangitoto Reef.
75. *T. spengleri*, Lam. Under rocky ledges near low water-mark; not common.

Sub-Order 4. PTENOGLOSSA.

Ianthinidæ.

76. *Ianthina communis*, Lam.
77. *I. iricolor*, Reeve.
78. *I. exigua*, Lam.

Dead shells of all these species are often drifted into Auckland Harbour after a succession of north-easterly gales. The last species is much more abundant than the others.

Scalaridæ.

79. *Scalaria zelebori*, Frauenf.
80. *S. jukesiana*, Forbes.
81. *S. tenella*, Hutton.

Among shell-sand, near high water-mark. I have not seen living specimens within the harbour, but they can be obtained by dredging at Waiwera and other places to the north.

ORDER II.—RHIPIDOGLOSSA.

Sub-Order 1. PODOPTHALMA.

Neritidæ.

82. *Nerita saturata*, Hutton. Under stones and in clefts of rocks between tide-marks.

Rotellidæ.

83. *Rotella zealandica*, Homb. and Jacq. A few worn specimens only.

Turbinidæ.

84. *Turbo smaragdus*, Martyn. Very abundant. Tide-pools, mud-flats, mangrove swamps, etc.
85. *Cookia sulcata*, Martyn. Outlying reefs at the North Shore and Rangitoto; not common.

Trochidæ.

86. *Euchelus bellus*, Hutton; var. *iricolor*. Under stones at low water-mark.
87. *Trochus viridis*, Gmel. On rocky ground near low water-mark; not common.
88. *T.* (*Cœlotrochus*) *tiaratus*, Quoy et Gaim. On *Zostera* beds; moderately plentiful.
80. *Zizyphinus selectus*, Chemn. Rocky ground near low water-mark; scarce.
90. *Cantharidus purpuratus*, Martyn. Coast near Lake Takapuna; on seaweeds at low water-mark.
91. *C. tenebrosus*, Adams. A most abundant shell on *Zostera* beds.
92. *C. rufozona*, Adams. A few specimens dredged in Rangitoto channel.
93. *C. simulatus*, Hutton. On seaweeds near low water-mark; scarce.
94. *Gibbula oppressa*, Hutton. Under stones near low water-mark; scarce.
95. *Monilea egena*, Gould. In sandy places below low water-mark; not common.
96. *Monodonta* (*Diloma*) *æthiops*, Gmel. Under stones, etc., near high water-mark; plentiful.
97. *M.* (*Diloma*) *subrostrata*, Gray. Abundant on *Zostera* beds.
98. *M.* (*Diloma*) *sulcata*, Wood. Reefs near Lake Takapuna.
99. *M.* (*Latona*) *mimetica*, Hutton. On *Zostera*; scarce.

Pleurotomariidæ.

100. *Minos rimata*, Hutton. A few dead specimens only.

Italiotidæ.

101. *Haliotis iris*, Martyn. Reefs off Rangitoto, and near Lake Takapuna.

Sub-Order 2. Edriopthalma.

Emarginulidæ.

102. *Parmophorus unguis*, L. Under stones between tide-marks; not common.
103. *P.* (*Tugalia*) *intermedia*, Reeve. In similar situations as the preceding.

ORDER III.—DOCOGLOSSA.

Acmæidæ.

104. *Acmæa pileopsis*, Quoy et Gaim. Faces of tidal rocks; not common.

105. *A. flammea*, Quoy et Gaim. Faces of tidal rocks, and under stones; plentiful.

Patellidæ.

106. *Patinella denticulata*, Martyn. Rocky places between tide-marks; scarce.

107. *P. radians*, Gmel. On rocks between tide-marks; plentiful.

Order IV.—POLYPLACOPHORA.

Chitonidæ.

108. *Chiton pellis-serpentis*, Quoy. Rocks between tide-marks; abundant.

109. *C. sinclairii*, Gray. Faces of exposed rocks; not common.

110. *C. sulcatus*, Quoy. Under stones between tide-marks; abundant.

111. *C. glaucus*, Gray. Under stones; plentiful.

112. *Lepidopleurus longicymbus*, De Blain. Under stones between tide-marks; very abundant.

113. *Tonicia undulata*, Quoy. Under stones in tide-pools; rare.

114. *Acanthopleura cœlatus*, Reeve. On tidal rocks, Rangitoto Island.

115. *Chætopleura nobilis*, Gray. On rocks near low water-mark, Rangitoto Island; not common.

116. *Acanthochites zealandicus*, Quoy et Gaim. Tide-pools; plentiful.

117. *A. porphyreticus*, Reeve. A few specimens, dredged in Rangitoto Channel.

118. *A. violacea*, Quoy et Gaim. Under stones in tide-pools; rare.

119. *Cryptoconchus porosus*, Burrow. On rocks, roots of sea-weed, etc., at and below low water-mark.

ORDER V.—PULMONATA.

Sub-Order GEOPHILA.

Section AGNATHA.

Streptaxidæ.

120. *Elæa coresia*, Gray. Under bark, rotten logs, etc.

121. *E. jeffreysiana*, Pfeiff. With the preceding.

122. *Rhytida greenwoodii*, Gray. Formerly existed on the Mount Eden lava streams, and dead shells may still be occasionally found.

123. *Testacella vagans*, Hutton. Gardens in the vicinity of Auckland; rare. I cannot help thinking that this will prove to be the European *H. mangei*, and that it is only naturalized in New Zealand.

Section Elasmognatha.

Janellidæ.

124. *Janella bitentaculata*, Quoy et Gaim. Plentiful. It can usually be found in some quantity at the bases of the leaves of *Phormium tenax*.

Section Goniognatha.

Orthalicidæ.

125. *Carthæa kiwi*. Gullies at Northcote, and near Lake Takapuna; rare. The leaf-sheaths of the nikau palm (*Areca*) are a favourite hiding-place for this species.

Section Holognatha.

Helicidæ.

126. *Tornatellina novo-zeelandica*, Pfeiffer. Crawling on ferns and shrubs. Not uncommon, but very easily overlooked.

127. *Patula coma*, Gray. Shelters under bark or logs, or under decaying leaves of *Brachyglottis*. Common.

128. *P. buccinella*, Reeve. Not uncommon. Often frequents the leaf-sheaths of *Astelia* and *Freycinetia*, etc.

129. *P. corniculum*, Reeve.
130. *P. bianca*, Hutton.
131. *P. anguicula*, Reeve.
} Under bark, or amongst decaying leaves, etc.

132. *P. timandra*, Hutton. Not uncommon, especially among decaying *Brachyglottis* leaves.

133. *P. tapirina*, Hutton. Rare.

134. *P. egesta*, Gray. Among decaying leaves in dark and gloomy places.

135. *Fruticicola pilula*, Reeve. Common in shady gullies.

136. *Microphysa caput-spinulæ*, Reeve. Under stones, etc.

137. *Endodonta leimonias*, Gray.
138. *E. pœcilosticta*, Pfeiff.
139. *E. marina*, Hutton.
140. *E. nerissa*, Hutton.
} Under bark or decaying leaves, or crawling on ferns or shrubs.

141. *Phrixgnathus maria*, Gray. Not uncommon.
142. *P. erigone*, Gray. Under decaying leaves.
143. *Amphidoxa cornea*, Hutton. } Under bark, logs, etc., or
144. *A. chiron*, Gray. } among dead leaves.
145. *Otoconcha dimidiata*, Pfeiff. Rare. Hiding in the leaf-sheaths of *Astelia*, or in similar situations.

Charopidæ.

146. *Charopa ida*, Gray. Common under bark, logs, etc.
147. *Psyra dimorpha*, Pfeiff. Rare. Usually found under bark, or in sheaths of *Areca* or *Astelia* leaves.
148. *Therasia celinda*, Gray. Among decaying leaves, etc.
149. *T. tamora*, Hutton. With the preceding.
150. *T. thaisa*, Hutton. Under stones on the cone of Rangitoto.
151. *Thalassia portia*, Gray. Common.
152. *T. zealandica*, Gray. Common.

Vitrinidæ.

153. *Vitrina kermadecensis*, Pfeiff. Formerly existed in several gullies near Auckland, but I think has now died out.

Section DITREMATA.

Onchidiidæ.

154. *Onchadella nigricans*, Quoy et Gaim. Crawling over tidal rocks. Very plentiful.

Sub-Order 2. BASOMMATOPHORA.

Limnæidæ.

155. *Limnea arguta*, Hutton. Lake Takapuna. Rare.
156. *Bulinus variabilis*, Gray. Lake Takapuna; streams and ditches at Panmure. Rare.
157. *Planorbis corinna*, Gray. On *Azolla*, Onehunga Springs.

Ancylidæ.

158. *Latia neritoides*, Gray. Lake Takapuna. Abundant.

Auriculidæ.

159. *Ophicardelus costellaris*, Adams. Brackish-water swamps, mangrove swamps, etc. Common.
160. *Marinula filholi*, Hutton. Dead shells are occasionally picked up on the beaches, but up to the present time I have not been able to ascertain its habitat when living.
161. *Leuconopsis obsoleta*, Hutton. Under stones, near high water-mark; local.

Siphonariidæ.

162. *Siphonaria australis*, Quoy et Gaim. Faces of tidal rocks; not uncommon.
163. *S. zealandica*, Quoy et Gaim. With the preceding.

Amphibolidæ.

164. *Amphibola avellana*, Chemn. Mud-flats and sheltered tidal inlets; abundant.

Order VI.—OPISTHOBRANCHIATA.

Sub-Order 1. Tectibranchiata.

Philinidæ.

165. *Philine angasi*, Crosse. Occasionally dredged on sandy flats in Rangitoto Channel.
166. *Melanochlamys cylindrica*, Cheeseman. Tide pools at the Tamaki Heads; rare.

Actæonidæ.

167. *Buccinulus albus*, Hutton. A few worn specimens have been dredged in the harbour.

Cylichnidæ.

168. *Cylichna striata*, Hutton. Dredged in Rangitoto Channel.

Bullidæ.

169. *Bulla quoyi*, Reeve. On corallines near low water-mark.
170. *Haminea zealandica*, Kirk. On *Zostera* beds; very abundant in some localities.

Aphysiidæ.

171. *Aclesia glauca*, Cheeseman. Sandy flats; not uncommon.

Pleurobranchidæ.

172. *Pleurobranchus ornatus*, Cheeseman. Under stones in rock-pools; scarce.
173. *Pleurobranchæa novo-zealandica*, Cheeseman. On sandy flats; not uncommon.

Sub-Order 2. Nudibranchiata.

Dorididæ.

174. *Doris wellingtonensis*, Abr. Occasionally seen in sheltered places on rocky ground, but far from being common.
175. *D. rubicunda*, Cheeseman. On seaweeds near low water-mark; common.

176. *D. flabellifera*, Cheeseman. On corallines near low water-mark; scarce.
177. *D. luctuosa*, Cheeseman. On seaweeds; two or three specimens only.
178. *Chromodoris aureo-marginata*, Cheeseman. On seaweeds near low water-mark; a few specimens only.

Doridopsidæ.

179. *Doridopsis citrina*, Cheeseman. On seaweeds and corallines; the most abundant Nudibranch in Auckland Harbour.
180. *D. mammosa*, Abr. *Zostera* beds, but not common.

CLASS III.—LAMELLIBRANCHIATA.

ORDER I.—DIMYARIA.

Teredinidæ.

181. *Teredo antarctica*, Hutton. Boring in piles, etc.; much too abundant.

Pholadidæ.

182. *Barnea similis*, Gray.
183. *Pholadidea tridens*, Gray.

} Boring in sandstone rocks; plentiful.

Saxicavidæ.

184. *Saxicava australis*, Lam. At the roots of *Ecklonia radiata* and other sea-weeds; not common.

Corbulidæ.

185. *Corbula zealandica*, Quoy et Gaim. Can be dredged in great abundance in the deeper parts of the harbour.

Anatinidæ.

186. *Myodora striata*, Quoy et Gaim. Sandy places below low water-mark.
187. *Anatina angasi*, Sow. Muddy places below low water-mark; rare.

Mactridæ.

188. *Mactra discors*, Gray. Not common.
189. *Hemimactra ovata*, Gray. Deep mud by the side of tidal channels.
190. *H. notata*, Hutton. A few specimens picked up on the beach near Lake Takapuna.
191. *Zenatia acinaces*, Quoy et Gaim. Mud-flats below low water-mark; not uncommon.

Paphiidæ.

192. *Paphia novæ-zealandiæ*, Chemn. Sandy flats between tide marks; common.

193. *P. spissa*, Reeve. Sandy flats near Lake Takapuna.

Tellinidæ.

194. *Psammobia stangeri*, Gray.
195. *P. lineolata*, Gray.
196. *Hiatula nitida*, Gray.

} Sandy or muddy banks below low water-mark, but often washed up by gales.

197. *Tellina alba*, Quoy et Gaim. Very rare near Auckland,

198. *T. glabrella*, Desh. Near and below low water-mark; not uncommon.

199. *T. subovata*, Sow. Frequently dredged in the deeper parts of the harbour.

Petricolidæ.

200. *Venerupis reflexa*, Gray.
201. *V. elegans*, Desh.

} Either hiding in the old burrows of *Pholas*, or burrowing for themselves in the softer rocks.

Veneridæ.

202. *Venus oblonga*, Hanley. Not common.

203. *V. yatei*, Gray. Not common, but sometimes washed up by gales.

204. *V. stutchburyi*, Gray. Sandy and muddy banks, between tide-marks. Abundant.

205. *V. costata*, Quoy et Gaim. Occasionally washed up after storms.

206. *V. mesodesma*, Quoy et Gaim. Banks below low water-mark. Not rare.

207. *Dosinia australis*, Gray.
208. *D. subrosea*, Gray.
209. *D. lambata*, Gould.

} All occasionally thrown up after gales.

210. *Tapes intermedia*, Quoy et Gaim. Near low water-mark. Not rare.

Pisidiidæ.

211. *Pisidium lenticula*, Dunker. Among *Chara* and *Nitella*, Lake Takapuna, but not common.

Cardiidæ.

212. *Cardium striatulum*, Sow. A few odd valves have been picked up after gales.

Chamidæ.

213. *Chamostrea albida*, Lam. Affixed to rocks near low water-mark. Scarce.

Lucinidæ.

214. *Lucina dentata*, Wood. Sometimes picked up after gales.

Ungulinidæ.

215. *Mysia zealandica*, Gray. } Mud-banks at or below low
216. *M. striata*, Hutton. } water-mark.

Erycinidæ.

217. *Kellia citrina*, Hutton. In crevices of rocks between tide-marks. Tamaki Heads.

218. *Pythina stowei*, Hutton. Dredged in Rangitoto Channel.

Solemyidæ.

219. *Solemya parkinsonii*, Sm. Often washed up after easterly gales, and a few living specimens have been found buried in mud near low water-mark.

Carditidæ.

220. *Cardita australis*, Lam. Not common.

221. *C. compressa*, Reeve. Can be dredged in abundance in the deeper parts of the harbour.

Unionidæ.

222. *Unio menziesii*, Gray. Lake Takapuna and St. John's Lake; abundant.

223. *U. depauperatus*, Hutton. Lake Takapuna, *Hutton.* I am not acquainted with this species.

Nuculidæ.

224. *Nucula nitidula*, Adams. Muddy places below low water-mark; plentiful.

225. *N. lacunosa*, Hutton. With the preceding, and equally plentiful.

226. *Solenella australis*, Quoy et Gaim. A single living specimen dredged in Rangitoto Channel.

Arcidæ.

227. *Arca decussata*, Sow. Rangitoto Reef, near low water-mark.

228. *Pectunculus laticostatus*, Quoy et Gaim. Reef off Lake Takapuna, near low water-mark.

229. *P. striatularis*. Lam. Dead shells are occasionally washed up.

Order II.—HETEROMYARIA.

Mytilidæ.

230. *Mytilus magellanicus*, Lam. A few dead shells picked up near Lake Takapuna.
231. *M. latus*, Ch. Abundant on exposed rocks, and on the piles of wharves.
232. *M. ater*, Frauen. Rocks near high water-mark; plentiful.
233. *Modiola australis*, Gray. Not common.
234. *M. fluviatilis*, Hutton. Brackish water near Lake Takapuna.
235. *Lithodomus truncatus*, Gray. Boring in rocks between tide-marks. Abundant.
336. *Crenella impacta*, Hermn. Under overhanging ledges near low water-mark, spinning a nest for itself among Tunicata and seaweeds.

Order III.—MONOMYARIA.

Pinnidæ.

237. *Pinna zealandica*, Gray. Muddy bays near low water-mark; not uncommon.

Pectinidæ.

238. *Pecten zealandica*, Gray. Near low water-mark, under stones, or at the roots of seaweeds.
239. *P. laticostatus*. Sand-banks, at and below low water-mark.

Anomiidæ.

240. *Placunanomia zealandica*, Gray. Under stones near low water-mark, Rangitoto Reef; rare.

Ostreidæ.

241. *Ostrea glomerata*, Sow. On rocks between tide-marks; common.

Class IV.—BRACHIOPODA.

242. *Terebratella rubicunda*, Sol. Rangitoto Island; under stones near low water-mark; not uncommon.

ART. XX.—*The Land* Mollusca *of the Thames Goldfields.*

By JAMES ADAMS, B.A.

[*Read before the Auckland Institute, 14th November,* 1886.]

IT will surprise many of those who spend a large part of their lives in the forests of New Zealand to learn that there are a great number of land-shells in the bush. These shells, however, are in general so small and so inconspicuous that they are only found after a careful search, although every forest has, perhaps, thousands of at least forty different species. They are not only overlooked on account of their small size, but they hide also under leaves, or under the bark or in the crevices of the trees.

A few of the larger ones are, of course, well known in the localities where they are numerous—such as *Paryphanta busbyi*, and *Rhytida greenwoodii*—but the greater number range in size from that of a pea to a pin's head. Indeed, one of them, and not the smallest, has a Latin cognomen that means "pin's head." There are at present known to science about one hundred and twenty of the Land Mollusca of New Zealand, and these have been classified and described by Captain Hutton in a paper in the sixteenth volume of the "Transactions."*

It occurred to me, when collecting land-shells for him and for my friend Mr. Cheeseman, that it might be useful to make a list of the species found in the Thames District, and to mention at the same time the most favourable localities for searching for them. In one respect the land-shells are deserving of more than a passing attention, and that is the surprise that every one must experience in finding them at all in New Zealand.

They are easily drowned in fresh water, and salt water is sudden death to them. They cannot bear exposure, as they quickly disappear from even rude clearings; and yet our land-shells have their nearest relations in Tahiti, Samoa, and the Solomon Islands. Countless ages must have elapsed while such slowly-moving animals gradually spread over the intervening space between such distant countries. Indeed, their great antiquity is confirmed by the fact of finding fossil land-shells on a fossil tree in the Palæozoic rocks. It may be supposed that, when forests flourished on the oldest sedimentary rocks of New Zealand, the ancestors of the present land-shells swarmed under the dead leaves and on the tree trunks.

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* "Trans. N.Z. Inst.," vol. xvi., art. viii.

One vast forest extended, perhaps, from New Zealand to Queensland on the west, and to Tahiti on the east. It may be significant that this very ancient form of fauna is abundant on the nikau (*Areca sapida*), and on the kiekie (*Freycinetia banksii*), both of which belong to the most ancient forms of flora. The nikau is a favourite for land-shells in any situation, but they are found more numerously on it in deep shady valleys near the banks of streams. The shells usually found are *Carthæa kivi*, *Patula buccinella*, *P. corniculum*, *Phrixgnathus maria*, *Amphidoxa chiron*, and *Thalassia neozelanica*. A couple of years ago, after an unsuccessful search for land-shells on the main range of this peninsula, I cut down a nikau (*Areca sapida*), and by examining each leaf right into the heart I found twelve different species, chiefly of the genera *Patula*, *Phrixgnathus*, and *Psyra*.

The kiekie (*Freycinetia banksii*) usually contains the same kinds of land-shells as those found on the nikau; but, as a rule, the less number of nikaus in the locality, the greater number and greater variety of shells the kiekie affords. There is a species of *Phrixgnathus*, mentioned in the list appended, that appears peculiar to this tree.

The tree-fern is another very ancient type of flora, and here also a successful search for land-shells can be made; but they are easily overlooked in the brown scales and decaying fronds, except such conspicuous shells as *Patula corniculum*.

I have made a special trial of how many kinds of land-shells can be gathered in and about the black tree-fern (*Cyathea medullaris*), and the silver tree-fern (*Cyathea dealbata*) that formed a grove, and there were found 19 different species. Of these, 6 were species of *Patula*, 3 of *Phrixgnathus*, 2 of *Endodonta*, 2 of *Therasia*, 1 *Elæa*, 1 *Amphidoxa*, 1 *Fruticicola* and *Thalassia neozelanica*.

The land-shell last mentioned is the commonest found in the bush. It is generally the first to meet the eye when the day's search begins. This search is of course delayed until the real bush track is entered on, that leads through the groves of pukapuka (*Brachyglottis repanda*) that usually form the outskirts of the forest.

The large leaves accumulate in hollows, or near the roots of the mahoe (*Melicytus ramiflorus*), or the pukatea (*Atherosperma novæ-zealandiæ*), or the taua (*Beelshmeidia taua*), and these piles of damp decaying leaves become a favourite haunt for *Rhytida greenwoodi*, *Thalassia neozelanica*, and *Phrixgnathus maria*. Many other shells are also frequently found, but they are usually dead ones.

On advancing further, or rather climbing higher into the bush, a place must be sought on the slope of a ridge, where small stones are covered with black mould and decaying leaves; and, by patient search, small live land-shells will be found, such as *Psyra planulata*, *Phrixgnathus erigone*, *Patula buccinella*, *Therasia celinde*, and *Amphidoxa chiron.*

The handsome hairy shell, *Thalassia portia*, is very local, and though four or five may be found in one place, the vicinity may be searched in vain for any more.

Many land-shells are found under the bark of dead trees, especially in damp places. The rimu (*Dacrydium cupressinum*) is best for several kinds of *Patula*, and under the loose bark of the taua (*Beelschmeidia tawa*), *Phrixgnathus conella*, *Elæa jeffreysiana* and *Endodonta pœcilosticta* are not uncommon.

On cushions of moss growing on dead trees, or on patches of Hymenophyllum, *Endodonta leimonias* can be found, but this minute shell is very inconspicuous.

The fleshy tubers of *Earina autumnalis* may harbour *Otoconcha dimidiata* ; but this shell is more likely to be found under the outer decaying fronds of the nikau (*Areca sapida*) in damp situations.

The eggs of land-shells are found chiefly under the fronds of the nikau, or within the leaves of kiekie or of *Astelia solandri.* That the land mollusca and their eggs have many enemies, appears evident to me, but to write on this subject would require much closer observation than I have been able to devote to it.

FRESHWATER MOLLUSCA.

The freshwater mollusca are represented in every stream and in every swamp, and though very plentiful, there are very few species. In the Kaueranga River, about half a mile from its mouth, there is an abundance of a *Mytilus* which resembles *M. ater*, but it may be a new species. In the upper course, *Melanopsis bifasciata* is not uncommon on pieces of dead wood, and some tributary rivulets abound in *Potamopyrgus corolla.*

Planorbis corinna, and *Pisidium neozelanica*, appear to occur in only one place, but they are both inconspicuous and easily overlooked. The one is found on *Azolla rubra*, and the other on the muddy bottom at the roots of *Cyperus ustulatus.* I append a list of the Mollusca found in the district, which may probably be increased by the addition of a few more species.

CATALOGUE OF THE LAND AND FRESHWATER MOLLUSCA OBSERVED IN THE THAMES DISTRICT.

I.—LAND MOLLUSCA.

1. *Carthæa kivi*, Gray. On leaves of nikau, kiekie, and kawakawa.
2. *Tornatellina neozelanica*, Pfeiffer. On fronds of ferns.

3. *Patula coma*, Gray. Under the bark of dead trees; chiefly rimu and taua.
4. *P. buccinella*, Reeve.
5. *P. corniculum*, Reeve. On fern trees and leaves of nikau.
6. *P. brauca*, Hutton.
7. *P. anguicula*, Reeve.
8. *P. timandra*, Hutton. Under bark of dead rimu.
9. *P. tapirina*, Hutton.
10. *P. biconcava*, Pfeiffer.
11. *Thera stipulata*, Reeve. Under leaves in stony places.
12. *Fruticicola pilula*, Reeve. On nikau.
13. *Microphysa caput-spinulæ*, Reeve. On kiekie.
14. *Strobila*, sp.
15. *Endodonta leimonias*, Gray. On Hymenophylla, in dense bush.
16. *E. pœcilosticta*, Pfeiffer. Under dead leaves.
17. *E. marina*, Hutton.
18. *E. nerissa*, Hutton.
19. *Phrixgnathus maria*, Gray. Very common in all places where shells are found.
20. *P. conella*, Pfeiffer. On nikau and kiekie.
21. *P. regularis*, Pfeiffer.
22. *P. erigone*, Gray.
23. *P. celia*, Hutton. Under the leaves of kiekie.
24. *Amphidoxa cornea*, Hutton. On nikau leaves.
25. *A. chiron*, Gray.
26. *A. costulata*, Hutton.
27. *A. perdita*, Hutton.
28. *Otoconcha dimidiata*, Pfeiffer. Under nikau leaves or moss, in very damp places.
29. *Charopa ida*, Gray. On nikau.
30. *Psyra dimorpha*, Pfeiffer. Under dead leaves of pukapuka.
31. *P. planulata*, Hutton. Very common, but chiefly under decaying nikau leaves.
32. *Psyra*, sp.
33. *Therasia celinde*, Gray. On fern-trees.
34. *T. tamora*, Hutton. Under dead leaves.
35. *T. decidua*, Pfeiffer.
36. *Thalassia portia*, Gray. Under dead branches of wood in stony places.
37. *T. neozelanica*, Gray. Very common.

38. *Janella bitentaculata*, Quoy and Gaimard.
39. *Elæa coresia*, Gray. In dead trees.
40. *E. jeffreysiana*, Pfeiffer.
41. *Rhytida greenwoodi*, Gray. Under damp leaves, near the roots of pukapuka or pukatea.
42. *Leptopoma*, sp. Under dead leaves in forest ranges.

II. FRESHWATER MOLLUSCA.

43. *Limnæa arguta*, Hutton. On leaves in swamps.
44. *Bulinus variabilis*, Gray. In running streams.
45. *Planorbis corinna*, Gray. On leaves of swamp plants.
46. *Melanopsis trifasciata*, Reeve. In the Kaueranga River.
47. *Potamopyrgus cumingiana*, Fischer. On cress in rivulets.
48. *P. corolla*, Gould.
49. *P. antipodum*.
50. *P. pupoides*.
51. *Pisidium neozelanica*. At the roots of swamp plants.
52. *Mytilus ater?* In the Kaueranga River.

Art. XXI.—*Description of the Little Barrier or Hauturu Island, the Birds which inhabit it, and the Locality as a Protection to them.*

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 14th November*, 1886.]

Having heard the practical and beneficial proposals to science and agriculture made by Judge Fenton at the last meeting of this Institute, I thought it might be useful to give a brief and general description of Hauturu Island, which I have visited five times, spending in all about ten months, searching and cutting tracks in various directions. Hauturu Island is situated 12 miles in a north-easterly direction from Rodney Point. The island is, in a straight line from north to south, $4\frac{1}{4}$ miles, from east to west $3\frac{1}{2}$ miles, in extent, and rises about 2,383 feet above sea-level. It is very broken, except on the south-eastern portion, where there is a small flat, and a few slopes grown over with grass, ferns, and small ti-tree; these places were cleared by cutting firewood. A main range runs across the island from west to east, which in places is very narrow and steep. The Island is well timbered, and there are some very fine kauris in the interior.

The general bush consists of—

Manuka	Rewarewa	Rata
Puriri	Nikau	Taridi
Tawa	Maire	Punga
Rimu	Miro	Pohutukawa

The Pohutukawa about Christmas-time gives this island the appearance of a large rose garden, when these trees are covered with their red blossoms, on which the honey-eaters delight themselves from early morn till late in the evening, climbing about from one blossom to another to suck the honey. The korimoko may also sometimes be seen chasing a tui, making various evolutions in the air, and, on returning, making the place ring with their powerful whistle. On the heights are numerous shrubs similar to the vegetation on the New Zealand Alps. Some of the gullies are very dense with creepers, such as supplejack, "lawyers," and a large variety of ferns and moss. There are several creeks: four have their outflow north, one north-east, two south, three west. There are some minor ones, but in summer most of them get dry, except one north, one south, and one west, which always have water, especially the one in the centre of the island. There are some large and deep water-holes, and in some places the creeks are narrow. The mountains are nearly perpendicular and of various shapes and forms, some bare, others grown over with low vegetation; the scenery is wild, but very romantic: some places are so broken that I was obliged to use a rope for pulling up and letting down my provisions and dog. In one locality, I could not find a place to camp without the risk of rolling over the cliffs, and had to tie myself to a tree. The formation is mostly conglomerate, and dark rock similar to basalt.

Having described the island, I will now bring before you the advantages Hauturu Island possesses over others for protecting and preserving the birds. Firstly, there are only three landing-places; two are known to the coasting vessels: one on the south-western side, where the Maori settlement is, the other is half-a-mile west, where I had my camp; but even these places have boulder shores, and the landing is dangerous, as a heavy surf rolls in constantly, except when the weather is north or north-east and there is no swell on. On the south-western side, on top of the hill, one can overlook both landing-places. Here the land is not so broken, and could be cultivated. The third landing-place, a boulder beach on the eastern portion of the island, is very rough. I had a boat smashed into fragments by the surf at this place. There is no fresh water near it in summer. One good man, who took a delight in his duty, could act as overseer on the whole island.

The high slopes would be a favourable resort for kakapo (*Stringops*), crow (*Glaucopis*), saddle-back (*Creadion*), New Zealand titmouse (*Orthonyx ochrocephala*), creeper, and *Certhiparus novæ-zealandiæ*. The lower ridges would be suitable for kiwi (*Apteryx*), the deep gullies for wrens (*Xenicus*), thrushes (*Turnagra*), robins (*Petroica*), etc. The above-mentioned localities are well suited for all the specimens named, by my own observations in various places.

Appended is a list of the birds which inhabit Hauturu Island, viz.:—

Hieracidea ferox
Circus gouldi
Athene novæ-zealandiæ
Halcyon vagans
Pogonornis cincta
Prosthemadera novæ-zealandiæ
Anthornis melanura
Zosterops lateralis
Acanthisitta chloris
Orthonyx albicilla
Gerygone flaviventris
Petroica toi-toi
P. longipes
Anthus novæ-zealandiæ
Rhipidura flabellifera
Creadion carunculatus
Platycercus novæ-zealandiæ
P. auriceps
P. alpinus
Nestor meridionalis
Eudynamis taitensis
Chrysococcyx lucidus
Carpophaga novæ-zealandiæ
Apteryx mantelli
Hæmatopus unicolor
Larus dominicanus
L. scopulinus
Sterna frontalis
Puffinus gavius
P. assimilis
P. tristis
Procellaria cookii
P. parkinsoni
P. gouldi
Prion turtur
Haladroma urinatrix
Dysporus serrator
Phalacrocorax brevirostris
P. varius
Eudyptula minor.

The following are foreign birds which have migrated to Hauturu Island:—

Coturnix pectoralis
Turnix varius
Passer domesticus
Fringilla chloris
Turdus merula
T. musicus.

The Natives assured me that these last-named birds were not brought there.

The above list of 40 different specimens of New Zealand birds will show that the locality is more favourable than the mainland. There also exist several specimens which are nearly extinct, or very rare, on the mainland. I agree with Judge Fenton that bees are destructive to birds, from my personal observations—viz., to the honey-eaters (*Nectarinea*) and *Psittacidæ*, which breed in hollow trees. Honey-eaters are deprived of their food by the bees at a time when they most need it—when they have young—and, being insectivorous, they catch the bees and sometimes get stung and die. Furthermore, the bees occupy the breeding resorts of *Psittacidæ*. Settlers and Natives told me they found kaka eggs, and young parakeets, in the honey-comb of wild bees on the mainland.

On Hauturu Island there are no bees: the chief, Tenetahi, would not allow them to be landed, as he wished to protect the birds. There is one drawback—viz., wild pigs and cats, which are very destructive. The former root all the ground-birds out, and devour them; the latter watch night and day for their prey. But these two pests a good marksman with well-trained dogs could soon put a stop to. If the members of this Institute are in favour of obtaining Hauturu Island for preserving and protecting the Native birds, from my knowledge, and after many years studying the habits of New Zealand birds, I could not recommend a more favourable place. It would be of great benefit to science and agriculture to have such a means of preventing the extinction of these remarkable birds, which, as they multiplied, could easily be transferred to the mainland for the purpose of checking the insect pests; and if my aid in the project is of any use, I will be most happy to procure (gratis) live specimens of both sexes of *Apteryx* (kiwi) and *Stringops* (kakapo), if the Committee will provide me with cages and arrange for the transport, before or when I am again on the West Coast, about December next. The insectivorous birds and honey-eaters could be fed during transport on mashed potatoes, and common biscuits soaked in water, with sugar, and a few meal-worms or ant-eggs. As I expect to be away on another expedition, I have asked Professor Thomas if he would kindly read this paper for me; and if members wish to ask any questions in reference to these observations, I will be most happy to reply.

The above is written from my personal observations and facts.

Art. XXII.—*Notes on Ornithology.*

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 18th October*, 1886.]

Petroica toi-toi—Pie-tit (*Miro-miro*).

This beautiful little bird is a native of the North Island, but on the mainland is becoming scarce. I found a few pairs in the Tangahuia Ranges in 1879, in the Tokatea and Waitakerei Ranges in 1880, and in Pirongia, Rangitoto and Mokau Ranges in 1882. They are more plentiful, however, on certain islands in the Hauraki Gulf. When I visited Morotiri Island in 1880, and also Taranga Island in 1883, they were rather rare. On Hauturu Island, in October, 1880, I found this bird very common, but on my second trip in 1882 they seemed to have diminished.

The sexes differ considerably in plumage: the male bird has upper part black, a white spot on the top of the bill, a white bar across the wings; throat, breast, and abdomen white: the female, upper part greyish-brown, white spot on top of the bill, yellowish-white bar on the wings, and greyish-white on the throat, breast, and abdomen. The young birds are spotted. The pair build the nest together, of moss, spider-webs, and rotten wood, lining the inside with the down of seeds taken from the various flowers. The nest is always flattened in the fork of a tree. I never found it more than 8 or 10 feet above the ground, and in very thick scrub. The female lays in October from 3 to 4 eggs, and male and female breed and rear the young together twice a year. In the beginning of December the young birds are full-grown, and the parents leave them. On Hauturu Island, in 1880, I found a nest containing two white-brownish speckled eggs. About the end of December, 1882, I found a nest with 4 eggs, near our whare. In 14 days the young birds came out of the shells. Every morning and evening, while the female was sitting, the male came and serenaded her. The song consists of six notes, as "*ti, oly, oly, ho,*" which he always repeats twice. One male came several successive mornings near my whare, I threw him some bread crumbs, which he picked up; a week after he brought a female and three young ones, feeding them in front of the whare. After a time the male got so bold that he actually came to the door and called for food. They stayed about the whare till I left it. Through its boldness, I think, this bird is becoming scarce. They prefer clearings, where they hop about on low branches with the wings slightly drooped, the tail always erect, and uttering a sweet whistle of one note, as "*see*;" the male sometimes five notes. The female is of a most retiring disposition, and is not so often seen as the male. Their food consists of insects and larvæ. On the morning of the 10th December, 1883, (after a severe thunderstorm and rain in the night,) I went up the ranges, and in a very thick gully I heard a twitter; on approaching, I perceived a pair of *Petroica toi-toi* hopping about very excitedly; after watching them for a time, I went closer and looked into the nest, where I saw three eggs covered with water. On my taking away the nest, the birds did not show any anxiety for their loss. They are very useful in destroying insects, with which the New Zealand forests swarm. I often saw them carrying insects over an inch long to their nests.

PETROICA LONGIPES, *Less.*—Wood Robin (*Tototowai*).

This species is confined to the North Island, where it was formerly plentiful, but is now only to be found in a few localities, and is very rare, and will soon become extinct like so many other New Zealand birds. Dr. Buller told me that he could not get a pair even at a high price.

On the north-western slope of Hauturu Island, in October, 1880, I shot one female. In November, 1882, I went to the centre of the island, where I saw several pairs. It prefers secluded gullies, near creeks, and hops about on the ground or in low scrub. The male sings very early in the morning, and late in the evening. Only on one occasion have I observed this bird singing on the top of a high tree, which it did for a quarter of an hour. The song is very sweet and powerful, and, when undisturbed, the bird is very tame. When I was digging out various specimens of *Procellaria*, this robin always came round and picked up the worms and other insects from under my hoe. On one occasion, when I was sitting on a stump watching a long-tailed cuckoo devouring a large *weta*, with my gun across my knees, one of these robins came and perched on the barrel. Often when at lunch, one or a pair came and picked up the crumbs at my feet. If I threw a piece of biscuit or meat, it was taken away a short distance and eaten, and the recipient returned for more. At the commencement of the breeding season, which begins in October, the female lays from 3 to 4 eggs; each pair occupies a certain limit, and if interfered with by others, the weaker is obliged to retreat. Their food consists of insects and their larvæ. I never met this bird on my southern expeditions, and the only pair on the mainland were those I saw on the Tohua Ranges. Early in December, 1883, during my stay on Hauturu Island, the Natives found a nest with four young birds (*Petroica longipes*), but when I reached the spot the birds had flown. The nest, which had evidently but recently been disturbed, was built of moss, grass, etc., and in the niche of a tree. This bird reminds me very much, in its movements and habits, of the European robin (*Rubicula sylvestris*), and I felt it an act of vandalism to shoot some for specimens. They are very useful birds, and deserve every protection.

ANTHORNIS MELANURA.—Bell-bird (*Korimako*).

This bird is very common in the South Island of New Zealand, also on several small islands on the east coast. At Whangarei Heads, in the North Island, I saw one specimen which was blown in a gale from Morotiri Island, and was in such a state of exhaustion that it could hardly move, and died in a few moments. On skinning, I found it very thin, the crop being quite empty. I searched all the northern forests from the Mokau to the Bay of Islands, and across from one coast to the other, but never again observed it. I attribute its disappearance to cats, rats, bees, and bush-fires. The first time I saw this bird in the South Island was in the forests on Banks Peninsula, in 1877, and again in the same year on my trip to the west coast, where I found it common. In the North Island I could not discover it on the mainland, but on visiting Morotiri Island, April, 1880; Hauturu Island, October, 1880; and Taranga Island in November, 1880, I found them plentiful. In December, 1880, on my second visit to Morotiri Island, I found that the birds had materially decreased in number. On my second trip to Hauturu Island in October, 1882, at the centre of the island, I found the bird at home, morning and evening. I had a concert near my nikau whare, from 10 to 20 birds of both sexes sitting on the trees and singing in chorus together. The morning and evening song differs from that during the day, the morning and evening notes consisting of three distinct sounds resembling the chimes of bells, from which I suppose the bird derived its name. The song during the day is more of a warbling sound. One gives the signal to begin, with a snap of the bill, and all the birds join in the chime, keeping perfect time together until the leader, with another snap, gives the signal for a rest. After a few minutes rest, the chiming song is repeated.

In September, male and female begin to build the nest, of small branches and moss, lined with feathers, in thick branches of trees from 20 to 50 feet above the ground; and I have also found nests in hollow trees. In October the female lays from 4 to 5 white eggs with light-red spots, which they hatch together, and both parents feed the young brood. When leaving the nest, the male looks after his family till they are able to take care of themselves. At the approach of danger I have seen a male knocking a young bird from a branch when it would not listen to his call.

This bird is very bold and tame; it lives on insects, berries, and honey from trees and flowers, especially the flax blossoms (*Phormium tenax*), which in some places grows in great abundance, and has a quantity of honey in the calyx, into which the Bell-bird inserts his bushy tongue to suck out the honey. On the Little Barrier, on the 10th December, 1883, I found three nests under a bunch of tussock (a parasite growing on a tree), completely sheltered from wind and rain, 20 feet above the ground. In each nest there were 4 birds; I took one nest, to ascertain if the bird could be kept in confinement. After having them in my care for several days, during which I fed them on soaked biscuit mixed with honey, and cooked potatoes, they got on well; but, through the carelessness of my assistant, they escaped.

I made a stay at the West Coast Sounds in the South Island, in 1884, where the Bell-bird is not so common, the specimens which I procured in Dusky Sound being considerably larger, darker, and softer in plumage than those of the North Island. Male and female differ in size and plumage, the latter being smaller and duller. I feel sorry that these birds have also disappeared, in some localities, as they brighten the melancholy stillness of New Zealand forests by their powerful song, and are very useful in destroying numerous insects.

Art. XXIII.—*Ornithological Notes.*

By A. Reischek, F.L.S.

[*Read before the Auckland Institute, 20th September*, 1886.]

Creadion carunculatus.—Saddleback (*Tieke*).

This bird derives its popular name from a peculiarity in the distribution of its two strangely contrasted colours, uniform black, back and shoulders ferruginous, the shoulders of the wings forming a saddle. In structure it resembles the starling (*Sturnidæ*); it has also the wedge bill. In December, 1877, on my expedition in the South Island, I found this bird on the chain of high ranges along the left bank of the Teremakau River, but it was rather scarce. I have seen it frequently near Lake Brunner and on Greenstone Hill, also on Mount Alexander, and in April, 1879, on Mount Alcidus, Rakaia Fork.

During my researches in the North Island, in 1880, I found this bird on Hauturu Island, but rare, and again in October, 1882, when I went to the centre of the island, but it was still scarcer. On my visit to Taranga Island, in November, 1880, I was greatly pleased to find the saddleback in abundance; and on a later trip, in February, 1883, it was still more numerous. On my first trip, in 1880, to this island, I found a saddleback's nest about 10 feet from the ground in a manuka tree; this nest was made of moss, twigs, and fine grass, with one white brownish-spotted egg in it. In February, 1883, on exploring in a north-easterly direction, I heard a peculiar whistle, which differed from that of any other New Zealand bird. On going closer I perceived five birds, and, concealing myself, in order to watch them, to my surprise I saw male, female, and three young *Creadion carunculatus*. The female was feeding the young birds, which had just left the nest. I first shot the parents; the young, which had never moved from the branch, I gave to Dr. Buller, F.R.S., with a description, and he read a paper before the Philosophical Society, Wellington. After this, I procured several specimens of adult and young birds, which had the same plumage as the old birds, black and ferruginous, only a little duller; their wattles are either invisible or very small. I measured the wattles of adult males, and found them half-an-inch long, and of a deep orange colour; those of the female are smaller, and of a citron hue.

Strange to say, in the South Island I only saw this bird on the higher ranges, where it prefers steep thickly-wooded gullies, but on Taranga Island, in the North, I found them everywhere, both on the ranges and near the seashore, especially on the flax blossom, from which they suck the honey. I also observed it on the Great Barrier in June, 1882, and on Rangitoto Ranges in the King country in March, 1882.

The female lays from two to three eggs in November; male and female hatch and rear their young together. The saddleback is a very noisy bird. The whistle consists of three and four notes—the first three, like "*ri, zi, o*," he repeats twice, and then the four notes in succession, like "*te, te, te, te.*" In the breeding season, when the female is hatching, the male generally sits near her on a branch, singing. The notes are not so harsh as the former ones. If this bird observes anything unusual, he hops in a very excited manner, with the wings close to the body, head bent downward, and stopping and listening at intervals, through the trees to examine the object. When satisfied, he flutters to a distance, the flight being very feeble, as the wings are very short. They are very active in climbing, hopping from one branch to another, picking in decayed wood, or crevices in the bark, in a similar manner to the woodpecker, searching for insects and their larvæ, of which they destroy a number, thus being useful. They also feed on berries and honey. During all this time they keep up a continual whistling.

Curious to say, during five years' observation, in which I have procured a series of specimens of *Creadion carunculatus*, adult and young in all stages, I never noticed any difference in plumage; they were always black, with a ferruginous saddle.

This bird is very rare on the mainland in the North Island. On dissecting their crops, I found insects and minute seeds.

Creadion cinereus, *Buller*.—Saddleback (*Tieke*).

This bird is distinct from *Creadion carunculatus*; the body is smaller, the bill longer and thicker, the tail also is longer, and the plumage different. Its colour is a uniform olive-brown, the wings and tail darker, with a reddish tint on the upper and lower tail-coverts. The wattles are smaller, about a quarter of an inch long, and of light yellow colour. I first saw this bird in December 1877, at Greenstone Hill, near Lake Brunner, and subsequently in February, 1878, at Mount Alexandra.

I have observed them in pairs, along with the yellow-head (*Orthonyx ochrocephala*), and with *Creadion carunculatus*, also the brown creeper (*Certhiparus novæ-zealandiæ*), hopping about from branch to branch in search of food. I shot a series of specimens of *Creadion cinereus*, and on skinning them I found the reproductive organs of both sexes well-developed. On my return to Christchurch, when speaking of this variety or species, I was told that this is the young of *Creadion carunculatus*. When I pointed out the difference in size and plumage, I was informed that the plumage would become the same, in the third year, as that of *Creadion carunculatus*—*i.e.*, a uniform black, with back and shoulders ferruginous. Being at this time a new arrival in the colony, I did not contradict my informant; I corresponded with Dr. Buller, who agreed with me that *Creadion cinereus* is a distinct species from *C. carunculatus*. But determined to find out the truth, I followed up the subject until February 7th, 1883, and on my trip to Taranga Island my efforts were crowned with success, for I observed the first pair feed their young, which I gave to Dr. Buller to enable him to bring forward his lost species, on which he read a paper to the Wellington Philosophical Society. After that, I procured a few more specimens of *Creadion carunculatus*, feeding their young, which were just out of the nest, the plumage being exactly like that of the parents, only a little duller, uniform black and ferruginous on the back and shoulders; the wattles are either invisible or very small. I have observed a series of *Creadion carunculatus* in all stages, and never saw any difference in their plumage.

Through all the northern forests, I have never met with *Creadion cinereus*. In 1884, during my researches on the West Coast Sounds, I saw *Creadion cinereus* up the ranges, in low scrub, male and female together in pairs. I shot one pair in Dusky Sound, in June 1884, a second pair in August of the same year, and a third pair in Milford Sound in October 1884. I never observed in any of the *Creadion cinereus* which I shot at different seasons the slightest difference in plumage. Their food consists of insects, their larvæ, and small berries, which I have found in their crops when dissecting. I only found this bird in the South Island, and even there they are scarce near settled districts. I have met them frequently on the West Coast in uninhabited places. The whistle of *Creadion cinereus* consists first of three notes, "*te, a, r*," which he repeats several times, then four, like "*te, te, te, te*." Their movements are quick in hopping and climbing, but feeble in flying; they prefer thickly-wooded and steep gullies.

Glaucopis wilsoni, *Gray*.—Crow (*Kokako*).

This remarkable bird, the natives told me, was once common on all the ranges of the North Island forests, but now it only frequents the higher ranges, away from habitations, where it appears at the end of April and stays till September. It is confined to the North Island. Early in the morning, and in the evening, the traveller will hear some very sweet notes, like a flute. The call of the male and female is alike, consisting of two notes, like "*rio*," but the song of the male bird is different, and composed of five pleasing notes, like "*rio*, *ku*, *ku*, *ku*," which sound near, though the bird is generally a considerable distance off. They are very tame, but when they are much disturbed it is very difficult to detect them without a dog. When approached, they hide in the thick crowns of trees, peeping through the branches at intervals to see if the intruder has disappeared, in which case they begin to whistle. Should the bird be disturbed a second time, it hops away with marvellous swiftness through the branches, from one tree to another, so that it requires a very quick shot to procure it. The birds always go in pairs, male and female together; and if the call be imitated, they come hopping along, often so near that I could almost touch them. In October, they retreat to very thickly-wooded gullies, between the highest ranges, where they breed, and are seldom seen. The plumage is slate-colour, with a brownish tinge on the wings, back, and tail, a small black bar on top of the head, near the root of the bill; wattles blue in the adult, pink, and smaller, in the young bird. My belief is that they breed twice a year, and have two or three young at a time. Early in April, 1880, on the Tokatea Ranges, near Castlehill, I found in a tussock on a tree a nest with three young half-fledged birds, one of which I secured; the others escaped. The nest was built very carelessly of dry branches, ferns, and moss, and about 30 feet from the ground. In February, 1882, I shot two full-grown young birds in the Pirongia Ranges. I also observed this bird in September, 1879, in the Tangahuia Ranges; in 1880, in Maungataroto; near Ngunguru in 1882, and on the Great Barrier and Waitakerei Ranges. It is strange I never met with this bird on any of the islands off the east coast except the Great Barrier, where most of the New Zealand birds are more plentiful than on the mainland. This bird feeds on berries and the young leaves of various plants, which I have found in their crops. It uses its wings, which are short and small for its size, very seldom, and only to flutter down, but is very active and quick in climbing. In December, 1885, I observed three young birds sitting outside a nest, which was in the crown of a very thick miro, in the Waitakerei Ranges. They disappeared into the nest when I approached, and in a few days went away with their parents. In the pairing season, when not disturbed, the male makes various evolutions by drooping and spreading the wings, erecting the tail, with bent down head and outstretched neck, in a similar way to the capercailzie (*Tetrao urogallus*), and whistles to the female, who sits still and seems to admire her companion's movements.

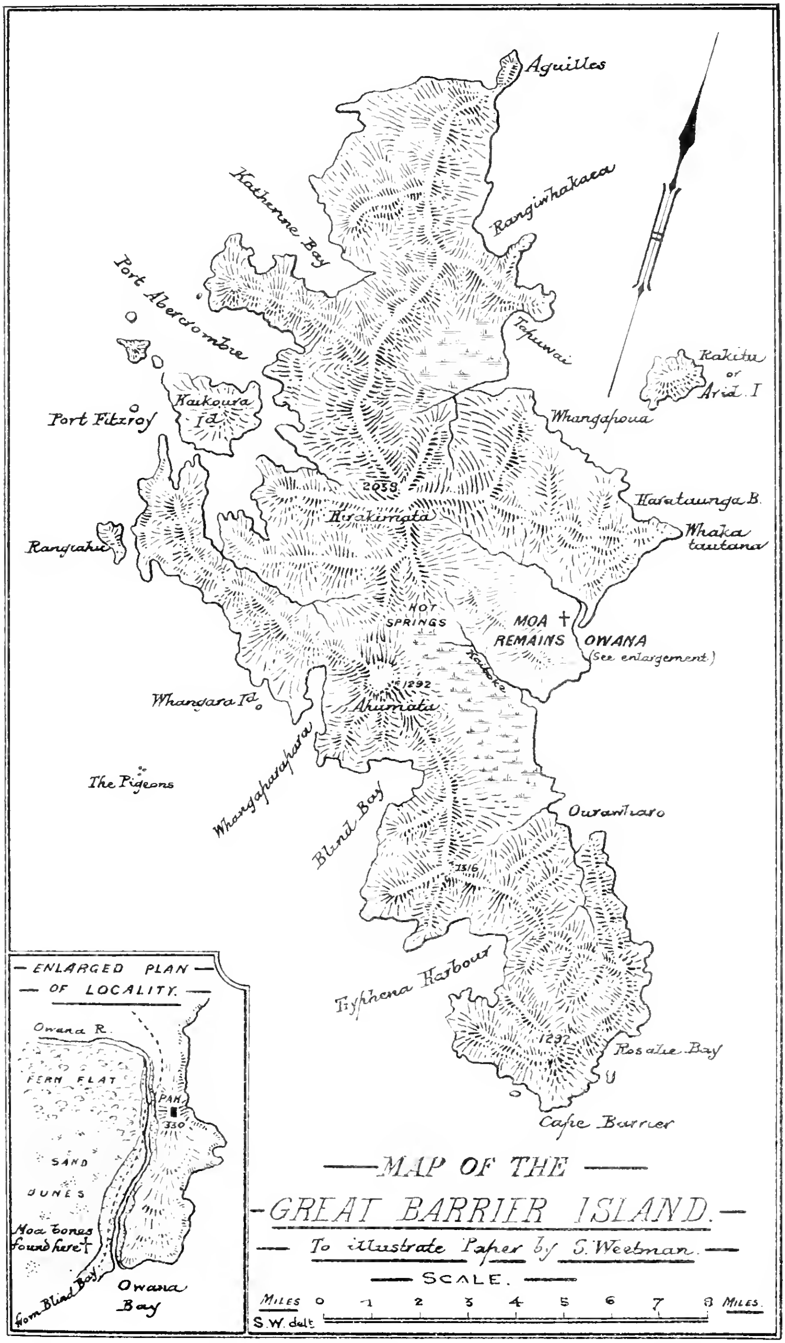
Their limits are growing narrower, owing to ravages of bush-fires and of cats and rats.

Orthonyx albicilla.—White-head (*Popokatea*).

This bird is found in the North Island, in both the lower and higher ranges. The first pair I saw was on the Tokatea Ranges near Castlehill, in April, 1880; the second on Hauturu Island, where they are plentiful, in October, 1880. I shot a pair on the Pirongia Ranges in February, 1882, and about the end of April I saw another pair at the Mokau. I never saw this bird on the mainland north of Auckland. Mr. T. Cheeseman, F.L.S., told me that eight or ten years ago these birds were quite common about Auckland, but they have now completely disappeared. Strange to say, on my second trip to Hauturu Island, in 1883, I was agreeably surprised to find that since my visits in 1880 and 1882 the white-head had increased in numbers. Its movements are similar to those of the European cole titmouse (*Parus major*), hopping and climbing about, and sometimes hanging by the feet under the branch of a tree, picking into the bark for insects and small seeds. It is a lively inquisitive little bird, any noise in the bush attracts a flock of them, which come near with a shrill whistle, stopping a little while to see what it is, and then flying away again. It prefers certain localities, and there are always several pairs together. In December, 1882, I noticed that the same pairs came in the morning and evening near one of my whares, and they were so tame that I could observe them feeding their young from the door. The male and female build the nest (which is very neat) together, out of twigs, moss, and grass, and line it with feathers, from 8 to 16 feet above the ground, in very thick trees, manuka. At the end of October the female lays four eggs, of a pinkish colour, with light-brown spots. I have also found this bird's eggs in December, so they must breed twice a year. This they do together.

One evening, at the Little Barrier, hearing a noise, I cautiously approached, and from my concealment saw a more-pork following a white-head, near a nest. The male immediately tried to divert and allure it away, which he succeeded in doing by hopping further and further, calling the whole time, and on being pursued darted into the thickest scrub, where it was impossible for his larger enemy to follow. I then lost sight of him, but, on going back, to my surprise I found he had already returned, and was hopping round the nest, on which the female was sitting on eggs, which I forwarded to Dr. Buller.

I found a few specimens of the white-head in the Rimutaka Ranges, near Wellington, in October, 1884. There are also some


Aguilles
Katherine Bay
Rangiwhakaea
Port Abercrombie
Tapuwai
Rakitu or Arid. I
Kaikoura Id
Port Fitzroy
Whangapoua
2038
Harataunga B.
Hirakimata
Whaka tautana
Rangiahue
HOT SPRINGS
MOA REMAINS
OWANA
(See enlargement.)
1292
Whangara Id.
Ahumata
The Pigeons
Whangaparapara
Blind Bay
Ouranharo
1316
Tryphena Harbour
1292
Rosalie Bay
Cape Barrier
ENLARGED PLAN
OF LOCALITY.
Owana R.
FERN FLAT
PAH
330
SAND
DUNES
Moa bones found here
from Blind Bay
Owana Bay
MAP OF THE
GREAT BARRIER ISLAND.
To illustrate Paper by S. Weetman.
SCALE.
MILES 0 1 2 3 4 5 6 7 8 MILES.
S.W. delt.

on the Great Barrier Island, but none on the Hen and Chickens, or any other nearer islands. The females and young birds are duller in plumage than the adult males: Head, breast, and abdomen white, with a very slight brownish tinge; wings, back, and tail light-brown. Their call consists, first, of three notes, like "*riu, riu, riu,*" then four, like "*zir, zir, zir, zir.*" They are useful, as they destroy a number of insects, which I have found in their crops, with minute seeds. This bird resembles in structure, habits, and call, the *Parus major*. In my opinion a more suitable name for it would be the "New Zealand Titmouse."

ART. XXIV.—*Notes on some Moa Remains found at the Great Barrier Island during February*, 1886.

BY SIDNEY WEETMAN.

[*Read before the Auckland Institute*, 18*th October*, 1886.]

Plate XXII.

BEFORE going to the Barrier, in August, 1885, I was told by Mr. G. A. Martin, of the Survey Department, that, when at the island in 1881, he had found some Moa bones close to the Owana River, and not far from the beach. So when we were camped near there at the beginning of the present year, I asked my party, who were in the habit of walking on the beach on Sundays, to look out for Moa bones, which they kindly did, Sunday after Sunday, but without success, until shortly before we left, when Mr. George Malcolm, who had been with Mr. Martin, succeeded in finding some bones, supposed to be those of the Moa. These I brought to town, and submitted to Mr. Cheeseman, who pronounced them to be Moa and Seal bones, which was so far satisfactory, as establishing the fact that Moa bones had for the first time—as I learn from Mr. Cheeseman—been found off the mainland.

These bones comprise—

1 *Femur*,
2 *Tibiæ*,
1 *Metatarsus*.
A portion of a rib;

and belonged, I am informed by Mr. Cheeseman, to one of the smaller species; the leg bones measuring in all about 22 inches, so that the bird must have been about 4 feet in height.

They were found near the surface of the drift sand, about 30 yards distant inland from and 20 feet above high water-mark, spring tides, and almost directly opposite to the mouth of the Owana River, as shown on the plan (Plate XXII.), from which it will be seen that the river, when within eight chains of the coast, turns almost at right angles and runs parallel with the coast for about 40 chains before joining the sea. On this narrow strip of land, which rises to a height of 330 feet above the sea, a most picturesque, and what must have been an almost impregnable, *pa* stands, having a perpendicular rock face towards the sea, and a very steep slope inland towards the river. From this fact, and the one that the only dry flat on the island is there, it is reasonable to suppose that it was a favourite camping-ground of the Natives, and that much feasting must at times have been indulged in. Therefore, I think we may conclude that these bones, associated as they were with those of the Seal, formed, with them, in all probability, the remains of a repast.

The most interesting question to decide is whether the bird was found on the island, or taken there, and it is one upon which I cannot venture to express an opinion; but, from the very precipitous, broken, and rocky nature of the island, coupled with the fact that it must, at the time of the Moa, have been almost entirely covered with dense forest, I am inclined to think that if it existed there at all, the Moa would have considerable difficulty in travelling, and would be compelled to come down on to the beaches for a "constitutional," where it would easily be captured by a Moa-hunter.

In conclusion, I may mention that Mr. Malcolm, who found these bones, is of opinion that they are not as large as those found by Mr. Martin's party. If this is so, it is obvious that more than one Moa was eaten there; and should remains be found at different parts of the island, there will be some foundation for the belief that the bird existed there.

Art. XXV.—*On a New Species of* Alpheus.

By T. W. Kirk.

[*Read before the Wellington Philosophical Society, 18th February, 1887.*]

Plate VId.

Alpheus halesii.

Carapace smooth, long, somewhat compressed, one and a half times as long as broad, the portions over the eyes very prominently arched; rostrum small, extending back beyond the base of the eye arch; total length one-fourth that of carapace.

Internal antennæ, second joint twice the length of the first; the basal scale terminates in an acute point.

External antennæ, basal scale stout, larger than the peduncle, very thick on outer edge, curved outwards, terminating in sharp point.

Large hand, sometimes right, sometimes left; three-fourths the length of the animal (from tip of rostrum to end of telson); quadrate, superior inner angle keeled, with a line of hairs on the anterior two-thirds of the length; outer angle also keeled, but not so prominently, no hairs. A very pronounced keel runs down the centre of the back (outer face) of hand, terminating in a swelling at the insertion of the mobile finger. Inferior outer angle keeled but hairless, keel does not reach to the base of the immobile finger. Inferior inner angle not keeled, but with a row of stout hairs running the whole length, and continued on to the immobile finger, a line of minute tubercles at the base of these hairs.

Immobile finger stout, with strong and curved claw, rather swollen in the middle, with five or six bristles at equal distances along the outer margin, but inside the line of hairs mentioned as running along the inferior margin of hand. On the inner margin of this finger, and about the centre, is a deep oval pit, on the posterior margin of which is a bunch of stout hairs. A pair of stout hairs placed just at the curve of the claw.

Mobile finger stout, compressed, with a large oval tubercle corresponding with and fitting into the pit on the immobile finger; upper edge sharp, a line of hairs along the margin; closes well within the curved hook of the other finger.

Wrist short, swollen, anterior edge sharp but not toothed; a short stout spine, directed backwards, at the inner and outer posterior margins.

Arm triangular; superior angle with a stout spine directed forwards, situate one-fourth of the distance from the anterior margin, with a few stout hairs in front and behind. Internal margin terminates anteriorly in a spine, with a tubercle close above its base; four stout spines placed at equal distances along the margin behind, the spines being flanked by a line of hairs; external margin sharp and very finely serrated along the entire length.

Smaller hand, fingers long, curved, hairy, meeting at the tips, but not touching at any other part of their margins. Wrist of second pair of legs with first joint longest. Terminal joint of other legs flattened for swimming and shaped like a spear-head.

Size of largest Specimen.

	Inches.
From tip of rostrum to end of telson ...	$1\frac{7}{20}$
Length of carapace	$\frac{9}{20}$
Greatest width of carapace	$\frac{5}{20}$
Length of largest hand (inclusive of fingers)	1·0
Width ,, ,, ...	$\frac{5}{20}$
Thickness ,, ...	$\frac{3}{20}$
Length of immobile finger	$\frac{4}{20}$
,, mobile ,, ...	$\frac{3}{20}$

Locality: East Coast of Wellington Province.

This species approaches *A. rubrum*, from Europe. It is named in honour of Mr. Hales, on the coast of whose sheep-run it was obtained.

DESCRIPTION OF PLATE VId.

Fig. 1. Animal, showing inside of large hand.
Fig. 2. Back of large hand, showing keel, etc.

Art. XXVI.—*Notes on some* Foraminifera, *from the Hauraki Gulf.*

By Dr. Rudolph Haeusler.

[*Read before the Auckland Institute, 21st February,* 1887.]

During my first visit to Auckland, I took the opportunity of collecting and examining large quantities of sand and mud along the shores of the Hauraki Gulf, which proved to be very rich in *Foraminifera* and other minute organisms. The material was taken at low water in creeks and pools, and on the sandy beaches, and washed in the ordinary simple way, by which a fairly pure residuum of *Foraminifera, Diatoms, Crustaceans, Polyzoa*, etc., was obtained.

After my return from the King Country, I hope to be able to devote some time to the study of the *Rhizopoda*, and to give a detailed description of the numerous varieties, with illustrations of the principal types, a list of synonyms, and tables of geological and geographical distribution. In this short paper, I merely intend to give a general idea of the rhizopodal fauna from the littoral zone, and a list of species or types. The slides containing the enumerated forms will be left at the Auckland Museum.

The general appearance of these washings remains very uniform. The characteristic features are the extraordinary abundance of the porcellaneous and some of the higher vitreous types, the scarcity of arenaceous and the lower vitreous forms. The *Miliolida* form over 90 per cent. of the whole fauna, as in various other shore-gatherings from the northern seas. The only new varieties belong, as far as I can judge, to this extensive group, but it is not unlikely that other forms new to science will be found after further researches, especially in the shallow creeks facing the open sea. With the exception of these varieties, all the species found near Auckland occur in the same cathymetrical zone of almost every latitude, and in many tertiary and even older formations of Europe. The specimens are, as a rule, of good size, and even the most delicate tests remarkably well preserved. They can easily be picked out with an ordinary pocket-lens, and examined with a 1-inch objective.

In the porcellaneous group, the genus *Miliolina* is best represented, while the allied genera, *Nubecularia*, *Biloculina*, and *Spiroloculina* occur only in isolated individuals. Ribbed and otherwise ornamented species are exceedingly rare. The *Miliolines* are very variable, and run so gradually into each other that no distinct lines of demarcation can be drawn. Monstrous specimens are frequent, and difficult to determine.

The second large group is almost entirely absent. It is evidently in deeper water that we must look for arenaceous forms of the families *Astrorhizidæ*, *Lituolidæ* and *Textularidæ*. The most interesting species from these shores is *Thurammina papillata*, of which one of the slides contains two small spherical specimens.

The *Lagenidæ*, belonging to the third group (*Hyalinea*), are also exceedingly rare. The most beautiful, delicately ornamented, *Lagena squamosa* is the most abundant. The higher rotaline forms are well represented, and belong to geographically widely diffused types.

1. Gen. NUBECULARIA.

No good specimen, but small fragments of a variety of *N. lucifuga*, Defr.

2. Gen. BILOCULINA.

Rare specimens of *B. ringens*, Lam.

3. Gen. MILIOLINA.

With the typical forms, numerous abnormally developed shells were obtained, which can be considered as intermediate forms between the quinqualoculine and triloculine *Miliolinæ* and the symmetrical *Biloculinæ* and *Spiroloculinæ*, and the different dimorphous groups.

It is an easy task to construct long series which show almost every conceivable deviation with regard to general form, arrangement and relative size of chambers, shape and position of the aperture, and colour, which prove clearly how little value we have to attribute to morphological characters, which are often considered of greatest importance for the systematical arrangement of species, and even whole genera. Some specimens are almost symmetrical, others show different modes of growth at different ages. Frequently the final chamber does not follow the general plan of growth. A careful comparison of numerous specimens is necessary to ascertain the relationship between the widely different modifications of the simplest types.

Innumerable mutations of the following species are met with:—*Miliolina circularis*, Born.; *M. seminulum*, Lin.; *M. oblonga*, Mont.; *M. labiosa*, D'Orb.; *M. secans*, D'Orb.; *M. bicornis*, W. and T.; *M. linnæana*, D'Orb. To which we can add, as distinct varieties:—*M. aucklandica* and *M. polymorpha*.

4. Gen. Spiroloculina.

Small specimens, occupying an intermediate place between *Miliolina* (*Quinqueloculina*) and *Spiroloculina*.

5. Gen. Rhabdammina.

Fragments of monothalamous arenaceous tubes, belonging, probably, to a large species of the *Astrorhizidæ* group (var. of *Rh. abyssorum?*).

6. Gen. Reophax.

Irregular, dentaline modifications of *R. scorpiurus*, Mont., with dark grey, calcareous cement.

7. Gen. Haplophragmium.

Small, finely arenaceous, colourless, and ochreous forms of *H. canariense*, D'Orb., and *H. globigeriniforme*, P. and T., similar to those found in the North Atlantic and in some mesozoic strata (zone of *Ammonites transversarius*, etc.).

8. Gen. Thurammina.

Delicate, spherical tests of *Th. papillata*, Brady, with short papillæ distributed regularly all over the surface, resembling the passage forms of *Th. albicans* and *Th. papillata* from the upper jurassic strata.

9. Gen. Valvulina.

Finely arenaceous, much compressed specimens of *V. conica*, P. and T., almost isomorphous with *Trochammina squamata*.

10. Gen. Bolivina.

Very rare, delicate, glassy modifications of *B. punctata*, D'Orb.

11. Gen. Lagena.

Four species of the groups *Lævigatæ* and *Reticulatæ*. The absence of the cosmopolitan *L. globosa*, *L. lævis*, *L. marginata*, and *L. sulcata*, so common in British littoral deposits, is a curious fact.

12. Gen. Globigerina.

Small ash-grey specimens of *G. bulloides*, D'Orb.

13. Gen. Patellina.

Two young shells of *P. corrugata*, Will.

14. Gen. DISCORBINA.

This group is well represented along the whole coast, and numerous fine specimens were obtained, the largest near the pier of North Shore. When the surface is much worn, or the aperture filled up or damaged, it is difficult to distinguish them from the other rotaline forms with which they are always associated. The following species were recognized:—*D. rosacea*, D'Orb.; *D. turbo*, D'Orb.; *D. globularis*, D'Orb.; *D. valvulata*, D'Orb.; *D. orbicularis*, Terq.

15. Gen. TRUNCATULINA.

A few doubtful specimens, probably of *T. lobatula*, were found at Cheltenham Beach.

16. Gen. CARPENTERIA ?

A single fragment from the same locality appears to belong to this curious group.

17. PULVINULINA.

Fine large specimens of *Pulv. repanda*, F. and M., are frequently met with; also, *P. elegans*, D'Orb.

18. Gen. ROTALIA.

Two distinct varieties, of very different size, of the common *R. beccarii.*

19. NONIONINA.

Numerous beautiful tests of at least three species are found everywhere—*N. depressula*, W. and T.; *N. scapha*, F. and M.; *N. asterisans*, F. and M. ?

20. Gen. POLYSTOMELLA.

Several varieties of these beautifully-marked forms were obtained. They belong to *P. striatopunctata*, F. and M.; *P. crispa*, Lin.; *P. macella*, F. and M.

LIST OF SPECIES.

1. *Nubecularia lucifuga*, Defr., v.r.
2. *Biloculina ringens*, Lam., v.r.
3. *Miliolina circularis*, Born., r.
4. *M. seminulum*, Lin., v.c.
5. *M. oblonga*, Mont., v.c.
6. *M. labiosa*, D'Orb, c.r.
7. *M. secans*, D'Orb., c.r.

8. *M. bicornis*, W. and T., v.r.
9. *M. linnæana*, D'Orb., r.
10. *M. aucklandica*, sp. nov.
11. *M. polymorpha*, sp. nov.
12. *Spiroloculina*, sp. ind.
13. *Rhabdammina abyssorum*, Sass.
14. *Reophax scorpiurus*, Mont.
15. *Haplophragmium canariense*, D'Orb.
16. *H. globigeriniforme*, P. and T.
17. *Thurammina papillata*, Brady.
18. *Valvulina conica*, P. and T.
19. *Bolivina punctata*, D'Orb.
20. *Lagena apiculata*, Reuss.
21. *L. squamosa*, Mont.
22. *L. hexagona*, Will.
23. *L. striatopunctata*, P. and T. ?
24. *Globigerina bulloides*, D'Orb.
25. *Patellina corrugata*, Will.
26. *Discorbina rosacea*, D'Orb.
27. *D. turbo*, D'Orb. (?)
28. *D. globularis*, D'Orb.
29. *D. valvulata*, D'Orb.
30. *D. orbicularis*, Terq.
31. *Truncatulina lobatula*, W. and T.
32. *Carpenteria* (?)
33. *Pulvinulina repanda*, F. and M.
34. *P. elegans*, D'Orb.
35. *Rotalia beccarii*, Lin.
36. *Nonionina depressula*, W. and T.
37. *N. scapha*, F. and M.
38. *N. asterisans*, W. and T.
39. *Polystomella striatopunctata*, F. and M.
40. *P. crispa*, Lin.
41. *P. macella*, F. and M.

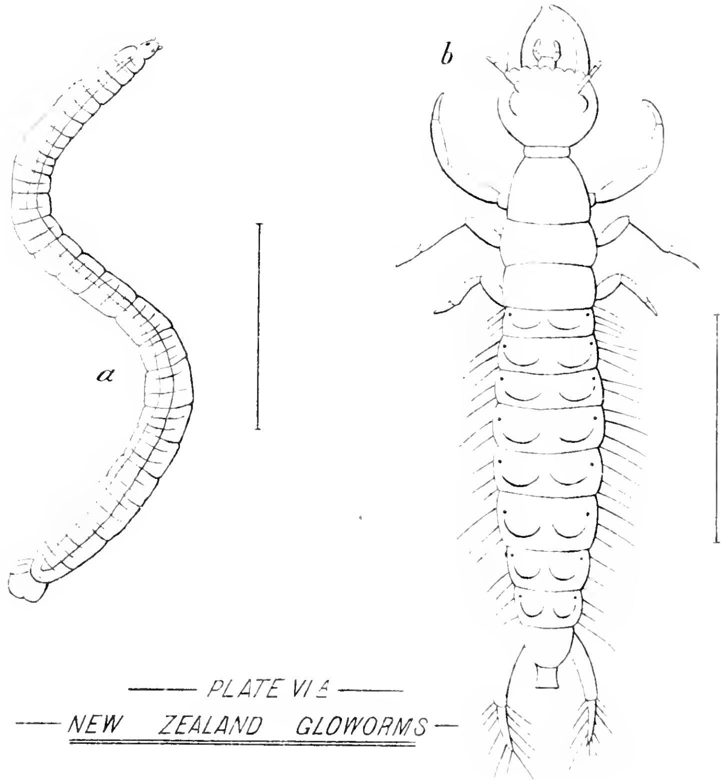
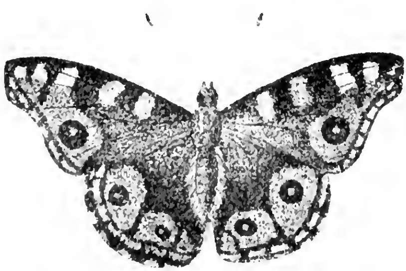
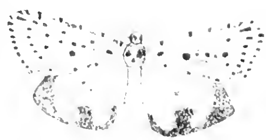


PLATE VI A

NEW ZEALAND GLOWORMS

PLATE VI C





DEOPEIA PULCHELLA.

JUNONIA VELLIDA.

G.V.H. delt

ART. XXVII.—*On the Occurrence of* Junonia vellida *and* Deopeia pulchella *in New Zealand.*

By G. V. HUDSON.

[*Read before the Wellington Philosophical Society, 18th February*, 1887.]

Plate VIc.

DURING the present summer a new butterfly has appeared in the Wellington District, which I have every reason to believe has not previously been met with in New Zealand. On December 26th, while collecting on the sea-beach near Paremata, I noticed a large butterfly, which I at first thought was *Vanessa cardui*, but on capturing the insect was surprised to find it quite distinct. By careful searching I procured four more specimens, one of which I forwarded to Mr. Olliff, of Sydney, for identification, who has kindly informed me that it is *Junonia vellida*, a very common Australian insect. Since that time I have taken two more specimens at Wainuiomata, and the insect is very abundant at Paikakariki, where I saw a great number last week, but was unable to take any owing to their great timidity, and the rough nature of the ground.

I think there can be little doubt that this insect is a true native of New Zealand, which has been previously overlooked, as it is quite impossible that so many specimens could have been accidentally introduced by artificial means.

I have also to announce the capture of *Deopeia pulchella* at Wainuiomata, another welcome addition to our fauna. It is a very wide-spread species, but this is, I think, the first specimen which has been taken in New Zealand.

The beautiful Painted Lady butterfly (*Vanessa cardui*), has also been more abundant this year than I have known it since my arrival in 1881.

ART. XXVIII.—*Descriptions of New Spiders.*

By P. GOYEN.

[*Read before the Otago Institute, 17th November*, 1886.]

Fam. LYCOSIDÆ.

Genus **Lycosa**, Latr.

Lycosa virgata, sp. n.

Mas.—Length, 8 mm. The sexes do not differ greatly in size.

Cephalothorax brown, with a brownish-yellow stripe extending on each side from the posterior margin to the middle row of eyes, and a median line of the same hue extending from the base of the posterior slope to the hindmost row of eyes, behind which it is widest. On each lateral slope there are a few dark-brown triangular flecks. Falces and sternum pale-brown; legs, palpi, and spinners brownish-yellow, flecked with brown; abdomen dark-brown above, with a narrow median band of pale-yellow extending from the base to a point about a third of the length of the abdomen from the spinners, and on each side of this band runs, from the base to the spinners, a line of rather indistinct dark flecks. The colouration and markings are similar in the female, but of a lighter shade.

Cephalothorax about 1 mm. longer than broad at its broadest part, somewhat longer than the patella and tibia of a leg of the fourth pair, about twice as broad at the third pair of legs as at the caput, rounded at the sides; posterior slope very and lateral slope moderately steep, not convex above; ocular area very hairy, and slightly sloping forward from the posterior to the central pair of eyes.

Front row of *eyes* curved backwards and shorter than the middle row, which is shorter than the posterior row; eyes of anterior row very small, and about equally distant from one another; those of the posterior row smaller than those of the middle row.

Falces slightly convex near the base, only slightly diverging towards the extremities, groove toothed on each side: on the under-side 3 teeth, 2 large and 1 small, and on the upper side 1 large tooth, with a very minute one on each side of it; claw short and slender.

Maxillæ slightly inclined to the lip, small at the base and gradually becoming larger towards the extremities; rounded in front on the outer side, and having a dense fringe of fine hair on the inner side.

Lip only slightly convex, more than half as long as the maxillæ; constricted at the base, broadest near the middle, and slightly rounded in front.

Sternum ovate-cordate, with a median groove extending from the anterior to the posterior margin.

Abdomen ovate, about as long as and slightly narrower than the cephalothorax, densely hairy; spinners somewhat divergent, inferior pair longer and stouter than the superior pair; anus prominent.

Legs 4, 1, 2, 3; no spines on the tarsi, nor on the under-side of the femora and patellæ. The patellæ of the first and second pairs are without spines, but those of the third and fourth pairs have one or two slender spines on the superior surface. The femora of all the legs are spinous above, and the tibiæ and metatarsi above and below.

Palpi armed with spines above only; humeral joint thickest at the fore extremity, bent outwards and laterally compressed;

cubital joint somewhat longer than the radial, but not so strong; digital joint beak-like; bulbus genitalis brown, situated in a hollow at the base of the digital joint, globular, deeply cleft at the anterior surface; from the inner lobe spring two corneous processes, the one nearest the middle of the bulbus being long, bent outwards at right angles near its middle part, and having its exposed surface somewhat plane and its end divided; the other short, conical, straight, and directed downwards and slightly towards the centre of the bulbus; bulbus marked transversely by a sinuous shallow groove with brown margins. The vulva of the female consists of two semicircular orifices separated by a high narrow septum; posterior margin highest opposite the septum.

Hab. Otago: very common in open country. *P.G.*

Lycosa canescens, n. sp.

Mas.—Length, 7 mm. The sexes do not differ greatly in size.

Cephalothorax of a brown ground-colour, densely covered with a yellowish-grey pubescence; falces, sternum, lip, and maxillæ brown (the two latter of a paler hue than the two former); legs and palpi brownish-yellow, flecked and annulated with brown; abdomen of the same ground-colour, and furnished with the same kind of pubescence as the cephalothorax, having on its dorsal surface a narrow medial band of whitish hair extending from the base to the middle, and from this point on each side and at the same distance from the centre a line of pale coloured spots; spinners brownish-yellow. The colour and pubescence of the female resemble those of the male, but the abdominal markings are either very indistinct or wholly absent.

Cephalothorax about 1 mm. longer than broad at its broadest part, about as long as the patella + tibia of a leg of the 4th pair, nearly three times as broad at the 3rd pair of legs as at anterior angle of the caput, rounded at the sides, posterior and lateral slope moderately steep, not convex above, and slightly sloping forwards from the posterior to the central pair of eyes.

Anterior row of *eyes* curved backwards, only very slightly shorter than the middle row, which is shorter than the posterior row; eyes of anterior row small, not differing greatly in size, centrals nearer to the laterals than to each other; eyes of middle and posterior rows large, and not differing greatly in size.

Falces slightly convex, and slightly diverging towards the extremities; groove-toothed on each side; on the under side 3 teeth, and on the upper side 2 teeth; claw short, and very strong at the base.

Maxillæ slightly convex, smaller at the base than at the fore extremities, rounded on the outside and in front, where on the inner side there is a very dense fringe. *Lip* convex, about half as long as the maxillæ, widest near the middle, the fore extremity slightly rounded in the female, and almost truncate in the male.

Sternum ovate-cordate, glossy, and slightly convex.

Abdomen ovate, of the male about as long as but slightly narrower than the cephalothorax, of the female longer than the cephalothorax and about as broad. Spinners prominent, inferior pair longer and stouter than the superior pair.

Legs 4, 1, 2, 3; all the joints armed with spines except the tarsi, and the patellæ and femora have no spines on their inferior surface.

Palpi furnished with spines on the superior surface only; humeral joint thickest at the fore extremity, bent outwards and laterally compressed; cubital and radial joints not differing greatly in length and strength; digital joint beak-like; bulbus genitalis brown, situated in a hollow at the base of the digital joint, resembling that of *L. virgata*, except that the shorter spine is much less distinct, and directed towards the base of the larger one.

Vulva of female not so long as, and more rounded posteriorly than that of *L. virgata*; and the exterior orifice is only partially divided by a deep lobe extending from the centre of the anterior margin half-way across it.

Hab. Otago. *P.G.*

I have never found this spider anywhere but in river-beds, and from the density of its pubescence I think it highly probable, though I have never seen it in water, that it seeks its prey in water as well as on land.

Lycosa taylori, n. sp.

Mas.—Length, 11 mm.

Cephalothorax brown, with a brownish-yellow central area of highly irregular and ornamental outline, and a longitudinal band of the same hue on each side; the tibial, metatarsal, and tarsal joints of the legs brown, the other joints brownish-yellow flecked with brown; digital joint of palpi brown, the other joints of the same hue as the femoral and patellar joints of the legs; falces reddish-brown; lip brown; maxillæ brown at the base, and passing into brownish-yellow towards the extremities; sternum dark brown, with a medial longitudinal band of brownish-yellow which dilates towards the posterior extremity, where it covers the whole surface; abdomen, above dark brown mottled with black and yellow, below brown-yellow, sparingly flecked with black: at the base of the dorsal surface there is a large T-shaped yellow fleck, and towards the spinners on each side a large oval fleck of the same hue; spinners brownish-yellow.

Cephalothorax 1 mm. longer than broad at its broadest part, about as long as the patellar + the tibial joint of a leg of the

4th pair, moderately constricted at the caput; posterior and lateral slopes moderately steep, not convex above, rounded at the sides, fovea very distinct.

Front row of *eyes* somewhat bent backwards, very small, centrals larger than the laterals and nearer to those than to each other; eyes of middle row distinctly larger than those of the hinder row, and distant from the laterals of the front row by about the diameter of a fore-central eye: the hind row is the longest, and the middle somewhat longer than the front row.

Falces convex, and slightly diverging towards the extremities; groove toothed, 2 teeth, one much larger than the other, on the upper side; and 3, 1 small and 2 large, on the lower; claw moderately long, and strong at the base.

Maxillæ convex, smallest at the base and gradually increasing in breadth towards the extremities, rounded on the outside and truncated on the inside in front, where there is a dense fringe, and somewhat inclined to the lip.

Lip half as long as the maxillæ, convex, narrowest at the base and broadest towards the middle, very slightly rounded in front, and having immediately behind its fore-margin two distinct dents.

Sternum cordate, and somewhat convex.

Abdomen oblong-ovate, slightly narrower and about 1 mm. longer than the cephalothorax; spinners not prominent, superior and inferior pairs not differing greatly in length.

Legs 4, 1, 2, 3 (1 and 2 almost equal); all the joints of 3 and 4, except the tarsi, armed with spines, and also all those of 1 and 2, except the tarsal and patellar joints; but only the tibiæ and metatarsi have spines on the inferior surface.

Humeral joint of *palpi* bent outwards, laterally compressed, stouter at the extremities than elsewhere, and armed with numerous spines on the superior surface; cubital joint longer than but not so strong as the radial; digital joint beak-like, about as long as radial + cubital; bulbus genitalis situated in a hollow at the base of the digital joint, brown, globular in outline, hollowed out in front, cleft at the sides, having two corneous processes in front, both springing from near the centre of the bulb, and directed outwards; the inner the longer, much bent, deeply grooved on the inner side of the basal half, and near its extremity suddenly contracted on the posterior side; the outer legs bent, having the same general direction as the inner, and lying partly under it. There is a transverse groove at the base of the bulb, and the largest lobe is crossed by a sinuous brown band.

Female: Not seen.

Hab. Leith Valley, near Dunedin; under stones. *P.G.*

A very handsome spider, and named in honour of Wm. Taylor, Esq., Inspector of Schools, to whom I am indebted for several rare spiders.

Lycosa æ rescens, n. sp.

Mas.—Length, $9\frac{1}{2}$ mm.

Cephalothorax greenish-brown, with a pale-yellow fleck on the caput behind each posterior eye, and a heart-shaped fleck of the same hue behind the junction of the caput with the thorax; lateral margins pale-yellow, with a fleck or two of brown; thoracic fovea reddish; falces reddish-brown; lip and maxillæ palish-brown; sternum brown; legs and palpi yellow, with brown extremities, and a few brown flecks on the femora, patellæ and tibiæ; abdomen above of the same hue as the cephalothorax, with a median longitudinal band of palish-yellow, bordered on each side by an irregular streak of brown, and extending from the base to a point somewhat beyond the middle, where the brown borders diverge, and thence towards the spinners crossed by short bars of brown; at the sides greyish mottled with brown; below reddish-brown, with two longitudinal rows of very minute brown spots, extending from behind the genital aperture to near the spinners. These spots are due to minute bald depressions in the integument. The whole body is rather densely covered with a fine pale pubescence.

Cephalothorax about 1 mm. longer than broad at its broadest part, not quite so long as the patella + tibia of a leg of the 4th pair, less than 2 mm. wide at the inferior margin of the fore part of the caput, and considerably narrower than this at the top in front.

Front row of *eyes* slightly bent backwards, small, centrals slightly larger than the laterals, and nearer to those than to each other; eyes of middle row distinctly larger than those of the hind row, and separated from the fore-laterals by about the diameter of one of the latter. The hind row is the longest, but the fore and middle row do not differ much in length. The eyes of the hind and middle row and the laterals of the front row are placed on black spots.

Falces long, somewhat convex and slightly diverging towards the extremities; groove toothed on both sides—on the under-side 3, and on the upper side 2 teeth, the posterior one being the smallest on each side. Claw moderately long and slender.

Maxillæ convex, increasing gradually in width from the base to the anterior extremities, slightly rounded on the outside, and almost truncate in front, where there is a very dense tuft of hair on the inner angle of each. Lip about half as long as the maxillæ, tumid at the base, then slightly constricted, then widening to near the middle, then becoming slightly narrower towards the anterior extremity, which is truncate.

Sternum cordate, glossy, and convex.

Abdomen ovate, about as wide as and about 1 mm. longer than the cephalothorax; spinners compact and moderately prominent, superior and inferior pairs not differing greatly in length and strength.

Legs 1 and 2 almost equal, 4th pair the longest and the 3rd the shortest; no spines on the tarsi; metatarsi and tibiæ spinous above and below; patellæ and femora spinous above only (patellæ of 1st pair with only 1 spine above, or none).

Palpi spinous above, but without spines below; near the anterior extremity of the humeral joint 4 spines, and behind these, at considerable intervals, 1, 1; humeral joint about equal in length to the radial + the cubital joint, bent, laterally compressed, thickest at the anterior extremity; cubital joint slightly longer than the radial, but not quite so strong; digital joint much shorter than the radial and cubital together, beak-like in shape; bulbus genitalis situated at the base of the beak, globular in outline, deeply cleft from the middle to the anterior surface. From the inner lobe of the bulbus springs a curved horny process, the direction of which is outwards and backwards, and the exposed surface of which is almost plain.

I have but one example of the female of this species. It does not differ much in size from the male, and resembles it in colours and markings as well as in other essential specific characters. The vulva is brown, semicircular in outline, with sharp ends directed backwards, and consists of two roundish apertures separated by a septum, anteriorly very slightly and posteriorly greatly dilated.

Found under stones in the Valley of the Waitaki. *P.G.*

The species of *Lycosa* described above are easily distinguished by their colours and markings alone.

Fam. THERAPHOSOIDÆ.

Genus **Hexathele,** Ausserer.

Hexathele petreii, n. sp.

Fem.—Length, 20 mm.

Cephalothorax brown-yellow, somewhat darker at the pars cephalica than at the pars thoracica; falces dark-brown; lip brown, becoming paler towards the anterior extremity; maxillæ yellow-brown; sternum, legs, and palpi brownish-yellow. The abdomen above of the same hue as the cephalothorax, with a fleck of brown at the base, and a median longitudinal dark knotted band commencing at a small distance behind this basal fleck, and extending towards the spinners to a point beyond the middle, from which point to the spinners the abdomen is crossed obliquely by a double row of 2 to 4 bands of the same hue. In some examples there are faint indications that at some stage of the animal's existence a pair of oblique dark bands is thrown off from each knot of the median band. On the ventral surface the abdomen is brown, mottled with brown yellow; posterior side of spiracular plates whitish; spinners of the same colour as the legs. The whole body, except the cephalothorax, is copiously furnished with dark hair.

Cephalothorax as long as the patella + tibia of a leg of the fourth pair; about 1 mm. longer than broad at its broadest part, and rather more than 1 mm. narrower at the fore-part of the caput than at its broadest part; truncated in front and behind; slightly rounded at the side; pars cephalica high; pars thoracica low; thoracic fovea deep, broad and rounded behind, and narrower and somewhat angular in front; lateral furrows well-marked; caput and thorax distinct.

The *eyes* in two rows, the anterior row bent backwards, and the posterior forwards, the latter longer than the former; the fore-centrals round, and the fore-laterals largish, round, and posited somewhat obliquely, the centrals about as distant from each other as from the laterals; eyes of posterior row longish, round, and posited obliquely, the centrals much smaller than the laterals and almost contiguous to them, and about as distant from the fore-centrals as these are from the fore-laterals; the hind-laterals nearer to the fore-laterals than these are to the fore-centrals; a few bristly hairs behind the ocular area, and a tuft in front of the fore-centrals.

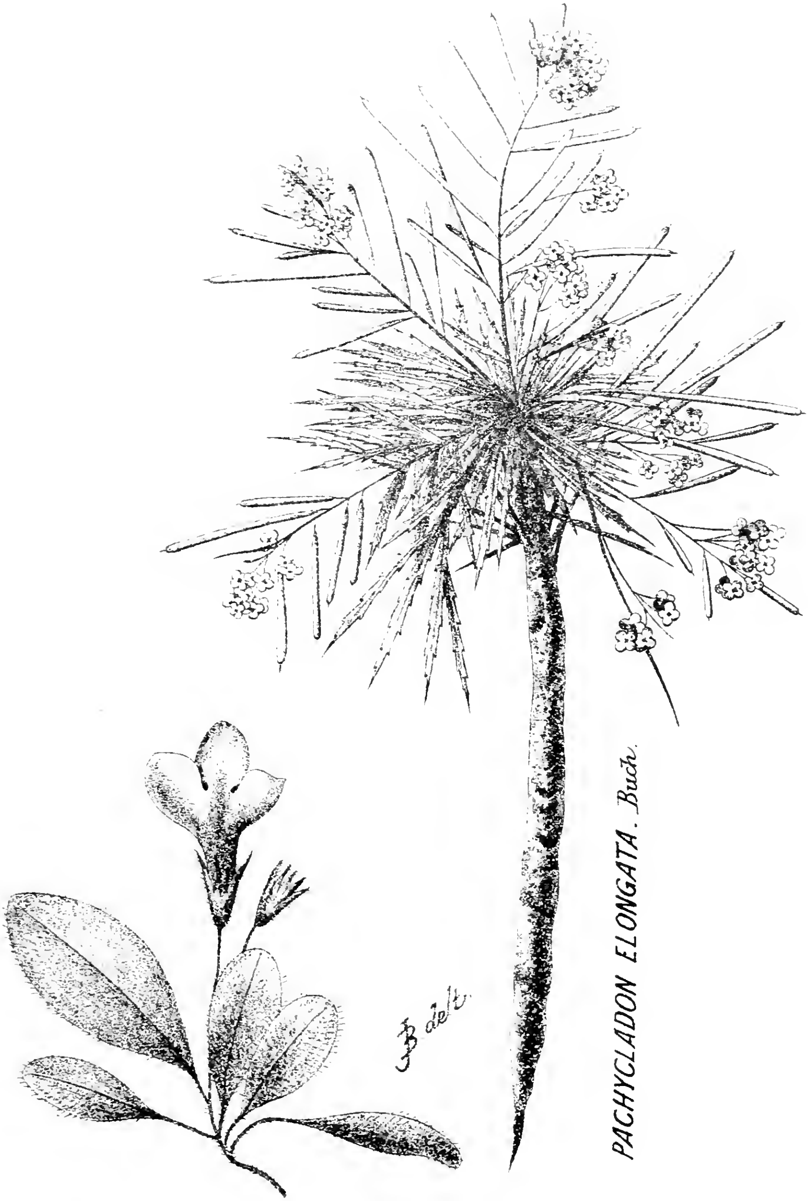
Falces very long and strong, projecting 5 mm. beyond the clypeus, strongly convex, almost glabrous on the outer side, and abundantly furnished with bristly hairs on the inner side and in front; claw long and moderately strong; groove with a large number of teeth on each side, those on the inner side large, and those on the outer side minute.

Maxillæ strongly diverging, in shape resembling the exinguinal joints of the legs and not differing greatly in length from them, the basal half furnished with short black spines, and the fore-margin with a fringe of fine reddish hair. Lip triangular in outline, about as broad as the base is long, convex, separated from the sternum by a semicircular groove, and armed in front with very short blunt spines.

Sternum broadly elliptical, emarginated at the anterior and somewhat pointed at the posterior extremity, the sides somewhat projecting opposite the 1st, 2nd, and 3rd pairs of legs, and behind each projection there is a roundish bald dent.

Abdomen broadly ovate, narrowest towards the base, 12 mm. long and 9 mm. broad at its broadest part, and projecting over the thorax.

The *spinners* of each fore-pair near each other; the outer short and truncated, the inner nearly as long again as the outer and rounded towards the extremity; the posterior pair very long, about 6 mm.



PACHYCLADON ELONGATA. Buch.

OURISIA MONTANA. Buch.

Palpi about as long as cephalothorax + falces; humeral joint much bent outwards, and laterally compressed; cubital joint thickened towards the fore-extremity and shorter than the radial joint, the latter not differing much in length from the digital joint; all the joints armed with spines, but the two anterior ones much more copiously than the rest, and the humeral and cubital have them above only, and the other joints at the sides and below only; digital joint terminated by a single pectinated claw.

Legs, 4, 1, 2 and 3 about equal; tarsi of 1st and 2nd pairs without spines, those of the 3rd and 4th pairs armed with spines below only; metatarsi of 3rd and 4th pairs armed with spines above and below, those of the 1st and 2nd pairs below and at the sides; tibiæ of all the legs furnished with spines at the sides and below, and those of the 3rd pair sometimes have one or two spines above; patellæ spinous at the sides only; femora all armed with spines above, but not below. At the fore extremity of the coxal joint there is a fringe of fine spines, and a few spines are found at the fore extremity of the exinguinal joint. Claws 3, long and strong; superior pectinated, inferior much bent but without teeth.

Mas.—The male resembles the female in colour and markings, except that the palpi and the 1st pair of legs are reddish-brown. The dimensions of the cephalothorax and its appendages—except the falces, which are much smaller—do not differ much from those of the female; but the abdomen, though its length and breadth have about the same ratio to each other, is much smaller. The tibiæ and metatarsi of the 1st pair of legs differ greatly in shape and armature from those of the corresponding pair in the female. The tibiæ are very turgid, and, in addition to the ordinary spines below and at the sides, furnished with two very stout bent spines at the fore-extremity, the inner of which is longer and stouter than the outer. The basal half of the metatarsi is bow-shaped, with the arc directed upwards and outwards; the joint is much thickened at the anterior end of the arc, and furnished with one spine in the middle and one at the anterior end, on the outside of the arc, and two on the underside at the fore-extremity of the joint. Bulbus genitalis directed backwards, turbinate, and drawn out into a long, thin, slightly bent, sharp-pointed spine.

Hab. Interior of Otago, *D. Petrie*: *P.G.*

Named in honour of D. Petrie, Esq., M.A., F.L.S., by whom it was discovered, and to whom I am greatly indebted for a large number of interesting spiders and much assistance in botanical work.

The tube is circular, very large and deep, not differing much in diameter throughout its whole length, and, like that of *Nemesia*, though less thickly, lined with web, but without a lid.

For an inch or two round the mouth there is spun a loose, coarse web, for the purpose, probably, of entrapping beetles and other insects that its occupant preys upon. This web appears to be more or less continuous with the lining of the nest, and makes the mouth of the tube appear slightly funnel-shaped. When the spider is absent on a foraging expedition, the nest is left quite open, but when it re-enters the nest it generally spins a few threads of web across it, at or near the top.

Genus **Migus**, Kirk.

Migus distinctus.

Mas.—Length, 9 mm.

Pars thoracica brownish-yellow, with the anterior and lateral margins of the fovea dark brown; pars cephalica greenish brown-yellow; sternum pale, and maxillæ brownish-yellow; lip of a greenish hue at the basal half, and of the same hue as the maxillæ towards the front; falces greenish brown-yellow with a bright reddish brown fang; the exinguinal and coxal joints of the legs pale yellow, the other joints and the palpi of the same colour as the falces. The abdomen above dark brown, minutely speckled with pale brown spots, and having two longitudinal rows of elongate, obliquely posited, spots of the same hue; below pale yellow towards the base, and of the same hue as the dorsal surface towards the spinners; spinners pale yellow. The cephalothorax is glabrous, except at the lateral margins, where there is a fringe of dark hairs directed upwards, and between the eyes and the fovea where there are a few dark bristly hairs directed forwards. The rest of the body and its appendages are furnished with hair.

Cephalothorax shorter than the patella + tibia of a leg of the 4th pair, rounded at the sides, about half as wide at the fore-angle of the caput as at its broadest part between the 2nd and 3rd pairs of legs, highest at the fore-central eyes, from whence it slopes gradually to the posterior margin; lateral slope not very steep; fovea semi-hexagonal in front and low and rounded behind; lateral indentations moderately well marked; caput distinct from the thorax, somewhat rounded in front; clypeus high, and slightly sloping forwards.

Both rows of *eyes* slightly bent forwards, and not differing much in length, the posterior bent more than the anterior; the fore-centrals each in a black tubercle, round, and rather less distant from each other than from the fore-laterals; the latter posited obliquely, longish, round, and somewhat larger than the former; eyes of posterior row sub-equal, slightly elongated, smaller than the fore-centrals; the laterals near the centrals but not contiguous to them; the laterals of both rows and the centrals of the hind row on a common black spot. The fore-centrals are the darkest in colour, and the fore-laterals are darker than the hind-laterals, and these again darker than the hind-centrals, which are of a brilliant pearly lustre.

Falces moderately strong, prominent, knee-shaped, shorter than the patella of a leg of the 1st pair; groove-toothed, 4 small teeth on the outer and 3 large ones on the inner side; the basal half glabrous, the fore part sparingly furnished with hairs; claw moderately long and strong.

Maxillæ strongly diverging, sides parallel, at the fore end slightly rounded, on the outer end produced to a subconical point on the inner side; no spines on any part.

Lip triangular, rather longer than broad at the base, convex, and separated from the sternum by a semicircular groove.

The *sternum* ovate in outline, broadest behind, emarginated at the anterior and somewhat pointed at the posterior extremity; the sides projecting slightly opposite the 1st, 2nd, and 3rd pairs of legs.

Abdomen ovate, longer than the cephalothorax and about as broad. Inferior spinners short and slender, superior more than twice as long as the inferior, and very stout.

Palpi considerably longer than the cephalothorax, armed with spines on the superior side of the humeral joint, and on the inferior side of the radial joint, and with two longish slender ones near the fore-extremity of the digital joint; humeral joint bent, laterally compressed, and nearly as long as the cubital and radial joints together; radial joint much longer and much stouter than either the cubital or the digital joint; bulbus genitalis directed backwards, turbinate, and produced into a long, slender, sharp-pointed spine.

Legs 1, 4, 2, 3, the 1st and 4th not differing much in length; armed with hairs, bristles, and spines, the last most numerous on the femora and stoutest at the sides of tibiæ and at the fore-extremity, below, of the patellæ of the first pair. The other joints have few or no spines. The metatarsi of the first pair are only slightly bent at the basal half, but the tibiæ of the same pair are considerably stronger than those of the other pairs.

The female of this species has been described by Cambridge; but, as the male differs very considerably from the female, I have given a detailed description of it here.

Found at Ravensbourne, near Dunedin, by Mr. Petrie and myself. I have traced it from Portobello nearly to Oamaru. It is never found many feet from the sea beach. The male is very sprightly, but the female is very sluggish, and invariably simulates death upon being touched. It is able to live a long time without food. I kept a female in a corked tube without food for nearly two months, and at the end of this time it appeared not to have suffered the least from its long fast.

The nests, strongly resembling those of *Nemesia*, though many times shallower and much smaller, are built in clay banks, and at all angles between the horizontal and the vertical, but generally at an angle vertical, or nearly so, to the earth's surface.

GASTRODIA HECTORI. Buch.

II.—BOTANY.

Art. XXIX.—*On some New Native Plants.*

By J. Buchanan, F.L.S.

[*Read before the Wellington Philosophical Society, 19th January,* 1887.]

Plates XIV.–XVIII.

Erigeron bonplandii, Buch.

A small shrubby very viscid plant, 10–12 inches high. Leaves numerous, linear obovate, obtuse, obscurely serrate, 2–4 inches long, $\frac{3}{4}$-inch at the broadest part, bright-green on the upper surface, and covered with close, white, shining tomentum beneath. Scapes 4, in the axils of the upper leaves. Stem bracts numerous, diminishing in size upwards. Heads nearly 2 inches in diameter, involucral scales in few series, long, linear, upright. Rays long, linear; anthers tailless. Pappus of few short hairs; achene with short rigid hairs on margins.

This very showy *Erigeron* was collected by Mr. Martin, on Mount Bonpland; there is a fine robust specimen growing in his nursery at Green Island. The large flower-heads of this species make it very attractive, and it is worthy of cultivation. This species is allied to *Erigeron novæ-zealandiæ*, figured in vol. xvii. "Trans. N.Z. Institute," but differs much from that species in its large leaves and numerous scapes.

Celmisia martini, Buch.

Rhizome stout. Leaf sheaths $\frac{1}{2}$ inch in diameter. Leaves 12 inches long, $\frac{1}{2}$ inch broad, obscurely serrate, linear-oblong, and tapering to an acute point at top, narrowing near the bottom to 1 inch, then spreading downwards into a broad villous sheathing petiole; under-surface covered with closely appressed white or very pale-buff tomentum; central vein dark-purple, dividing near the bottom into nine dark-purple veins; back of leaf covered, when young, with a white silvery pellicle, which afterwards breaks away, exposing the dark-green leaf. Scape stout, scarcely longer than the leaves. Bracts few, narrow, linear, 4 inches long, diminishing in size upwards. Head nearly 2 inches in diameter. Florets numerous, long, narrow, linear.

Hab. Mount Bonpland, 4,000 feet.

This fine *Celmisia* was collected by Mr. Martin on Mount Bonpland, and has succeeded well with him at his nursery at Green Island, where it was planted out, and bids fair to become a permanent plant of cultivation.

Aciphylla kirkii, Buch.

A rigid shining plant, 8–12 inches long. Leaves 8–9 inches long, $\frac{3}{4}$–1 inch broad. Leaves chiefly bifoliate, bifurcation 3–6 inches from top, obtuse, apiculate, finely marked with anastomosing striæ, and with a stout marginal nerve on both sides of the leaf, sheath at bottom membranous. Flowers diœcious. Male scape nearly straight, bracts long, 3-foliate. Female scape and bracts flexuose. Umbels numerous.

This well-marked species was collected on Mount Alta, in 1883, but as the only specimen then procured arrived at Dunedin in a very fragmentary state, it was laid aside. On a recent examination the material proved sufficient for a restoration, when carefully put together. Another species of *Aciphylla* may be looked for in the Wanaka District, of which I have only a fragment. The leaves are 12 inches long, smooth and shining, with the striæ only marked, and the serrations on the edges of the leaves scarcely felt.

Gastrodia hectori, Buch.

Root tuberous, stem and spike of flowers 18 inches high, closely sheathed for $\frac{2}{3}$ of its length by a long leaf, $\frac{1}{3}$ of the leaf being free, a short outer sheath at bottom encloses the base of the sheathing leaf. Scales none. Racemes $3\frac{1}{4}$ inches long. Flowers 13, close-set, brownish-yellow, $\frac{2}{10}$ of an inch in length, seed-vessel black, or dark brown, orbicular.

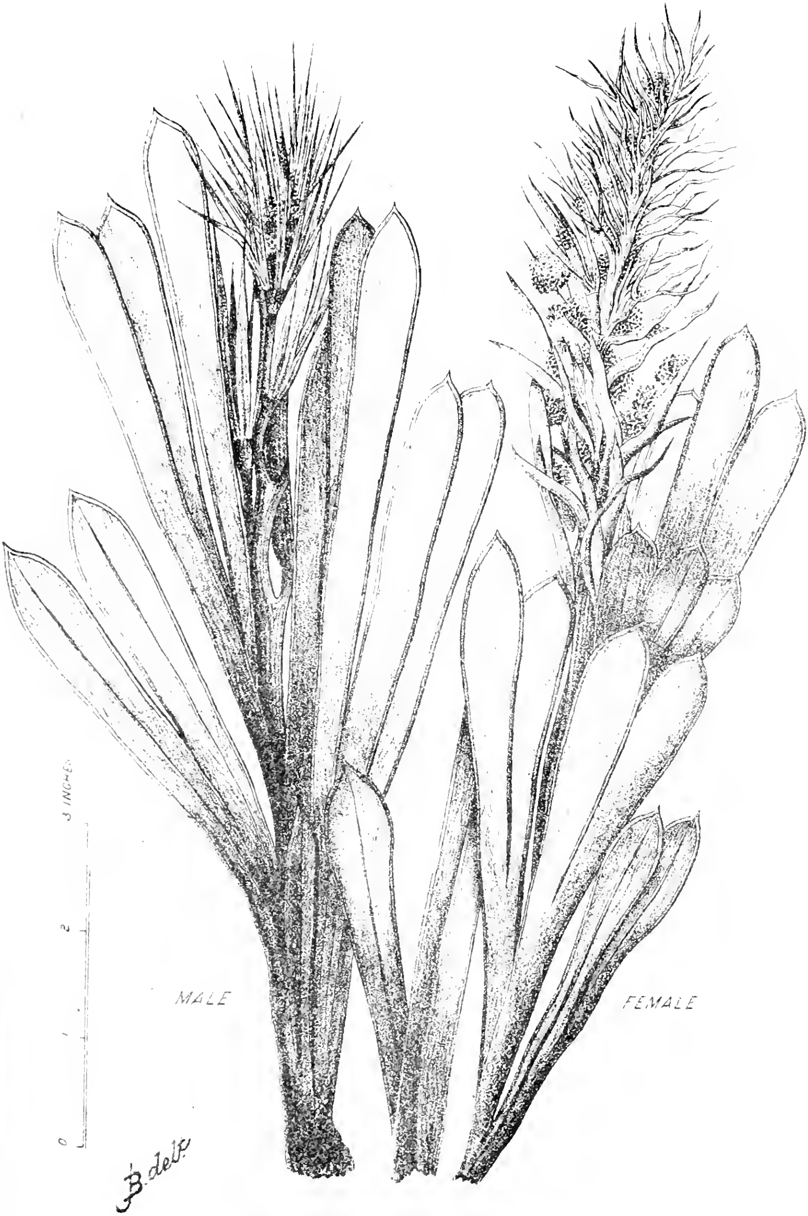
The present species was collected several years ago in Marlborough district, near Picton, and has also been seen on the Conway River. The species of *Gastrodia* are probably abundant, but their dark habitats, in dense bush country, prevent them from being easily seen.

Ourisia montana, Buch.

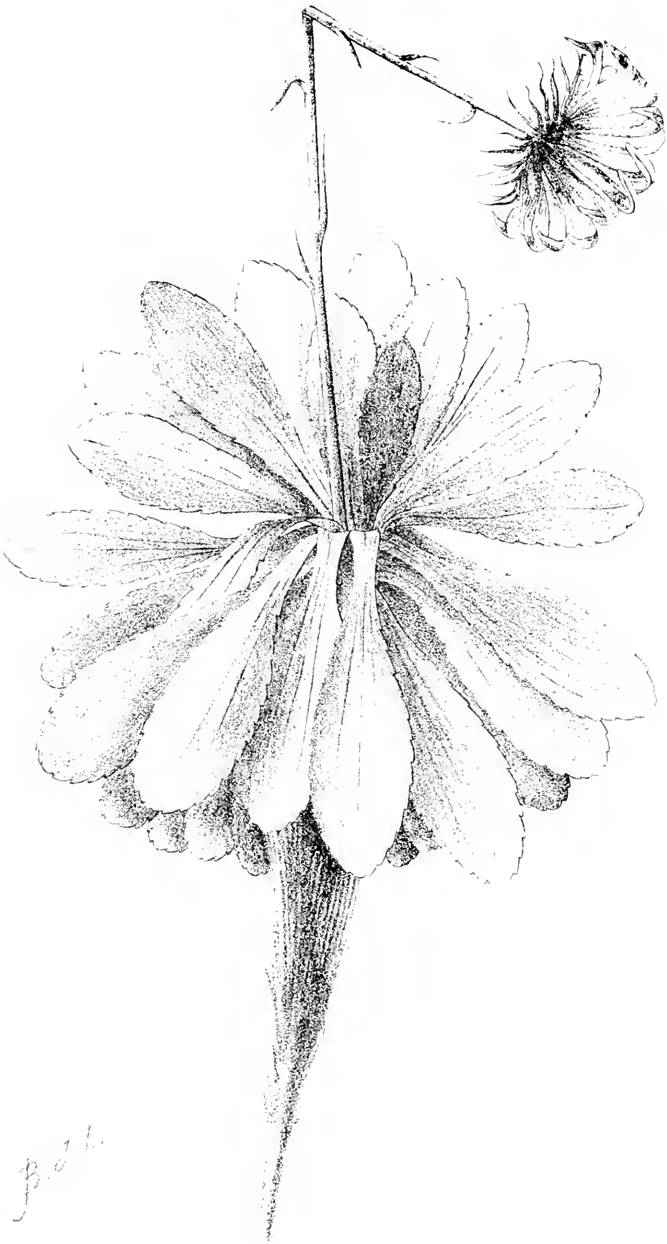
A small erect hispid plant, 1–$2\frac{1}{2}$ inches high. Stems creeping; leaves few, linear, ovate, or obovate, entire, 1–$1\frac{1}{4}$ inch long, $\frac{1}{3}$ – $\frac{1}{2}$ inch broad. Petiole one-third as long as the leaf. Scape $1\frac{1}{4}$ inch, with one very small bract. Flowers solitary, large for the size of the plant, pedicels slender, springing from the base, and with the flower topping the leaves. Corolla large, white, oblique, limb 5-fid., $\frac{3}{4}$ inch diameter. Calyx 5-partite.

The large entire leaves, long pedicels, and large flowers, distinguish this species from *Ourisia uniflora* and *Ourisia colensoi*. Collected on Mount Alta Range, at 5,000 to 6,000 feet altitude.

RANUNCULUS MUELLERI. Buch.



ACIPHYLLA KIRKII. Buch.



CELMISIA ROBUSTA. Buch.

Olearia alpina, Buch.

A small ornamental alpine tree, 8–12 feet high, trunk 6–8 inches in diameter; branches, and leaves below, covered with pale buff tomentum. Leaves 5–6 inches long, $\frac{1}{4}$ inch broad, linear, entire on the margins, midrib very stout, veins close, diverging at right angles, thus forming a series of lacunæ on both sides of the midrib. Heads numerous, in large panicles, with diverging branches, involucres turbinate, flowers not seen ; pappus reddish, whole inflorescence covered with brownish tomentum.

Common on the Tararua Mountains, and mountains towards Wanganui. A remarkable plant, closely allied to *O. excorticata*, Buch.; stems covered with thin brownish bark, which peals off in large papery sheets. This small tree is worthy of attention for ornamental shrubbery, although cultivation might rob it of much rugged beauty. Though closely allied to *O. excorticata*, Buch., the oblong leaf of that species presents when compared with the long linear leaf of this species a marked distinction.

Celmisia robusta, Buch.

A small robust branching species, 4–6 inches high. Leaves 1–1$\frac{1}{2}$ inch long, $\frac{1}{2}$inch broad, coriaceous, ovate-oblong, acuminate or rounded at the tip, and broadly sheathing at the base, finely toothed, greenish-white above and covered with closely appressed white tomentum beneath. Scape 4–5 inches long, with 6–10 linear bracts. Head 1 inch diameter ; involucral scales numerous, subulate, tapering, often recurved. Pappus orange colour, $\frac{1}{4}$ inch long, achene pubescent.

The affinity of this hardy mountain plant is with *C. hectori*, but the large obovate olive-green leaves of this plant necessitate the formation of a new species.

Haastia montana, Buch.

Closely tufted, branches erect, and covered with soft fulvous wool over the whole plant. Leaves loosely imbricating, rounded on top, obovate, erect or recurved, veins of the leaves irregular, indistinct. Heads small, $\frac{6}{10}$ths of an inch diameter, involucral scales reduced to fine black lines.

A very distinct plant from any of the other species of this genus. From *H. recurva* it may be distinguished by its large upright soft leaves, and from *H. sinclairi* by the absence of the large black involucral scales, and altogether different foliage from either.

This addition to the genus *Haastia* was discovered on Mount Alta Range, Lake Wanaka.

Ranunculus muelleri, Buch.

A stout, robust, fulvous and villous plant, 5–6 inches high. Root-stalk stout, rootlets numerous. Leaves all radical, round, crenate-lobed, 2 inches diameter, petioles 2 inches long. Peduncles few, 4–5 inches long. Flowers, 2–3 large, white, each flower with a broad linear bract underneath, and a flower-bud in the axil.

The present fine plant adds another species to the already large family of New Zealand *Ranunculus*. It was collected on the Tararua Mountains, the only specimen seen in flower, and has been since overlooked. I am indebted to Mr. Kirk for pointing out its claim as a new species.

Cassinia rubra, Buch.

A small delicate shrub, 2–4 feet high, with bright olive-green foliage. Leaves very small, erect, or decumbent, linear-oblong, obtuse, $\frac{1}{4}-\frac{1}{5}$ inch long, margins nearly flat. Heads of flowers dense, in close rounded corymbs. Flowers very small, numerous. Involucral scales in 3–4 series, bright pink or red.

This beautiful little plant was reported as collected on the Wanganui River, inland. No doubt such a beautiful shrub would prove a valuable addition to the gardens, if young plants could be procured and established.

Geum alpina, Buch.

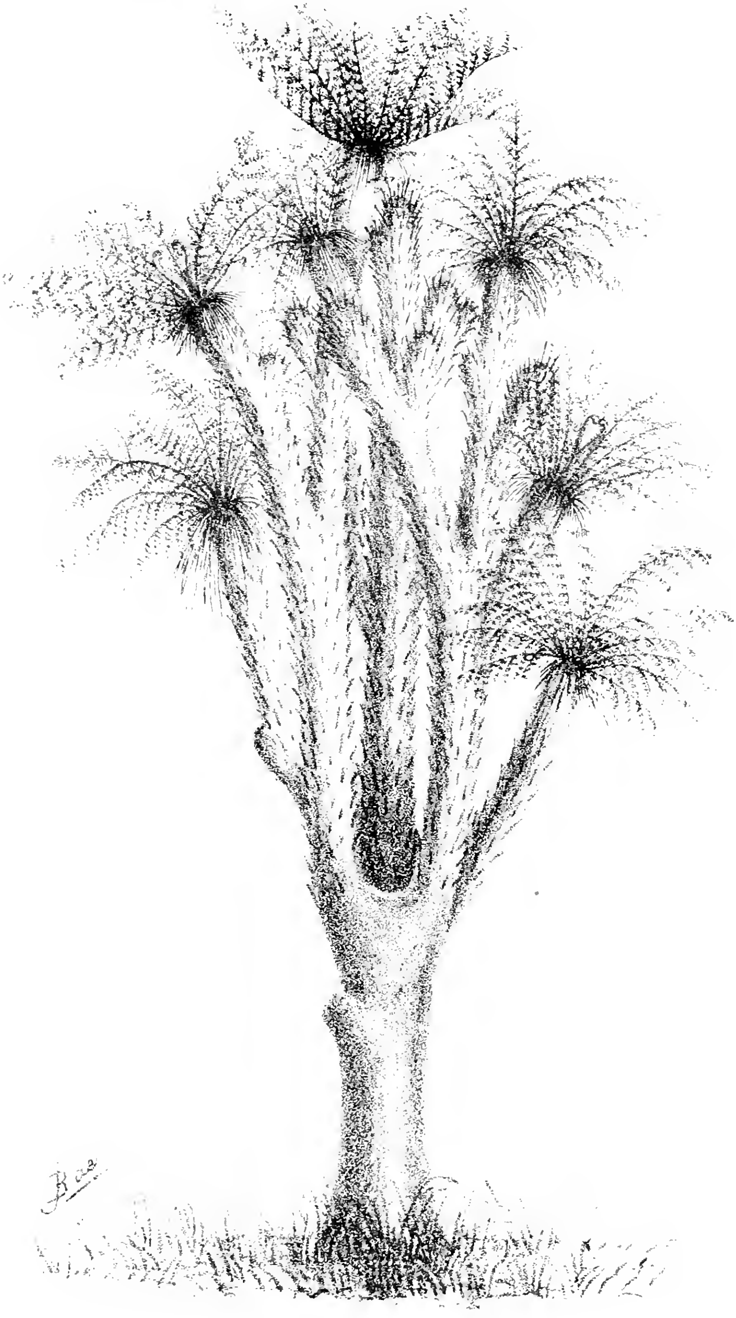
A small, prostrate, hairy, mountain plant, with stout prostrate rhizomes. Leaves alternate, closely arranged, $\frac{1}{2}-\frac{3}{4}$ inch diameter, rounded, lobed, and with fine crenate serratures. Flowers minute, yellow, on numerous branches towards the end of the stems.

In extremely small forms of this plant, the leaves are much reduced in size, and the numerous little yellow flowers scarcely exceed the calyx, a head of flowers not exceeding $\frac{2}{10}$ inch. No doubt this is a reduction of size entirely due to severe climatic influence.

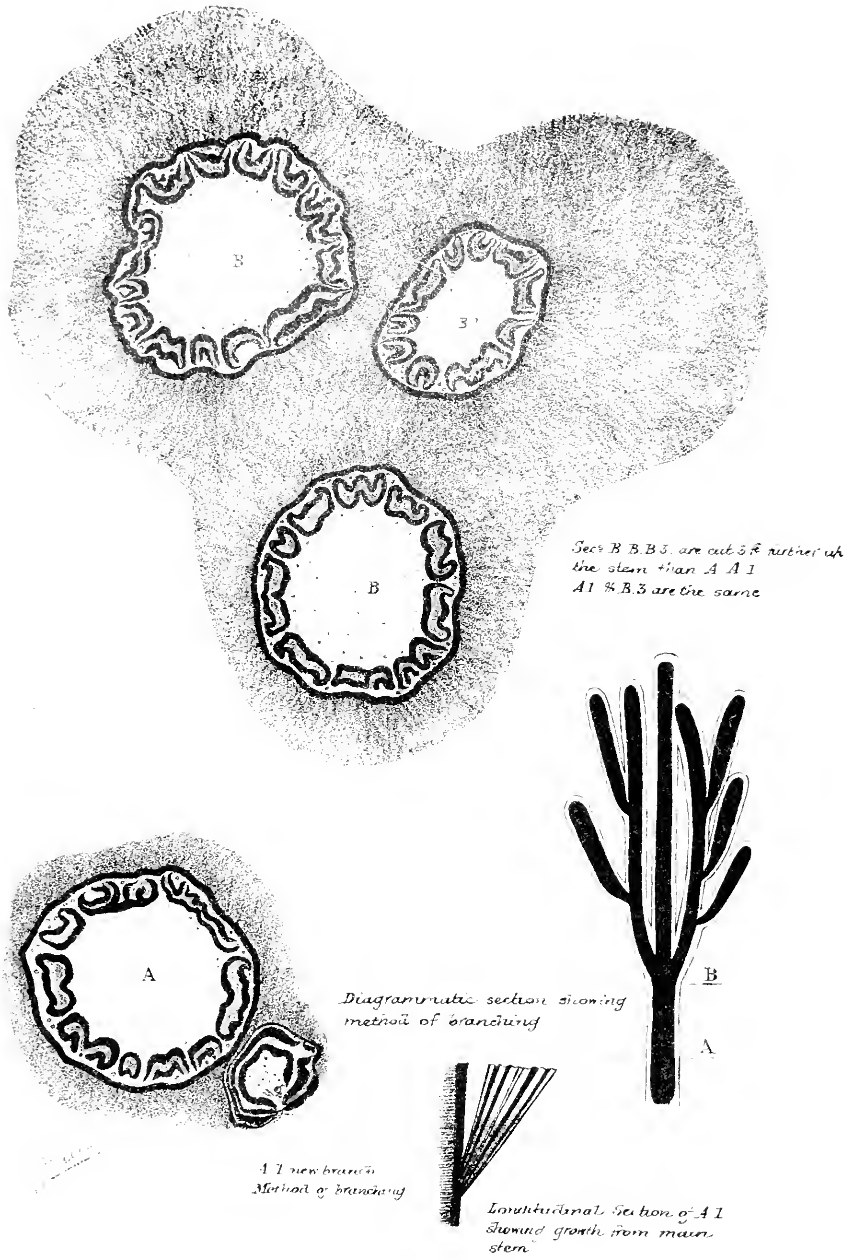
Pachycladon elongata, Buch.

A small glabrous, open-branched, alpine plant. Root long, fusiform, elongate. Leaves few towards the bottom, $\frac{3}{4}$-inch long, with 5–7 deep serratures. Upper and largest portion of plant composed of flowering racemes, which are afterwards replaced by long slender siliqua or pods, 1 inch long.

It would appear that a gradation of form can be traced in the genus *Pachycladon*, from Hooker's *Pachycladon novæ-zealandiæ*, through *P. glabra*, Buch., to the present attenuate form, which may be named *Pachycladon attenuata*, Buch. The gradation of form in this case cannot be ascribed to climatic influence, as the three species were all collected at the same altitude and locality, Three Kings Mountain, 5,000 feet altitude.



HEMITELIA SMITHII.



STEM SECTIONS OF HEMITELIA SMITHII.

ART. XXX.—*On a remarkable branching Specimen of* Hemitelia smithii.

By J. BUCHANAN, F.L.S.

[*Read before the Wellington Philosophical Society, 19th January,* 1887.]

Plates XII., XIII.

THE visitor to the slopes of Mount Cargill, near Dunedin, may have noticed the marked abundance of that beautiful tree-fern *Hemitelia smithii*, which often attains there a height of 20–30 feet; and he may also have noticed a strong tendency in this species to divide at the top of the stem into two, and sometimes three, branches. But a remarkable departure, however, from this limited terminal branching has been discovered, which forms the subject of the present paper. The accompanying sketch, drawn from measurements, proves the tree to have been 16 feet in height, and that it has 16 branches, as also several buds. The budding and branching may proceed from any part of the stem, and the specimen has several branches diverging in various directions, which again divide, as in dicotyledonous trees. The accompanying drawings (Plates XII. and XIII.) have been sketched by measurements taken from the fallen tree, it having recently been cut down by some boys.

The transverse sections are intended to illustrate the method of branching in this specimen of tree-fern; they are all drawn one-third natural size, except diagram *A B*, which is $\frac{1}{135}$ natural size.

There is one remarkable feature in connection with the true or inner stems and branches of tree-ferns: that is, the point of attachment of the branch with the inner or true stem does not increase much in diameter for several inches from the parent stem; it then gradually enlarges in an upward direction, and becomes covered by the fibrous mass. A weakness in branches might be suggested from this; but the great strength of tree-ferns is due to the strong fibrous matter enveloping them, which is remarkably strong, and would prove as reliable for a transverse strain as many timbers; they have often been used for short bridges, both as stringers and flooring.

In the diagrammatic section, *A B*, is shown the method of branching in this tree-fern: a branch is produced from a small bud, which pushes its way through the woody inner or true stem of the tree, and also the close fibrous outer covering. (See longitudinal section of *A 1*, where a transverse and longitudinal section is shown of the method of branching.) The large sections (*B B* and *B 3*) are cut 3 feet above *A*, showing the increase of size in 3 feet of the central core.

Art. XXXI.—*On the New Zealand Species of* Coprosma.

By T. F. Cheeseman, F.L.S., Curator of the Auckland Museum.

[*Read before the Auckland Institute, 18th October*, 1886.]

Next to *Veronica*, the genus *Coprosma* is the most puzzling in the New Zealand Flora. Not only are the species highly variable in their mode of growth, foliage, and vegetative characters generally, but the flowers are so small and inconspicuous, and so uniform in their structure, as to offer few distinctive characters of importance. It is thus no easy matter to identify the species even when they are examined in a fresh state, while in the case of dried specimens, it requires the utmost care to arrive at any satisfactory conclusions.

For a considerable time I have made the New Zealand *Coprosmas* a subject of special attention. Most of the species I have seen living in their native stations, and have thus had opportunities of tracing the variations due to differences in soil, altitude, and exposure. I have been enabled to collect large suites of specimens from all parts of the colony, and, in addition, have been favoured with others made for me by friends. Through the kindness of Sir Joseph Hooker, sets of my specimens have been compared with the types of the species described by Cunningham and others, and now preserved in the Kew Herbarium, so that my identifications have been rendered more certain. The information and materials that I have collected I now propose to make use of in drawing up a systematic account of the species, with the view of rendering their determination more easy, and of supplying, as far as I can, the admitted deficiencies existing in all previously published accounts.

The genus *Coprosma* belongs to the *Rubiaceæ*, or Madder family, represented in the temperate regions of the northern hemisphere by a sub-tribe (*Stellatæ*) of low-growing herbaceous plants, comprising, among others, the well-known Madder, Woodruff, Cross-wort, etc. It is, however, in the tropics and in the south temperate zone that the more typical members of the family are found. Many of these are highly ornamental, and are often seen in our gardens and greenhouses, as the various species of *Bouvardia*, *Ixora*, *Gardenia*, etc. Two well-known economic plants are also included—the Coffee shrub, and the quinine-producing *Cinchona*. The close alliance of these plants to *Coprosma* has led to the suggestion that its bark should be examined for quinine, or the allied alkaloids, and the berry for caffeine. I believe that no exhaustive chemical examination has yet been made, but some preliminary investigations that have been made by Mr. Skey and others do not warrant very favourable expectations.

The first species of *Coprosma* were collected in 1769 by Banks and Solander, during Cook's first voyage. Specimens of six species were brought home to England, and are now preserved in the Banksian Herbarium in the British Museum. In the manuscript account of the plants of New Zealand, drawn up by Dr. Solander, but which, for some unexplained reason was never published, although made quite ready for the press, even to the preparation of the engravings, the name *Pelaphia* was proposed for the genus; and the species were also fully and clearly described. However, as Dr. Solander's names were never actually published, they can have no standing in botanical works.

During Cook's second visit to New Zealand, in 1772, he was accompanied by Forster, the well-known naturalist. Plants were collected at Queen Charlotte Sound and Dusky Bay, and many of them were subsequently described by Forster in his "Prodromus." The term *Coprosma* was now for the first time applied to the genus, and two species described—*C. lucida* and *C. fœtidissima*. For many years these remained the only species actually published from New Zealand.

Nothing more was added to our knowledge of *Coprosma* until Allan Cunningham made his two visits to New Zealand in 1826 and 1838. In his "Precursor to a Flora of New Zealand," which contains the results of these journeys, ten species are enumerated. Three of these are mere synonyms; and two more were already known. The remaining five are good and distinct forms. Cunningham's descriptions, however, are extremely imperfect, and in many respects faulty and misleading. The types of his species are now preserved at Kew; but, according to Sir Joseph Hooker, ("Handbook," p. 111,) the specimens have been much intermixed by himself.

In 1846, M. Raoul published in his "Choix de Plantes de la Nouvelle Zelande," a description of *Coprosma robusta*, perhaps the most widely distributed of all our species, but which seems to have been confounded with *C. lucida* by previous botanists. About the same time Mr. Colenso contributed to the Tasmanian "Journal of Natural Science" a paper entitled "A Tour in New Zealand," in which several additional species were made known. This was afterwards reprinted in Hooker's "Journal of Botany;" but, unfortunately, I have been unable to obtain a copy. I much regret this, as it is possible that some of Mr. Colenso's species may be identical with some of those described by later writers; and, if so, his names should take precedence.

Hooker's "Flora Antarctica," which appeared in 1845, contains an account of the *Coprosmæ* collected by the author in the Auckland and Campbell Isles in 1840. Seven species were enumerated, six of which were considered to be new. But of these *C. affinis* has since been referred by its author to *C.*

fœtidissima; *C. myrtillifolia*, which was based on barren specimens, has been abandoned, and is probably identical with *C. parviflora*; while it is doubtful whether there is any real distinction between *C. repens* and *C. pumila*.

In 1854, Sir Joseph Hooker brought out his "Flora Novæ Zealandiæ." Botanists resident in New Zealand, especially Mr. Colenso and Dr. Sinclair, had sent large collections to Kew to be used in the preparation of this work, and among them no small number of *Coprosmæ*. The material thus brought together, though still imperfect, was much more extensive than that at the disposal of any of Hooker's predecessors, and it is needless to say that it was worked up with his customary care and accuracy, with the result of producing the first intelligible and comprehensive account of the genus. Nineteen species were described, of which five were new. The principal mistake made was in confusing a number of distinct and dissimilar species under the head of *C. myrtillifolia*, *C. divaricata*, and *C. propinqua*; but probably the specimens were not good enough, or complete enough, to show the distinction existing between them.

The arrangement followed in the more recently-issued "Handbook," differs slightly from that given in the "Flora," but there are no changes of any importance. The species confused with *C. propinqua* and *C. myrtillifolia* (= *C. parviflora*) are separated and put into their proper places, but no less than four distinct species are still included in *C. divaricata*. The disadvantage of working entirely on dried specimens is shown by the fact that in the specific descriptions hardly any use is made of the shape of the fruit, whereas it often gives good distinctive characters. The total number of species admitted in the "Handbook" is 24. Since its publication, no memoir treating of the genus as a whole has appeared, although from time to time new species have been described by Mr. Kirk, Mr. Petrie, Mr. Colenso, and myself.

The following summary sketch of the range of variation in the vegetative and floral characters of the genus may be useful to those who have not previously studied the species in detail:—

Habit, etc.—The greater number of the species are closely-branched shrubs, varying from 6 to 12 or 15 feet in height. Some attain the stature of small trees, the largest being *C. arborea*, which is sometimes 30 feet in height, with a trunk 18 inches in diameter. *C. baueriana* is remarkable for its great range in size, according to situation and exposure. When growing on black maritime rocks it is often under 2 or 3 feet; while in sheltered places, on rich sandy soil, specimens 25 feet in height have been measured. *C. areolata*, *C. propinqua*, and *C. fœtidissima* occasionally reach 15 or 20 feet, although usually less than that. *C. serrulata* is the smallest of the large-leaved species, and is generally under 4 feet in height. *C. spathulata* and *C. rhamnoides* have an average height of from 4 to 6 or 8 feet. *C. acerosa* has long and flexuous branches, often (in the typical form) much and closely interlaced, forming a dense bush 2 to 4 feet high; but some states of it are prostrate and sparingly branched. *C. depressa* is prostrate or sub-prostrate, and often under 1 foot in height. *C. repens* and *C. petriei* are the smallest species of the genus. They have prostrate and rooting, almost herbaceous, stems, closely appressed to the ground, and frequently only a few inches long.

The arrangement and disposition of the branches occasionally afford characters of importance: thus *C. areolata* can be at once distinguished from its nearest allies (*C. tenuicaulis* and *C. rotundifolia*) by its comparatively narrow and almost fastigiate outline. The mode of branching of *C. propinqua*, *C. parviflora*, *C. acerosa*, and others is characteristic of the species, and gives important aid in their identification.

Leaves.—In *Coprosma*, as in so many *Rubiaceæ*, the leaves are invariably opposite, entire, petiole, or sub-sessile, and connected by interpetiolar stipules. In size there is considerable range. *C. grandifolia* often has them as much as 9 inches in length, while in *C. repens* and *C. petriei* they are frequently under $\frac{1}{8}$ inch. The large-leaved species *C. grandifolia*, *C. lucida*, *C. robusta*, *C. baueriana*, etc., have a well-developed many-flowered inflorescence, and thus form a fairly well-characterized section of the genus. In the small-leaved species the flowers are either arranged in few-flowered fascicles or are solitary. As to shape, the leaves may be orbicular, ovate, oblong, lanceolate, or even linear. In the same species there is often considerable diversity of shape, and in *C. rhamnoides* leaves varying from orbicular to linear may be observed on the same bush. *C. serrulata* has the margins of the leaves minutely serrulate. All the other members of the genus have them quite entire when mature, but in some the very young leaves are obscurely incised. This is well seen in *C. robusta*. The texture varies considerably—from very coriaceous in *C. lucida*, *C. robusta*, and *C. crassifolia* to comparatively thin and membranous in *C. rotundifolia* and *C. tenuifolia*. The venation is pinninerved, at any rate in the great majority; but some of the small-leaved species have few lateral veins, although the midrib is always conspicuous and well developed. The veins frequently anastomose, in some forming copious minute reticulations, as in *C. tenuifolia*; in others larger areoles, as in *C. areolata* and *C. tenuicaulis*. All the species have a stout vein running round the whole of the margin of the leaf, and often giving it a thickened appearance.

In nearly all the species, except a few of the smaller-leaved ones, curious little pits exist on the under-surface of the leaves, in the axils formed by the union of the primary veins with the midrib. They are never more than $\frac{1}{8}$ inch in length, and are usually much less. Inside they are lined with numerous stiff white hairs, which, on being treated with caustic potash, are seen to be composed of two or three cells. So far as I have observed, the pits do not secrete anything, and I am quite unable to guess at their function. They are often inhabited by a minute yellow acarid, which makes use of them as a home. Sometimes two or three acarids may be found in the same pit, and they crawl freely about the young leaves and branches.

Stipules.—All the species possess interpetiolar stipules. They are more or less triangular in shape, often with minute denticulations towards the apex. The margins, or the whole surface, are frequently ciliated or puberulous. At their bases they are generally connate with the petioles, thus forming a short sheath round the branch. In *C. linariifolia*, especially on the young leafy branches, the sheaths are elongated, and form a very conspicuous, though variable character.

At the apex of the very young stipule a gland is situated which secretes a copious supply of a viscid mucilaginous fluid. These glands are highly developed and in an active state when the adjacent leaves are in the early stages of growth, but shrivel up and cease to secrete long before the leaves attain their full size. Their office is evidently to keep the young and tender leaves and branches plentifully bathed with fluid.

Indumentum.—Many of the species have puberulous or pubescent branches, and some have the under-surface, or both surfaces, of the leaves similarly provided, *C. rotundifolia*, *C. areolata*, and *C. ciliata* being perhaps the most conspicuous examples. The degree of pubescence is, however, a very variable character throughout the genus, and can only be employed with considerable caution for systematic purposes.

Inflorescence.—It is not always easy to understand the arrangement and position of the flowers, especially in some of the small-leaved species. The most developed inflorescence is seen in *C. grandifolia*, where it consists of trichotomously-divided many-flowered cymes, springing from the axils of the leaves. These cymes are often 3 inches in length, and bear from 20–40 flowers in the males, but a much smaller number in the females. At each division of the axis is a pair of connate leaf-like bracts. The ultimate divisions terminate in little clusters of flowers, each cluster being enclosed at the base by a shallow involucel formed by a pair of depauperated leaves and their stipules. Minute bracts are also present at the base of each flower. In *C. lucida* the inflorescence has precisely the same structure, but through the internodes of the primary and secondary axes being shortened it is much more compact. The internodes being still further reduced in length, we reach the arrangement seen in

C. robusta, where the flowers are congested into a dense many-flowered glomerule, or with two or three superposed glomerules. In *C. baueriana*, *C. petiolata*, and *C. cunninghamii*, the flowers are much less in number than in *C. robusta*, but their arrangement is on the same principle. In *C. arborea* the glomerules are rounder, and even more compact, and in addition to occupying the axils of the leaves, they often terminate the branches, which is never the case in *C. robusta*.

In the small-leaved species the flowers are much reduced in number, and are often solitary, especially the females. As to their arrangement, there are two main types, but they graduate insensibly into one another. In the first, the flower, or fascicle of flowers, is placed in the axil of a leaf, and is thus axillary. If, however, the pedicel of the flower is examined, it will be seen that in all cases two or three series of connate bracts are placed under the flower. The upper series forms a cup-shaped involucre, closely investing the base of the flower, and can be easily mistaken for a calyx, especially in the males, where the true calyx is either much reduced or altogether absent. These connate bracts evidently represent depauperated leaves and their stipules, so that the flowers really terminate minute arrested branchlets. This is the arrangement seen in *C. rotundifolia*, *C. areolata*, and *C. tenuicaulis*. In the second class the flowers quite obviously terminate leafy branchlets. In *C. fœtidissima*, *C. colensoi*, etc., they are placed at ends of the main branches, as well as on lateral branchlets, and several pairs of well-developed leaves are usually present, in addition to the bracts mentioned above. In other species (*C. propinqua*, *C. parviflora*, etc.), the flowers terminate short lateral branchlets only. As these branchlets are frequently much reduced, and often have only one pair of small leaves below the bracts, there is really not much to distinguish the inflorescence from that of the first type. This is particularly the case when the leaf at the base of the branchlet, and from the axil of which it has sprung, is persistent, as frequently happens.

Flowers.—The flowers are unisexual, and the sexes are placed on different plants. Occasionally, however, a few male flowers are intermixed with the females, and *vice versâ*. Some species, and especially *C. robusta* and *C. fœtidissima*, now and then produce hermaphrodite flowers, to all appearance well-developed and perfect, but which seldom mature fruit. The flowers are very uniform in shape all through the genus, and thus are of little value in the discrimination of the species.

The males are always larger and more numerous than the females. They have a broad or narrow campanulate corolla, divided half-way down, or further, into four or five lobes. The calyx, in the species in which it is present, is minute and cupular, and either truncate or obsoletely 4–5-toothed. In *C.*

arborea and *C. spathulata*, however, it is much larger, and has well-developed linear lobes. Most of the small-leaved species do not possess even the rudiment of a calyx, so far as the male flowers are concerned, but its place is well supplied by the cupular involucel previously alluded to. This involucel is a shallow cup-shaped organ, closely investing the base of the corolla. It is usually four-lobed, two of the lobes being rather larger than the others, but sometimes is quite truncate. It corresponds so closely in shape and position to a calyx as to be readily taken for one, and, in fact, it has often been described as such by authors. But there are sufficient reasons for believing it to be composed of a pair of depauperated leaves and their connecting stipules. In the first place, a similar involucel exists in the female flowers, where the true calyx is always developed; and in the second, if a sufficient number of specimens are examined, examples can be found where the two longer lobes are better developed, and evidently answer to metamorphosed leaves. In some species, and notably in *C. acerosa*, it is possible to trace a gradation of forms, from instances where the two longer lobes are hardly distinguishable from ordinary leaves, to cases where they are reduced to minute prominences on an otherwise truncate involucel. It should be mentioned, too, that the long lobes of the involucel are always placed crosswise (or decussately) to the pair of undoubted leaves below, which is precisely the position they ought to occupy on the assumption that they are metamorphosed leaves.

The stamens, which are either four or five in number, have long slender filaments, and rather large oblong anthers, which hang pendulous from the mouth of the corolla, swinging about with every breath of air. The pollen is small, smooth, and elliptical, and is produced in large quantities.

The female flowers are smaller and narrower than the males, approaching tubular in shape. The calyx tube is adnate to the ovary; the limb is almost always minute, and either obsoletely 3–5-toothed or truncate at the mouth. In *C. arborea*, *C. spathulata*, and *C. linariifolia*, however, the limb has comparatively long linear lobes. The styles are two, very long and slender, being often several times longer than the corolla. They are free to the base, and are covered with stigmatic papillæ for their whole length. The ovary is normally two-celled, with a single ovule in each cell; but frequently it is three- or four-celled, and more rarely six-celled. In *C. repens* it is quite common for the ovary to be four-celled.

Fruit.—This is a drupe with two (rarely four or six) one-seeded plano-convex pyrenes, applied to each other by their flat faces. In shape it varies from oblong or ovoid to globose; and in size from $\frac{1}{8}-\frac{3}{4}$ inch. The colour is chiefly orange or red; but some species have a semi-transparent colourless drupe (*C.*

arborea, *C. cunninghamii*, etc.). In others it is blueish (*C. acerosa*, *C. parviflora*), and in some black (*C. spathulata*, *C. tenuicaulis*, etc.). The shape is pretty constant in each species, and hence it is of considerable value as a distinguishing character; but the size, and to a lesser degree the colour, are very variable.

Fertilization.—All the species appear to be wind-fertilized. When a male tree in full flower is shaken, clouds of the loose incoherent pollen are driven off; and the long projecting styles of the female flowers, densely clothed with stigmatic papillæ, are well calculated to catch the pollen. As a rule, insects are seldom seen on the flowers of any of the species. A small dipterous insect occasionally visits those of *C. robusta* and *C. propinqua*, apparently to feed on the pollen; but I have never observed it on the female flowers, and consequently it cannot aid in the fertilization of the species.

Distribution of the species.—Of the thirty-one species admitted, all but three are confined to New Zealand, including in that term the adjacent groups of the Kermadecs, the Chathams, and the Auckland and Campbell Islands. The species found outside the Colony are the following:—*C. baueriana*, which is plentiful in Norfolk Island; *C. petiolata*, which occurs both there and in Lord Howe Island; and *C. repens* (*C. pumila*), which is found on the mountains of Victoria and Tasmania.

In the systematic portion of this paper the distribution of the species within the Colony is given as fully as possible, so that it is unnecessary to dwell on that point here. With respect to the character of their habitats, the species may be roughly divided into the following five classes:—

1. Maritime, including *C. baueriana*, *C. petiolata*, and the typical form of *C. acerosa*.
2. Lowland species of wide and general distribution, with no marked preference for any particular soil or situation, such as *C. robusta*, *C. lucida*, *C. grandifolia*, etc.
3. Lowland species preferring swampy forests or rich alluvial soils—*C. propinqua*, *C. rotundifolia*, *C. areolata*, and several others.
4. Lowland species with a local and confined distribution, as *C. spathulata*, *C. arborea*, etc.
5. Species confined to hilly or subalpine localities, as *C. fœtidissima*, *C. colensoi*, *C. cuneata*, *C. repens*, and a few others.

Before passing to the systematic part of the paper, I have to tender my most sincere thanks to several gentlemen for their kind assistance in its preparation. To Mr. Petrie, of Dunedin, I am especially indebted. From him I have received copious and well-selected suites of specimens of the Otagan species, accompanied with descriptive notes of great value. In addition to this, he has communicated to me, in the course of a correspondence extending over several years, very many original and important observations derived from his own study of the genus, and which have been of great use to me. Such liberal and generous assistance is as rare as it is valuable. I have also to thank Mr. Colenso, Mr. Hamilton, Mr. Adams, Mr. Reischek, and others for specimens of species of the genus, and for information respecting them.

There remains for me to acknowledge the very important aid afforded by Sir J. D. Hooker and Mr. N. E. Brown, of the Kew Herbarium. The latter gentleman has most kindly made a comparison of my specimens with the types preserved at Kew, drawing up a special report on all points of interest; and his conclusions have been examined and verified by Sir J. D. Hooker. My warmest thanks are due to both.

Synopsis of the Species.

DIVISION A.—Erect trees or shrubs. Leaves large, broad, usually over 1 inch in length. Flowers fascicled on lateral peduncles, fascicles usually many-flowered.

Section I.—Peduncles long, 2–4 inches, trichotomously divided; flowers numerous, in fascicles at the ends of the divisions of the peduncle.

Leaves large, 3–9 inches long, membranous; male corolla $\frac{1}{3}$ inch, funnel-shaped ... ... 1. *C. lucida.*

Leaves smaller, 2–5 inches, coriaceous; male corolla $\frac{1}{5}$ inch, broadly tubular 2. *C. grandifolia.*

Section II.—Peduncles short, rarely over 1 inch; fascicles dense, many-flowered, or, more rarely, smaller and few-flowered.

Sub-alpine dwarf shrub. Leaves with serrulate margins ... ... 3. *C. serrulata.*

Maritime shrub. Leaves dark green, fleshy, obtuse, black when dry; branches glabrous, or slightly pubescent ... ... 4. *C. baueriana.*

Maritime shrub. Young leaves and branchlets minutely pubescent ... 5. *C. petiolata.*

Leaves coriaceous, oblong or elliptical, acute, $1\frac{1}{2}$–5 inches long; drupe orange ... ... 6. *C. robusta.*

Leaves coriaceous, linear or lanceolate, $\frac{1}{2}$–1 inch long; drupe pale and transparent ... ... 7. *C. cunninghamii.*

Leaves 1 – 2 inches, membranous, ovate-oblong, acute, perfectly glabrous, areolation very minute ... 8. *C. acutifolia.*

Leaves 1 – 4 inches, membranous, ovate to oblong-lanceolate, areolation not so minute as the preceding, veins and stipules often hairy ... 9. *C. tenuifolia.*

Tree, 20–25 feet. Leaves coriaceous, ovate- or orbicular-spathulate, narrowed into winged petioles ... 10. *C. arborea.*

DIVISION B.—Erect, rarely prostrate, shrubs. Leaves small, usually under 1 inch. Flowers in few-flowered fascicles on short lateral branchlets, or solitary. (The lateral branchlets are sometimes so much reduced that the flowers appear to be axillary.)

a. Leaves spathulate, suddenly narrowed into linear winged petioles, often longer than the blade. Small shrub 11. *C. spathulata.*

b. Leaves orbicular to linear-obovate or -oblong; petiole short.

* Twigs usually densely pubescent (nearly glabrous in *C. tenuicaulis*). Leaves orbicular, orbicular-spathulate or broad oblong (often narrow in *C. rhamnoides*). Drupe globose, black or red.

Height 4-10 feet. Branches widely divaricating. Leaves $\frac{1}{3}$ – 1 inch, membranous, orbicular, cuspidate. Drupe often didymous, red, $\frac{1}{8}$ inch diameter ... ... 12. *C. rotundifolia.*

Height 5–20 feet; branches fastigiate; bark pale; leaves $\frac{1}{3}$–$\frac{2}{3}$ inch, membranous, orbicular-spathulate or ovate-spathulate, veins reticulated in large areoles; fruit dark-red, or nearly black, $\frac{1}{6}$–$\frac{1}{4}$ inch diameter ... 13. *C. areolata.*

Height 5–8 feet; branches widely divaricating; bark purplish; leaves $\frac{1}{4}$ – $\frac{1}{2}$ inch, orbicular- or ovate-spathulate, rather coriaceous, veins reticulated in large areoles; fruit globose, black, $\frac{1}{8}$ – $\frac{1}{5}$ inch diameter ... ... 14. *C. tenuicaulis.*

Height 2–8 feet; dense or open; branches interlaced; leaves very variable, orbicular to narrow oblong, $\frac{1}{5}$–$\frac{2}{3}$ inch long, fruit globose, red, $\frac{1}{8}$–$\frac{1}{5}$ inch ... ... 15. *C. rhamnoides.*

** Twigs densely pubescent. Leaves oblong to linear-oblong or -obovate. Drupe (unknown in *C. ciliata*) globose.

Height 4–10 feet; leaves oblong, $\frac{1}{4}$–$\frac{2}{3}$ inch, densely ciliate ... ... 16. *C. ciliata.*

Height 5–15 feet; branches slender, often spreading in a horizontal plane. Leaves obovate or linear-oblong, $\frac{1}{5}$–$\frac{3}{4}$ inch, obtuse, coriaceous ... ... 17. *C. parviflora.*

*** Twigs nearly glabrous. Leaves variable. Drupe oblong (sub-globose in *C. crassifolia*), usually yellow.

Height 4–12 feet; branches excessively rigid, interlacing; leaves orbicular, very thick and coriaceous, $\frac{1}{4}$–$\frac{3}{4}$ inch; fruit sub-globose, $\frac{1}{4}$–$\frac{1}{5}$ inch ... ... 18. *C. crassifolia.*

Height 4–15 feet; branches stout or slender, often interlacing; leaves orbicular-spathulate to oblong, rather coriaceous, $\frac{1}{4}$–$\frac{3}{4}$ inch; drupe oblong or obovoid, $\frac{1}{5}$–$\frac{1}{3}$ inch ... ... 19. *C. rigida.*

Height 4–10 feet; branches divaricating, leaves rounded-oblong or orbicular, thin, $\frac{1}{4}$–$\frac{3}{4}$ inch; drupe oblong, $\frac{1}{4}$ inch ... ... 20. *C. rubra.*

Height 4–10 feet; branches slender, interlacing; leaves ovate-spathulate or elliptic-spathulate, thin, small, $\frac{1}{5}$–$\frac{1}{3}$ inch; drupe oblong, greenish-yellow, $\frac{1}{5}$–$\frac{1}{4}$ inch ... ... 21. *C. virescens.*

c. Leaves narrow-linear, $\frac{1}{4}$–$\frac{1}{3}$ inch × $\frac{1}{20}$ inch. A rambling or prostrate bush, 1–5 feet high; branches flexuous, interlaced ... ... 22. *C. acerosa.*

d. Leaves narrow, linear-oblong, $\frac{1}{4}$–$\frac{1}{2}$ inch × $\frac{1}{10}$ inch. A large shrub, 8–20 feet high; branches widely divaricating ... ... 23. *C. propinqua.*

DIVISION C.—Erect, rarely prostrate shrubs. Leaves small or of medium size, $\frac{1}{6}$–2 inches long. Flowers terminating leafy branchlets, always solitary (except the males in *C. linariifolia* and sometimes in *C. fœtidissima*).

Height 6–15 feet; leaves linear or linear-lanceolate, acute, $\frac{1}{2}$–$1\frac{1}{2}$ inch; stipules sheathing; male flowers in terminal 3 – 5-flowered fascicles ...	24. *C. linariifolia.*
Slender, 6–15 feet high, extremely fœtid when bruised; leaves oblong, obtuse, rather thin, $\frac{1}{2}$–2 inches; male flowers large, $\frac{1}{3}$ inch, sometimes fascicled	25. *C. fœtidissima.*
Slender, 3–8 feet high; not fœtid; leaves $\frac{1}{4}$–$\frac{3}{4}$ inch, oblong, obtuse or retuse, rather thin; flowers $\frac{1}{6}$–$\frac{1}{8}$ inch	26. *C. colensoi.*
Stout, much branched, 4–10 feet high; leaves $\frac{1}{4}$–$\frac{3}{4}$ inch, linear-obovate, obovate-oblong, or cuneate-oblong, obtuse, coriaceous	27. *C. cuneata.*
Slender, leafy, erect, 5–10 feet high; leaves $\frac{1}{4}$–$\frac{1}{3}$ inch, linear or linear-lanceolate, flat, thin	28. *C. microcarpa.*
Stout, erect or prostrate, 1–4 feet high; leaves $\frac{1}{6}$–$\frac{1}{4}$ inch, linear-lanceolate, concave, coriaceous...	29. *C. depressa.*

DIVISION D.—Stems short, prostrate, and rooting. Leaves small, $\frac{1}{10}$–$\frac{1}{3}$ inch long. Flowers solitary, terminal.

Leaves linear-oblong to rounded-oblong or obovate; male corolla large, curved, tubular, $\frac{1}{3}$–$\frac{2}{3}$ inch long ...	30. *C. repens.*
Leaves linear-oblong or linear-obovate, often hairy. Male corolla small, narrow below, campanulate above, $\frac{1}{5}$–$\frac{1}{3}$ inch long	31. *C. petriei.*

1. C. grandifolia,

Hook. fil., Flora Nov. Zeal., i., p. 104; Handbk. N.Z. Flora, p. 112; *C. latifolia*, Col., MSS.; *Pelaphia læta et P. grandifolia*, Banks et Sol., MSS.; *Ronabea australis*, A. Rich., Flora Nouv. Zel.

North Island.—Common throughout, from the North Cape to Wellington. Altitudinal range from sea level to 2,500 feet.

South Island.—Nelson, common in lowland districts, both in the eastern and western portions of the Province, *T.F.C.*

Quoted from Otago by Mr. Buchanan ("Trans. N.Z. Inst.," i., p. 43), but I have seen no specimens from thence.

A large, sparingly-branched shrub, 8–15 feet high, with dark-brown bark. Leaves much the largest of the genus, 5–9 inches long, obovate-oblong or elliptic-oblong, acute, dull green, not shining or glossy, membranous, veins very finely reticulated. Peduncles 1–3 inches long, trichotomously divided. Flowers in fascicles at the ends of the divisions of the peduncle, each fascicle being enclosed in a shallow involucre formed by a pair of reduced leaves (bracts) and their connecting stipules. A distinct though minute calyx is present in both sexes. Male corolla $\frac{1}{3}$ inch long, funnel-shaped. Female much smaller, $\frac{1}{5}-\frac{1}{4}$ inch, tubular, Drupe about $\frac{1}{3}$ inch long, oblong, obtuse, yellowish-orange.

One of the most distinct species of the genus. The large foliage and well-developed inflorescence separate it from all its allies. *C. lucida* approaches it in inflorescence, but is at once distinguished by the much smaller more obovate coriaceous leaves, and by the stouter and more compact habit. *C. tenuifolia* has leaves very near in outline, colour, texture, and venation, but they are much smaller; and, judging from the fruit, the inflorescence is very different.

Mr. Colenso has very kindly favoured me with flowering and fruiting specimens (collected at Hawke's Bay) of a *Coprosma* labelled "*C. latifolia*, Col.," and which I understand he has lately described as a new species closely allied to *C. grandifolia*. After a careful examination, however, I have failed to find any characters to separate his plant from *C. grandifolia*, even as a variety. The leaves are perhaps a trifle more obtuse than is usual, but otherwise I see no difference at all from the ordinary form common near Auckland and in many other places.

2. C. lucida.

Forst., Prodr., p. 138; D.C., Prodr., iv., p. 378; A. Rich., Flora, p. 262; A. Cunn., Prodr., ii., p. 266; Raoul, Choix des Plantes, p. 46; Hook. fil., Flora Nov. Zeal., i., p. 104; Handbk. N.Z. Flora, p. 112. *Pelaphia laurifolia*, Banks et Sol., MSS.

North Island.—Common throughout, from the North Cape to Wellington. Altitudinal range from sea-level to over 3,000 feet.

South Island.—Nelson, plentiful, *T.F.C.*; Marlborough, *J. Buchanan*; Westland, *A. Hamilton!*; Canterbury, in Banks Peninsula and lowland districts, *J. B. Armstrong*, *T.F.C.*; Otago, common on the south-east and west coasts, not so plentiful in the north or in the interior, *D. Petrie!*; Stewart Island, plentiful, *D. Petrie*.

A handsome stout leafy shrub, 4–15 feet high, perfectly glabrous in all its parts. Leaves 2–5 inches long, oblong-obovate, oblong-lanceolate, or elliptic-oblong, coriaceous, obtuse, apiculate or acute, gradually narrowed into short stout petioles, pale glossy-green. Peduncles 1–2 inches long, trichotomously divided. Flowers numerous, in fascicles at the ends of the divisions of the peduncle. Calyx present in both sexes, but limb very inconspicuously toothed. Male corolla $\frac{1}{5}$ inch long, broadly tubular; female rather shorter and narrower. Drupe $\frac{1}{3}$–$\frac{1}{2}$ inch long, oblong or oblong-obovoid, obtuse, yellowish-orange.

C. lucida varies considerably in habit. When growing in the open it usually forms a dense round-topped shrub; but when met with as undergrowth in the forest it is much more sparingly branched, and the branches are much longer and spread more. It is allied by its inflorescence to *C. grandifolia*, but is at once recognised by its very different foliage and habit. From *C. robusta* it is removed by its paler obovate more coriaceous leaves, which dry a yellowish-green, and not blackish-brown as in that species; and by the longer peduncles and more open inflorescence. The drupe is also much larger and much more pulpy and juicy than that of *C. robusta*. There is no danger of its being confounded with any other of the large-leaved species. In the "Handbook" the leaves are erroneously described as membranous, probably from becoming thin when dried. In the fresh state they are always coriaceous.

3. C. serrulata.

Hook. fil., MSS.; Buchanan, Trans. N.Z. Inst., iii., p. 212; Kirk, *l.c.* x., App. p. xxxv.

South Island.—Sub-alpine localities, but not very common. Nelson, slopes of Mount Arthur and Mount Peel, 3,000 to 4,000 feet, *T.F.C.* Canterbury, mountain districts above 2,000 feet, *J. B. Armstrong!*; Arthur's Pass, Waimakariri Glacier, mountains near Lake Tekapo, *T.F.C.* Otago: Mount Ida, 2,000 to 3,000 feet; Mount St. Bathans, 2,000 to 3,000 feet; Mount Tyndall, 4,000 feet, *D. Petrie!*; Dusky Bay, on the mountains, *A. Reischek!*

A robust, leafy, sparingly-branched dwarf shrub, 1–4 feet high, perfectly glabrous in all its parts. Branches few, stout, straggling; old bark white and papery. Leaves coriaceous, 1–2½ inches long, oblong-obovate, broadly obovate, or nearly orbicular, rarely narrower and elliptical-oblong, obtuse or apiculate, narrowed into a short broad petiole; margins thickened, minutely serrulate; veins reticulated, very conspicuous on the under-surface. Stipules very large, triangular, margins ciliated. Inflorescence diœcious. *Males*: in axillary 3–7-flowered fascicles. Calyx apparently wanting. Corolla $\frac{1}{4}$–$\frac{1}{3}$ inch long, between funnel-shaped and campanulate, 4–5-lobed. Stamens, 4–5. *Females:* solitary, or in 3–5-flowered fascicles. Calyx adnate to the ovary, limb minute, cupular, sometimes with a few irregular teeth. Corolla $\frac{1}{5}$–$\frac{1}{4}$ inch long, tubular, shortly 3–5-lobed. Styles long and stout, often 1 inch long, cohering up to the mouth of the corolla. Drupe broadly oblong or sub-globose, $\frac{1}{4}$–$\frac{1}{3}$ inch long, reddish.

A remarkably distinct plant, at once recognized by the minutely serrulate leaves. It is usually found in sheltered places on steep mountain slopes, and rarely attains a greater height than four or five feet. The bark of the stem and branches is white and papery, and is easily detached. The leaves are often very coriaceous, perhaps more so than in most of the species. The male fascicles are often reduced to three or four flowers, and occasionally to a single one. The female flowers are generally solitary, although there is no difficulty in finding specimens with fascicles of three, and, more rarely, with five flowers.

It may be remarked, in passing, that in several of the species the very young leaves have their margins minutely incised or serrate, but the character is always an obscure one, and is never present in fully mature leaves, except in *C. serrulata*.

4. C. baueriana.

Endl., Iconog., t. iii.; Hook. fil., Flora Nov. Zeal., i., p. 105; Handbk. N.Z. Flora, p. 112. *C. lucida*, Endl., Prodr. Flor. Ins. Norfolk, p. 60, *non Forst.* *C. retusa*, Hook. fil., Lond. Journ. Bot., iii., p. 416. *Pelaphia retusa*, Banks et Sol., MSS.

North Island.—Abundant all round the coasts, on maritime rocks and sand-hills, but not found inland, save where planted by the Maoris in the cultivations, etc.

South Island.—Southern shores of Cook Strait, from Collingwood to Picton, but not common.

Chatham Island.—*J. Buchanan* ("Trans. N.Z. Inst.," vii., p. 336). Also found in Norfolk Island.

A shrub or small tree, very variable in size and habit of growth, in exposed rocky places often not more than 2–3 feet high, with almost prostrate branches; in rich sandy soils sometimes 15–25 feet, with a close head of spreading branches. Branches stout, glabrous, or the young ones minutely pubescent. Leaves bright shining green, almost fleshy, black when dry, 1–3 inches long, broadly ovate or oblong, rarely narrow oblong, obtuse or retuse, rarely sub-acute, quite glabrous; margins usually recurved, and often conspicuously so; veins finely reticulated. Stipules short and broad. *Male* flowers clustered in dense heads on short axillary peduncles. Calyx minute, cupular, obsoletely 4-toothed. Corolla campanulate, $\frac{1}{8}$–$\frac{1}{4}$ inch, 4 – 5-lobed. *Females:* Peduncles smaller and more slender than in the males, and heads smaller, rarely more than 3 – 6-flowered. Calyx-limb minute, truncate or obsoletely 4-toothed. Corolla smaller and narrower than in the males. Drupe oblong or ovoid, $\frac{1}{4}$ – $\frac{1}{3}$ inch long, yellowish-orange.

I doubt whether there is any real distinction between this species and *C. petiolata*. From *C. robusta* it is separated by its stouter and closer habit, more obtuse, and much more fleshy and glossy leaves, with recurved margins, by the smaller heads of flowers, and by the rounder fruit.

C. baueriana is more frequently seen in cultivation than any other species, chiefly on account of its very handsome glossy foliage and compact habit. States having the leaves variegated with white or yellow are not uncommon, and have been introduced into European gardens. It forms an excellent hedge, and as it is not easily affected by exposure to salt spray or drifting sand, is very suitable for planting in exposed places near the sea. Thus, at Taranaki, luxuriant garden hedges composed of it may be seen in situations open to the full force of the westerly gales.

At Maketu, in the Bay of Plenty, there exists a grove of this species, which the Maoris state had its origin from the skids which were used in pulling ashore the Arawa canoe, on its arrival in New Zealand with the first Maori immigrants. It is said that the skids were brought in the canoe from Hawaiiki, but the acceptance of this statement is rendered difficult by the fact that *C. baueriana* is not known to occur anywhere in Polynesia, or, indeed, out of New Zealand, save at Norfolk Island.

5. C. petiolata.

Hook. fil., Journ. Linn. Socy., i., p. 128; Handbk. N.Z. Flora, p. 113. *C. baueri*, F. Muell., Fragm. Phyt. Austr., ix., p. 69, *non C. baueriana, Endl.*

North Island.—Tapotopoto Bay, North Cape. *T. Kirk* ("Trans. N.Z. Inst.," i., p. 143); Castle Point, Wellington, *Colenso* ("Handbook").

Kermadec Islands.—McGillivray.

Also found in Lord Howe's Island and Norfolk Island.

With this species I am imperfectly acquainted. According to Sir Joseph Hooker it is distinguished from the preceding by the leaves being less fleshy, and by the young foliage and branches being covered with a minute pubescence. But *C. baueriana* often has the young branches covered with a minute velvety pubescence, and the leaves vary in texture. Sir F. Mueller, in his "Fragmenta" (vol. ix., p. 69), unites both species, and probably this is the correct view to take.

6. C. robusta.

Raoul, Choix des Plantes, 23, t. 21. Hook. fil., Flora Nov. Zeal., i. p. 105; Handbk. N.Z. Flora, p. 113.

North and South Islands.—Common in lowland districts, from the North Cape to Invercargill.

Chatham Islands.—*J. Buchanan* ("Trans. N.Z. Inst.," vii., p. 336).

A stout, leafy, glossy-green shrub, 6–15 feet high, perfectly glabrous in all its parts; bark greyish-brown. Leaves coriaceous, very variable in size and shape, $1\frac{1}{2}$–5 inches long, lanceolate to broad elliptic-oblong, acute, rarely obtuse, narrowed into short stout petioles, dark-green and shining above, paler below. Flowers clustered in axillary many-flowered glomerules. *Males:* Calyx minute, cupular, minutely 4 – 5-toothed or quite truncate. Corolla $\frac{1}{5}$–$\frac{1}{3}$ inch long, campanulate, shortly or deeply 3 – 5-lobed. Stamens, 3–5. *Females:* Much smaller, $\frac{1}{6}$ – $\frac{1}{4}$ inch long. Calyx-limb truncate, or rarely with a few irregular teeth. Corolla tubular, shortly 3 – 5-lobed. Drupes densely packed, oblong to ovoid, rarely obovoid, $\frac{1}{4}$–$\frac{1}{3}$ inch long, yellowish- or reddish-orange.

C. robusta has a very wide and general distribution. Unlike many of the other species, it is not restricted to any particular class of habitat, but is seen in all soils and situations, whether sheltered or exposed, near the sea or inland. As a rule, however, it does not ascend the mountains to a greater height than about 2,500 feet. In its ordinary state it is not at all difficult to recognize. The characters separating it from *C. lucida* I have pointed out under that species. From *C. baueriana* it is chiefly distinguished by its firm coriaceous leaves, which are not at all fleshy, by the much larger fascicles of flowers, and by the rather smaller and more pointed fruit. From *C. cunninghamii* it differs in the larger broader leaves, much more numerous flowers, and in the colour of the drupe, which appears to be always pale and transparent in *C. cunninghamii*. I have, however, intermediate forms which are difficult to place, judging from foliage and inflorescence alone. From *C. acutifolia*, *C. tenuifolia*, and *C. arborea*, it is at once separated by the texture and shape of the leaves, and by numerous other points.

7. C. cunninghamii.

Hook. fil., Handbk. N.Z. Flora, p. 113. *C. fœtidissima*, A. Cunn., Prodr., *in part*, *non Forst.*

North Island.—Not uncommon in the lowlands, chiefly in alluvial grounds by the banks of rivers.

South Island.—Usually near the coast. Various localities in Nelson, *T.F.C.* Banks Peninsula and lowlands of Canterbury, *Armstrong*, *T.F.C.* Otago: near Dunedin; Milton; Invercargill, etc., *D. Petrie!*

Chatham Islands.—*Dieffenbach* ("Handbook"); *Buchanan* ("Trans. N.Z. Inst.," vii., p. 336).

Altitudinal range from sea-level to 500 feet.

A large, sparingly-branched shrub, or small tree, 6–15 feet in height; bark pale. Leaves flat, coriaceous, variable in size, $\frac{1}{2}$–2 inches long, usually linear or linear-lanceolate, but occasionally broader and shorter and linear-oblong, acute, gradually narrowed into short stout petioles. Inflorescence composed of 3–12-flowered axillary glomerules. *Male* flowers $\frac{1}{6}$–$\frac{1}{5}$ inch long. Calyx minute, cupular, truncate, or obscurely lobed. Corolla campanulate, 4–5-lobed. *Female* flowers much smaller and narrower. Calyx-limb 4–5-toothed. Corolla $\frac{1}{8}$–$\frac{1}{6}$ inch, tubular, 3–5-lobed. Styles very long and stout. Drupe broad-oblong or sub-globose, pale, and semi-transparent.

Most closely allied to the preceding species, but in its usual state differing in the more slender open habit, pale bark, much smaller and narrower leaves, smaller fascicles of flowers, and particularly in the rounder, pale, and semi-transparent fruit. Intermediate states are plentiful, and some are very puzzling to place in the absence of fruit, especially some Otago specimens sent by Mr. Petrie, and which may be referable to small and narrow-leaved forms of *C. robusta.* It is also related to *C. propinqua*, which, however, can be easily separated by its more spreading habit, dark bark, smaller and narrower leaves, fewer flowers, and more elongated drupe.

8. C. acutifolia.

Hook. fil., Journ. Linn. Socy., Bot., I., p. 128; Handbook N.Z. Flora, p. 114.

Kermadec Islands.—McGillivray ("Handbook").

I am totally unacquainted with this species, and can add nothing to Sir J. D. Hooker's description. It seems to be allied on the one hand to *C. grandifolia*, and on the other to *C. tenuifolia*, but to be distinct from both. It is confined to the Kermadec Islands.

9. C. tenuifolia.

Cheeseman, Trans. N.Z. Inst., xviii., p. 315.

North Island.—Ruahine Mountains and other localities in Hawke's Bay, *W. Colenso!* Pirongia and Karioi Mountains, Mount Egmont Ranges, *T.F.C.* Forests between the Upper Wanganui and Taupo, *T. Kirk!*

I have already given a description of this species in the volume of the "Trans. N.Z. Inst." quoted above, and do not propose to repeat it here, as I have no fresh information to offer. The plant was first collected on the Ruahine Mountains by Mr. Colenso, many years ago. In the "Handbook" Sir Joseph Hooker referred it, with some doubt, to *C. acutifolia*. He now considers it to be distinct, and in this view is supported by Mr. N. E. Brown, who has pointed out to me that the venation of the leaves is entirely different in the two plants, and that *C. acutifolia* is quite glabrous, while *C. tenuifolia* is more or less pubescent on the stipules, young branchlets, and midrib and petioles. The inflorescence is probably quite distinct, but as at present the male flower of *C. acutifolia* and the young females of *C. tenuifolia* are alone known, it is difficult to form an opinion; although it seems likely that the inflorescence of *C. tenuifolia* will prove to be more compact than that of *C. acutifolia*.

10. C. arborea.

Kirk, Trans. N.Z. Inst., x., p. 420.

North Island.—Not uncommon from the North Cape southwards to the Waikato and Thames Rivers. Altitudinal range from sea-level to 1,000 feet.

A closely-branched round-headed tree, 20–30 feet high, with much of the habit and appearance of *Myrsine urvillei*. Trunk 6–14 inches in diameter, wood yellowish. Branchlets terete, puberulous towards the tips, bark greyish-brown. Leaves coriaceous, variable in size, 1–3 inches long, $\frac{1}{2}$ – $1\frac{1}{2}$ inches broad, ovate-spathulate or orbicular-spathulate, obtuse or retuse, suddenly narrowed into winged petioles $\frac{1}{5}$–$\frac{3}{4}$ inch long, yellowish-green above, often reddish below; veins closely reticulate; margins flat. Stipules short, triangular, finely ciliate when young. Flowers densely clustered in many-flowered glomerules or heads, which terminate the main branches as well as short axillary branchlets. *Males:* calyx narrow, deeply divided into 4–5 linear or linear-oblong ciliate lobes. Corolla campanulate, $\frac{1}{5}$-inch long, deeply 4–5-lobed, lobes broad, acute. Stamens 4–5, filaments very long. *Females:* glomerules smaller, usually 4–12-flowered. Calyx-limb 4–5-toothed. Corolla smaller and narrower than in the males. Drupes closely packed, globose, or more rarely broadly oblong or obovoid, colourless and semi-transparent, $\frac{1}{4}$–$\frac{1}{3}$ inch in diameter.

The largest species of the genus, and very distinct from any other. The foliage is nearest to that of *C. spathulata*, but is much larger, and the petioles much shorter in proportion. The male flowers are very closely packed, forming large spherical glomerules, and these are placed at the terminations of the main branches, as well as on short axillary branchlets. The calyx of the male flowers is better developed, and has deeper divisions than in any other species.

11. C. spathulata.

A. Cunn., Prodr. ii., p. 207; Hook. fil., Flora Nov. Zeal., i., p. 106; Handbk. N.Z. Flora, p. 114; Raoul, Choix des Plantes, p. 46. *Pelaphoides rotundiflora*, Banks et Sol., MSS.

North Island.—Abundant in forests from the North Cape to the Upper Waikato. Altitudinal range from sea-level to 1,000 feet.

A small shrub, rarely more than 5–6 feet in height. Branches few, slender and straggling, very young ones finely puberulous. Leaves rather distant, very variable in size, from $\frac{1}{2}$ to $1\frac{1}{2}$ inch long; blade orbicular or broadly oblong, obtuse, retuse, or emarginate, coriaceous, quite glabrous, suddenly narrowed into a narrow winged petiole which may be longer or shorter than the blade. Stipules triangular, cuspidate. *Male* flowers in 2–3-flowered axillary fascicles or solitary. Calyx deeply 4–5-lobed, invested at its base by an involucel composed of a pair of depauperated leaves and their stipules. Corolla campanulate, $\frac{1}{5}$–$\frac{1}{4}$ inch long, 4–5-lobed to the middle, lobes revolute. Stamens usually 4. *Females* usually solitary, but occasionally fascicled. Calyx-limb deeply 4-lobed, lobes erect, acute. Corolla rather smaller and narrower than in the males, funnel-shaped. Drupe globose, $\frac{1}{5}$–$\frac{1}{3}$ inch diameter, black and shining when fully ripe.

Allied to *C. arborea*, from which it is easily separated by the small size, different habit, smaller foliage on longer petioles, fewer flowers, and by the larger black fruit. The leaves are often a bronzy colour, shining and polished on the upper surface.

12. C. rotundifolia.

A. Cunn., Prodr., ii., p. 206; Hook. fil., Flora Nov. Zeal., i., p. 108; Handbook N.Z. Flora, p. 114; Raoul, Choix des Plantes, p. 46. *C. rufescens*, Colenso, Trans. N.Z. Inst., xviii., p. 261.

North and South Islands.—Common in alluvial soils at moderate elevations, from the North Cape to Invercargill. Altitudinal range from sea-level to 1,500 feet.

A large laxly-branched shrub, 6–12 feet high. Branches long and slender, widely-spreading, irregularly and sparsely branched, the young ones densely pubescent or almost villous towards the tips; bark greyish-brown. Leaves in distant opposite pairs, $\frac{1}{4}$–1 inch long, usually orbicular, but varying to broadly-oblong or ovate-oblong, cuspidate or abruptly acute, rarely obtuse, very thin and membranous, more or less pubescent and ciliate, especially on the margins and on the veins below, veins finely reticulated; petioles short, villous. Flowers in axillary few or many-flowered fascicles, rarely solitary. *Males:* True calyx absent, but in its place one or two membranous involucels composed of a pair of depauperated leaves and their stipules. Corolla broadly campanulate, $\frac{1}{10}$–$\frac{1}{8}$ inch long, deeply 4-lobed. Stamens, 4. *Female* flowers smaller and narrower than the male. Calyx adnate to the ovary, invested at the base by involucels similar to those of the male; limb minute, truncate, or obscurely toothed. Corolla $\frac{1}{10}-\frac{1}{12}$ inch, tubular, 3–4-lobed. Drupe variable in size, $\frac{1}{8}-\frac{1}{4}$ inch diameter, globose or broader than long, often didymous, red.

Distinguished from the following species by its spreading habit, large round leaves, usually densely aggregated flowers, and the smaller red drupe. From *C. tenuicaulis* it is removed by its coarser and more open habit, much larger and more membranous leaves, and by the colour of the drupe. *C. rubra* often closely approaches it in foliage; but the flowers are larger, and the drupe is oblong and yellow.

C. rotundifolia usually affects deep rich alluvial soils by the banks of rivers, and is particularly abundant in the swampy forests fringing the Northern Wairoa, Thames, Waikato, and other large streams in the North Island. The leaves are often deciduous, so that in spring the plant is usually quite bare. They are perhaps the most membrauous of the genus. The fruit is frequently didymous, as described in the "Handbook," but by no means invariably so.

13. C. areolata.

Cheeseman, Trans. N.Z. Inst., xvii., p. 315.

North Island.—Not uncommon in lowland districts.

South Island.—Nelson, plentiful, *T.F.C.* Westland, *A. Hamilton!* Canterbury, Banks Peninsula, *T.F.C.* Otago, not uncommon, *D. Cetrie.*

An erect, closely branched, shrub or small tree, 6–15 feet in height. Branches slender, close, fastigiate, ultimate pubescent or almost villous with soft greyish hairs. Leaves in opposite pairs, $\frac{1}{3}-\frac{2}{3}$ inch long, orbicular-spathulate, ovate-spathulate, or elliptic-spathulate, usually acute or apiculate, rather thin and membranous, flat, glabrous or nearly so above, usually pubescent on the veins below, suddenly narrowed into short hairy petioles; veins reticulated in large areoles. Flowers axillary, solitary or in few-flowered fascicles. *Males:* Usually 2–4 together, small, $\frac{1}{8}-\frac{1}{6}$ inch. True calyx wanting, but one or two calycine involucels closely invest the base of the corolla. Corolla broadly campanulate, deeply 4–5-lobed. *Females:* solitary, or two together, rarely more, $\frac{1}{10}-\frac{1}{8}$ inch long. Calyx-limb minute, truncate, or obscurely toothed. Corolla narrow, tubular. Drupe globose or broadly obovoid, $\frac{1}{6}-\frac{1}{4}$ inch diameter, reddish-black or nearly quite black.

Allied on one side to *C. rotundifolia*, and on the other to *C. tenuicaulis*. I have already pointed out its differences from the first of these, and *C. tenuicaulis* is at once separated by its smaller size, spreading branches, dark-coloured bark, more glabrous leaves and branchlets, smaller and more coriaceous leaves, and perfectly black globose fruit.

14. C. tenuicaulis.

Hook. fil., Flora Nov. Zeal., i., p. 106; Handbk. N.Z. Flora, p. 115.

North Island.—Not uncommon, especially in swampy forests. I have seen no South Island specimens. Altitudinal range from sea-level to 500 feet.

A densely and widely branched shrub, 4–8 feet high. Branches slender, bark plum-colour or dark purplish-brown; young branchlets finely and shortly puberulous. Leaves in opposite pairs, $\frac{1}{4}$–$\frac{1}{2}$ inch long, orbicular or ovate-spathulate, obtuse, somewhat coriaceous, flat, glabrous on both surfaces, narrowed into a broad flat petiole; veins reticulated in large areoles. Flowers axillary, solitary or more generally in 2–3-flowered fascicles. *Males:* No true calyx, but the usual calycine involucre present. Corolla broadly campanulate, $\frac{1}{6}$–$\frac{1}{8}$ inch long, 4–5-lobed. Stamens, 4–5. *Females:* tubular, $\frac{1}{7}$–$\frac{1}{8}$ inch long. Calyx-limb truncate. Corolla, 3–5-lobed. Drupe globose or depresso-globose, $\frac{1}{8}$–$\frac{1}{5}$ inch diameter, shining black.

A distinct and well-marked species, which keeps its characters well in all stations. I have already pointed out its differences from *C. areolata*, which is its nearest ally. It is also closely related to *C. rhamnoides*, some broad-leaved forms of which come very close. But *C. rhamnoides* always has much more pubescent branches, and usually narrower and more pointed leaves, with very different venation, and the drupe is usually red.

15. C. rhamnoides.

A. Cunn., Prodr., ii., p. 206; Hook. fil., Flora Nov. Zeal., i., p. 107; Handbk. N.Z. Flora, p. 116; Raoul, Choix des Plantes, p. 46. *C. divaricata*, A. Cunn. Prodr., ii., p. 207, *not of Hook. fil.* *C. concinna*, Col., Trans. N.Z. Inst., xvi., p. 330. *C. heterophylla*, Col., Trans. N.Z. Inst., xviii., p. 263. ? *C. gracilis*, A. Cunn., Prodr.

North and South Islands.—Abundant throughout, from the North Cape to Stewart Island. Altitudinal range from sea-level to 3,000 feet.

A small, densely-branched bush, 2–6 feet high. Branches spreading, stiff, rigid, and often interlaced in exposed places; more slender and open in shaded. Bark greyish, or reddish-brown, fissured. Ultimate branches densely pubescent, with short stiff white hairs. Leaves very variable in shape and texture, from orbicular or broadly-ovate to narrow oblong, and in some varieties lanceolate or even linear leaves are mixed with the broader ones; rounded, retuse, or acute, narrowed into a very short petiole, from coriaceous to almost membranous;

glabrous or puberulous on the under-surface, $\frac{1}{5}-\frac{3}{4}$ inch long by $\frac{1}{8}-\frac{1}{2}$ inch broad; veins reticulated and evident, except in the more coriaceous forms. Flowers axillary, or on short decurved lateral branchlets, solitary or in few-flowered fascicles. *Males:* True calyx wanting, but the usual cupuliform involucre composed of depauperated leaves and their stipules present. Corolla $\frac{1}{10}-\frac{1}{8}$ inch long, campanulate, 4 – 5-lobed to below the middle; lobes often recurved. Stamens, 4–5. *Females:* smaller, $\frac{1}{12}-\frac{1}{10}$ inch long. Calyx adnate to the ovary, its limb very short, truncate, or obsoletely toothed. Corolla tubular, 4-lobed to below the middle; lobes narrow, revolute. Drupe globose, usually bright red, occasionally black, $\frac{1}{5}$ inch diameter.

Var. *α. vera.*—Leaves orbicular or broadly-ovate, obtuse, often coriaceous. *C. rhamnoides*, A. Cunn.

Var. *β. divaricata.*—Leaves broadly ovate, oblong-ovate or oblong, acute, rather thin. Narrower leaves, linear or lanceolate, often mixed with the broader ones. *C. divaricata*, A. Cunn.; but not *C. divaricata*, Hook. fil.

One of the most puzzling and variable species of the genus. Two main forms are distinguishable, as described above; but it must be borne in mind that numerous intermediates occur, which might be placed under either head. Var. *α*, with rounded obtuse leaves, I am informed by Mr. N. E. Brown, answers to Cunningham's type-specimens of *C. rhamnoides*, now preserved in the Kew Herbarium. In its extreme state it is stiff and rigid, with coriaceous leaves; but the branches often become longer and more slender, and the leaves thinner, narrower, and sub-acute. In this state it is *C. concinna*, Colenso, as I find from specimens kindly forwarded by Mr. Colenso himself. Var. *β*, Mr. Brown assures me, is identical with the true *C. divaricata* of A. Cunningham, a very different plant to the *C. divaricata* of the "Handbook;" and with this view Sir J. D. Hooker now concurs. It varies much in the shape of its leaves—from nearly round to ovate, trowel-shaped, or oblong; but as a rule, they are narrower, thinner, and more acute than in the preceding variety, into which, however, it passes by insensible gradations. Some common subvarieties of it are remarkable for having narrow lanceolate or linear leaves mixed with those of the ordinary form; these leaves being most plentiful on the younger branches. Mr Colenso has described this as a distinct species, under the name of *C. heterophylla*.

The flowers are very uniform in both varieties, and offer no distinctive characters of importance. They are perhaps the smallest in the genus, *C. tenuicaulis*, *C. areolata*, and *C. rotundifolia* being the nearest in this respect. The fruit is always globose, and usually a dark red—"port-wine" colour. Some varieties, however, have a crimson drupe, and in others the fruit becomes nearly black when decaying.

16. C. ciliata.

(Hook. fil., Flora Antarct., i., p. 22; Handbk. N.Z. Flora, p. 115.)

Auckland and Campbell Islands.—Abundant ("Flora Antarctica").

I am not acquainted with this species, and can therefore add nothing to Sir J. D. Hooker's description. The flowers and fruit are unknown, and I am not sure that the plant will not prove to be a variety of *C. parviflora*, mountain forms of which often have ciliate leaves.

17. C. parviflora.

Hook. fil., Flora Nov. Zeal., i., p. 107; Handbk. N.Z. Flora, p. 116. *C. myrtillifolia*, Hook. fil., Flora Antarct., i., p. 21; Flora Nov. Zeal., i., p. 108 (var. *a*. only).

North and South Islands.—Abundant throughout, both in the lowlands and on the mountains.

Auckland Isles.—*Sir J. D. Hooker.*

Altitudinal range from sea-level to 4,000 feet.

A stout, erect, leafy shrub, 4–12 feet high. Branches stout or slender, much divided; branchlets often arranged in a horizontal plane, densely pubescent, sometimes quite shaggy; bark light grey. Leaves usually close set, fascicled on short lateral branchlets, $\frac{1}{5}-\frac{3}{4}$ inch long, $\frac{1}{10}-\frac{1}{4}$ inch broad, obovate, linear-obovate, or linear-oblong, obtuse and rounded at the tip, more rarely acute, coriaceous, flat or margins slightly recurved, glabrous, or the petiole and midrib slightly puberulous, or surfaces and margins ciliate with scattered soft hairs, gradually narrowed into short petioles, veins not conspicuous. Flowers solitary or 2–4 together. *Males:* True calyx wanting, but two minute 4-toothed involucels present at the base of the flower. Corolla $\frac{1}{10}-\frac{1}{8}$ inch long, broadly campanulate, 4–5-partite almost to the base. Stamens, 4–5. *Females:* Calycine involucels present as in the males. Calyx-limb minutely 4–5-toothed. Corolla $\frac{1}{12}-\frac{1}{10}$ inch, much narrower than in the males, and not so deeply cleft. Drupe globose, $\frac{1}{5}-\frac{1}{4}$ inch diameter, white or yellowish-white, translucent.

A well-marked and distinct species, which, though varying within certain limits, can always be distinguished from its allies by its leafy habit, pubescent branches, obovate or linear-obovate coriaceous leaves, and semi-transparent globose drupe. There are three main forms: the first, which may be considered the type of the species, is rather stout and closely branched, with moderately pubescent branches and obovate or linear-obovate coriaceous leaves, which are nearly glabrous. This form is found both in the lowlands and on the mountains. The second, which is common in many places on the mountains of Nelson and Canterbury, has a much more slender habit, softer more pubescent branches, and rather broader much thinner leaves, which are usually ciliate on both surfaces and margins with soft hairs. This might be distinguished as var. *pilosa.* The third form is stiff and rigid, and very closely branched, with white bark and very small almost linear leaves. It also is montane, and occurs in several places in the Southern Alps, from Nelson to Otago.

18. C. crassifolia.

Colenso, Tasmanian Journal of Natural Science.

North Island.—Whangarei, *T.F.C.*; Head of Manukau Harbour, *W. Colenso*, *T. Kirk!*, *T.F.C.* Sand-hills between Helensville and the West Coast, *T.F.C.*

South Island.—Nelson, Maitai Valley, and other places, *T.F.C.* Otago, not uncommon throughout the Province, *D. Petrie!*

A compact rigid bush, 6–12 feet high. Branches divaricating, excessively stiff and rigid, often interlacing. Bark reddish-brown or greyish-brown, rough, uneven, and fissured on the branches, smoother on the twigs. Ultimate branchlets glabrous or very finely puberulous. Leaves in pairs on opposite twigs, broadly oblong, ovate, or orbicular, rounded at the tip or retuse, suddenly narrowed into a very short puberulous petiole, flat, usually very thick and coriaceous, quite glabrous, often whitish below, $\frac{1}{5}-1$ inch long, $\frac{1}{6}-\frac{3}{4}$ inch broad; veins usually concealed; margins thickened. Flowers terminating short lateral often leafless branchlets (and thus appearing axillary), solitary or more rarely 2–3 together. *Males:* True calyx wanting, but one or more involucels present, composed of depauperated leaves and their stipules. Corolla $\frac{1}{6}-\frac{1}{4}$ inch long, campanulate, 4-lobed to nearly the base, Stamens, 4. *Females* tubular, $\frac{1}{8}-\frac{1}{6}$ inch long. Calyx adnate to the ovary, limb minute, truncate or obsoletely toothed. Drupe sub-globose or broadly oblong, $\frac{1}{5}-\frac{1}{4}$ inch diameter, dull yellow.

C. crassifolia, which is a distinct species, though closely allied to the following, was originally discovered by Mr. Colenso nearly 40 years ago, near the head of the Manukau Harbour. In the "Flora," and also in the "Handbook," Sir J. D. Hooker referred it, together with the three next species, to *C. divaricata*, A. Cunn. But Mr. N. E. Brown, who has lately carefully examined the whole of the Coprosmas in Cunningham's herbarium, has satisfied himself that the original type of *C. divaricata* is only a variety of *C. rhamnoides*, and that the four plants placed under it by Hooker are quite distinct, both from it and from one another. I understand that Sir Joseph Hooker now accepts this view. As a species, *C. crassifolia* is best distinguished by the excessively stiff and rigid habit, almost glabrous branchlets, rounded thick and coriaceous leaves, and sub-globose yellow fruit. The next species is separated by its more slender habit, narrower spathulate leaves, and more oblong drupe; *C. rubra* by its larger thin orbicular leaves, and much larger oblong fruit; while *C. virescens* is at once removed by its slender habit and thin spathulate leaves.

19. C. rigida, n. sp.

C. divaricata, Hook. fil., Flora Nov. Zeal., i., p. 107, in part; *non C. divaricata*, A. Cunn., Prodr.

North and South Islands.—Not uncommon throughout, in swampy forests.

A branching shrub or small tree, 5–15 feet high. Branches divaricating, stout or slender, open or much interlaced, glabrous or the very young twigs minutely pubescent; bark reddish-brown or plum colour. Leaves in opposite pairs on short lateral branchlets, $\frac{1}{4}$–$\frac{3}{4}$ inch long, obovate or oblong-spathulate, coriaceous but variable in texture, dark-green above but paler below, quite glabrous, gradually narrowed into short petioles, veins not reticulated. Stipules triangular, glabrous. Flowers solitary, or in 2–4-flowered fascicles on short lateral branchlets. *Males:* True calyx wanting, but one or more cupuliform involucres closely investing the base of the corolla. Corolla broadly campanulate, $\frac{1}{6}$–$\frac{1}{5}$ inch long, divided more than half-way down into 4–5 lobes. Stamens, 4–5. *Females:* Calyx adnate to the ovary, limb with 4–5 minute lobes. Corolla tubular, $\frac{1}{6}$–$\frac{1}{7}$ inch long, deeply 3–5-lobed. Drupe oblong, yellow, $\frac{1}{5}$–$\frac{1}{3}$ inch long.

This is one of the species included by Sir J. D. Hooker in *C. divaricata* of the "Flora" and "Handbook." It is very near to the preceding, but the habit is not nearly so rigid, the leaves are narrower and not so coriaceous, and the fruit is larger and more oblong.

20. C. rubra.

Petrie, Trans. N.Z. Inst., xvii., p. 269. *C. divaricata* var. *latifolia*, Hook. fil., Flora Nov. Zeal., i., p. 107; *non C. divaricata*, A. Cunn.

North Island.—*Colenso*, in Herb. Kew, Nos. 380, 1976.

South Island.—Otago: near Dunedin; Otepopo; Palmerston South, *D. Petrie!*

An open or closely branched shrub, 5–12 feet high; branches slender, divaricating, ultimate ones pubescent; bark reddish-brown, smooth. Leaves varying from broadly-oblong to nearly orbicular, obtuse or sub-acute, glabrous or ciliolate, rather thin and membranous, narrowed into rather long ciliolate petioles, $\frac{1}{4}$–$\frac{3}{4}$ inch long, $\frac{1}{6}$–$\frac{1}{2}$ inch wide; veins reticulated. Flowers sometimes solitary, but more generally in twos or threes on short lateral branchlets. *Males:* True calyx wanting, but one or more involucels closely invest the base of the corolla. Corolla $\frac{1}{8}$–$\frac{1}{6}$ inch long, bell-shaped, 4-lobed. Stamens, 4. *Females:* Calyx adnate to the ovary, limb minute, 4–5-toothed. Corolla tubular, 4-partite. Drupe oblong, $\frac{1}{4}$–$\frac{1}{3}$ inch long, yellowish-white, translucent.

This species has much resemblance in foliage and habit to *C. rotundifolia*, but differs altogether in the flowers and fruit, which clearly place it in the same section as the two preceding plants. It seems to have been originally discovered by Mr Colenso in some locality in the North Island; but I have myself only seen Mr. Petrie's specimens, collected in Otago. Mr. N. E. Brown informs me, however, that Mr. Colenso's specimens exactly match Mr. Petrie's.

21. C. virescens.

Petrie, Trans. N.Z. Inst., xi., p. 426. *C. divaricata* var. *pallida*, Hook. fil., Flora Nov. Zeal., i., p. 107; *non. C. divaricata*, A. Cunn.

North Island.—Wairarapa Valley, *Colenso.* (No. 333 in Herb. Kew.)

South Island.—Otago: vicinity of Dunedin; Otepopo, etc., *D. Petrie!*

A compact glabrous shrub, 6–12 feet high. Branches numerous, slender, interlaced; bark greenish. Leaves in pairs on opposite twigs, spathulate, obtuse, glabrous, membranous, $\frac{1}{5}$–$\frac{1}{3}$ inch long. Flowers solitary or in fascicles of two or three, terminating short lateral branchlets. *Males:* True calyx wanting, but the usual involucels formed of depauperated leaves and their stipules present. Corolla campanulate, deeply 4-lobed, $\frac{1}{8}$ inch long. *Females:* Calyx-limb indistinctly 4-toothed. Corolla tubular, deeply 4-lobed, smaller than in the males. Drupe oblong, $\frac{1}{4}$ inch long, greenish-white or yellowish, translucent.

A very distinct species, but perhaps more closely allied to *C. rubra* than any other. I give the North Island locality on the authority of Mr. N. E. Brown, who informs me that Mr. Colenso's specimens agree very well with Otago ones collected by Mr. Petrie.

22. C. acerosa.

A. Cunn., Prodr., p. 207; Hook. fil., Flora Nov. Zeal., i., p. 109; Handbk. N.Z. Flora, p. 118; Raoul, Choix des Plantes, p. 46.

North and South Islands.—Common throughout, from the North Cape to Stewart Island, and also in the Chatham Islands. Altitudinal range from sea-level to 4,000 feet.

A depressed, often excessively branched wide-spreading bush, 1–5 feet high. Branches numerous, spreading, trailing, or prostrate, tortuous and often interlaced, often zigzag, puberulous; bark yellowish-brown or dark-brown. Leaves in close or remote opposite pairs or fascicles, $\frac{1}{5}-\frac{3}{5}$ inch long, $\frac{1}{20}$ inch wide, very uniform in shape, narrow-linear, obtuse or sub-acute, sub-erect, rather rigid, veinless. Flowers apparently lateral, but in reality terminating minute arrested branchlets. *Males:* solitary, or in fascicles of 2–4. True calyx wanting, but one or two involucels present, composed of depauperated leaves and their stipules. Corolla broadly campanulate, $\frac{1}{6}$ inch long, 4-lobed to below the middle. Stamens 4, rarely 5. *Females* always solitary, invested at the base by calycine involucres similar to those of the males. Calyx adnate to the ovary, limb minutely 4-toothed. Corolla $\frac{1}{10}$ inch long, tubular, 4-lobed. Drupe globose, variable in size, $\frac{1}{6}-\frac{1}{2}$ inch, pale blue.

Var. α.—Sand-dune form. Yellowish-green; branches long, slender, much and closely interlaced. Leaves close set, rather long and slender. Flowers usually solitary.

Var. β.—Inland and mountain form. Browner and darker; branches not so numerous, stouter and more rigid; leaves often short and stiff; male flowers usually fascicled.

The typical form of this species is a most abundant plant on sand-hills all round the New Zealand coast. It has long weak flexuous and tortuous branches, which are usually much and closely interlaced, thus forming a dense scrambling bush 1–5 feet high. Var. β is by no means common in the North Island, but is plentiful in the elevated central districts of the South Island. Extreme forms of it, with few prostrate branches, shorter and stiffer, much more remote leaves, look very different to the typical state; but intermediates are common. As a species, *C. acerosa* is at once distinguished by its peculiar habit, extremely narrow leaves, and sky-blue drupe.

23. C. propinqua.

A. Cunn. Prodr., ii., p. 206; Hook. fil., Flora Nov. Zeal., i., p. 109; Handbk. N.Z. Flora, p. 116; Raoul, Choix des Plantes, p. 46. *Pelaphia parvifolia*, Banks et Sol., MSS.

North Island.—Abundant throughout, in swampy forests or by the sides of rivers.

South Island.—Not uncommon, extending as far as Stewart Island.

Chatham Islands.—H. Travers!

Altitudinal range from sea-level to 1,500 feet.

A large branching shrub or small tree, 6–20 feet high. Branches widely divaricating, glabrous or puberulous at the tips; bark brown, or brownish-grey. Leaves opposite or in opposite pairs, usually rather distant, $\frac{1}{4}-\frac{1}{2}$ inch long, $\frac{1}{12}-\frac{1}{8}$ inch wide, narrow linear-oblong, obtuse or sub-acute, rather coriaceous, gradually narrowed into a very short petiole or quite sessile. Flowers terminating short lateral branchlets. *Males:* In fascicles of 3–4, or, more rarely, solitary. True calyx wanting; but a 4-toothed cupuliform involucre, composed of a pair of depauperated leaves and their stipules, invests the base of each fascicle and also of each flower. Corolla broadly campanulate, $\frac{1}{6}-\frac{1}{5}$ inch long, deeply 5-lobed. Stamens, 4–5. *Females* solitary, much smaller than the males. Calyx adnate to the ovary, its limb 4-toothed or irregularly notched. Corolla tubular, $\frac{1}{7}-\frac{1}{8}$ inch long, 3–4-lobed. Drupe variable in shape, oblong to globose, $\frac{1}{3}$ inch long, blueish or blueish-black.

One of the largest of the species, being sometimes 20 feet high. It is allied on the one hand to *C. cunninghamii*, and on the other to *C. linariifolia*. From the first it differs in the more spreading habit, dark-coloured bark, smaller narrower leaves, and smaller and fewer flowers; from the last in the smaller, less acute, and more coriaceous leaves, in the stipules not being sheathing, in the inflorescence not being so distinctly terminal, and in the less-developed calyx of the female flowers. In the swampy kahikatea forests of the Thames and Waikato it is a most abundant plant, often forming the chief undergrowth over large areas. Though common in the South Island, it does not seem to attain the same size as in the North.

24. C. linariifolia.

Hook. fil., Handbk. N.Z. Flora, p. 118. *C. propinqua* var. γ. Hook. fil., Flora Nov. Zeal., i., p. 109.

North Island.—Hilly and mountainous districts, and in the interior, as far north as the Thames Valley.

South Island.—Abundant throughout, especially in river valleys.

Altitudinal range, from sea-level to 2,500 feet.

A large branching shrub or small tree, 6–20 feet high. Branches slender, spreading; younger puberulous; bark dark-grey. Leaves all opposite, $\frac{1}{2}-1\frac{1}{2}$ inch long, $\frac{1}{8}-\frac{1}{4}$ inch broad, linear or linear-lanceolate, more rarely oblong-lanceolate, acute or acuminate, flat, hardly coriaceous, suddenly narrowed into rather short slender petioles, blackish when dry, veins indistinct. Stipules glabrous or puberulous, upper ones connate for some length and sheathing the branch, margins usually ciliate. Flowers terminating leafy lateral branchlets. *Males:* in 3–5-flowered fascicles; each fascicle enclosed in one or two involucels composed of depauperated leaves and their stipules, and each flower with minute bracts at its base. True calyx wanting. Corolla broadly campanulate, $\frac{1}{6}-\frac{1}{4}$ inch long, divided about half-way down into 4–5 lobes; lobes usually revolute. Stamens, 4–5. *Females:* always solitary, seated within one or two involucels similar to those of the male fascicles. Calyx limb with 4–5 large oblong erect lobes. Corolla $\frac{1}{8}$ inch long, tubular. Drupe broadly oblong, $\frac{1}{3}$ inch long, pale and semi-transparent, with blueish streaks, crowned by the persistent calyx lobes.

The long sheathing stipules form a conspicuous, though variable, character for this species. In several respects it approaches *C. propinqua* and *C. cunninghamii.* I have already pointed out its differences from the first of these; and *C. cunninghamii* is easily separated by its larger paler foliage and more numerous flowers, the females of which have not the long calyx lobes of *C. linariifolia.* In exposed mountainous localities the habit becomes more compact, and the leaves shorter, broader, and more coriaceous, thus showing an approach to *C. cuneata.*

25. C. fœtidissima.

Forst., Prodr., No. 138; D.C., Prodr., iv., p. 578; A. Rich., Flora Nov. Zel., p. 261; A. Cunn., Prodr., ii., p. 206; Hook. fil., Flora Antarct., i., p. 20; Flora Nov. Zeal., i., p. 105; Handbk. N.Z. Flora, p. 116; Raoul, Choix des Plantes, p. 46. *C. affinis*, Hook. fil., Flora Antarct., i., p. 21.

North Island.—Chiefly in hilly and mountainous localities, but not common to the north of the East Cape, although extending as far as the Thames Goldfields.

South Island.—Abundant throughout, especially in the interior.

Auckland and Campbell Islands.—Plentiful, *Sir J. D. Hooker* and others. Altitudinal range from sea-level to 5,000 feet.

Usually a slender, sparingly branched shrub or small tree, 6–15 feet high, but occasionally attaining a greater size, and in the Auckland Isles reaching 20 feet, with a trunk $1\frac{1}{2}$ feet in diameter (Hook. fil., "Flora Antarctica"); intensely fœtid when bruised or while being dried. Branches slender, terete or tetragonous, glabrous or the very young ones minutely puberulous; bark pale. Leaves variable in size and shape, $\frac{1}{2}$ – 2 inches long, $\frac{1}{4}$ – $\frac{3}{4}$ inches broad, usually oblong, but varying from linear-oblong or linear-obovate to rounded oblong or broad-ovate, obtuse, acute, or retuse, narrowed into rather long and slender petioles, rather membranous, or in some varieties coriaceous; margins flat; veins indistinct or few and diverging. Stipules short and broad, cuspidate, often puberulous, margins ciliate. Flowers sessile, terminating the branchlets. *Males:* solitary or two or three together; rather large, $\frac{1}{3}$–$\frac{2}{3}$ inch long, often decurved. Calyx minute, cupular, irregularly 4-lobed, not always present, closely invested at its base by one or two cupuliform involucres composed of modified leaves and their stipules. Corolla campanulate, divided about half-way down into 4–5, rarely 8–10, lobes. Stamens the same number as the lobes. *Females:* always solitary, erect, $\frac{1}{4}$–$\frac{1}{3}$ inch long. Calyx adnate to the ovary, limb truncate or obscurely toothed. Corolla tubular, 3 - 4-lobed. Drupe $\frac{1}{3}$ inch long, oblong or ovoid, generally pale red in southern specimens, often white and transparent in the north.

C. fœtidissima forms a very considerable proportion of the undergrowth in the mountain forests of the South Island, but is not nearly so plentiful in the North. The horribly disagreeable odour of the leaves when bruised or drying, and the large terminal flowers, render it easy to recognise. The flowers are very frequently polygamous, and when so the calyx is always well-developed, which is not always the case in the normal male flowers. Its nearest ally is the following species.

26. C. colensoi.

Hook. fil., Handbk. N.Z. Flora., p. 117. *C. myrtillifolia* var. *linearis*, Hook. fil., Flora Nov. Zeal., i., p. 108.

North Island.—Thames goldfields, *J. Adams!* Te Aroha, Pirongia, and Karioi Mountains, altitude 1,500 to 3,000 feet, *T.F.C.* Mountains near Cook Strait, *Colenso* ("Handbook").

South Island.—Stewart Island, *D. Petrie!*

A small, slender, open or closely-branched shrub, 4–8 feet high. Branches slender, terete, puberulous; bark pale, when old often loose and papery. Leaves yellowish-green, variable in size, $\frac{1}{2}$ - 1 inch long, linear-oblong or linear-obovate to broad-oblong or obovate, obtuse, retuse, or emarginate, rarely acute, narrowed into rather slender petioles, rather membranous; margins flat or slightly recurved; veins usually indistinct. Flowers solitary, terminating the branchlets. *Males:* On very short decurved pedicels. True calyx wanting, but corolla seated in an involucel composed of a pair of depauperated leaves and their stipules. Corolla small, $\frac{1}{8}$ inch long, broadly campanulate, 4-lobed. Stamens, 4–5. *Females:* On short decurved pedicels as in the males. Calyx-limb minute, 4 - 5-toothed. Corolla not seen. Drupe (unripe) oblong, $\frac{1}{6}$ inch long.

It will be noticed that the above description, which is drawn up entirely from specimens collected by myself on Te Aroha and Pirongia mountains, hardly corresponds with that given in the "Handbook." Sir Joseph Hooker, who has examined my specimens, is inclined to think that they represent a new species; but Mr. N. E. Brown places them under *C. colensoi*; stating, however, that they do not match the typical form of that plant. Not being acquainted with the true *C. colensoi*, I can hardly state what the differences are, for in a genus like *Coprosma* too much reliance cannot be placed on descriptions alone. However, the most prudent course is to keep the two plants under the one name until further information is obtained. Mr. Petrie's specimens from Stewart Island have very much more coriaceous leaves, with different venation, and may be true *C. colensoi;* but as they have neither flowers nor fruit, it is difficult to pronounce on them.

27. C. cuneata.

Hook. fil., Flora Antarct., i., p. 21, t. 15; Flora Nov. Zeal. i., p. 110; Handbk. N.Z. Flora, p. 117.

North Island.—Mount Egmont, abundant, 3,500 to 5,000 feet altitude. *Dieffenbach, T.F.C.* Ruahine Mountains, *Colenso, H. Tryon!* Lake Taupo, and Hikurangi, *Colenso.*

South Island.—Abundant in mountain districts.

Auckland and Campbell Islands.—Sir J. D. Hooker.

Altitudinal range from 500 to 5,000 feet.

A stout, densely-branched shrub, 2–10 feet high, in alpine situations becoming smaller and still more compact and rigid. Branches stout, usually densely leafy, the younger ones puberulous; bark dark-grey or brown. Leaves close set, often crowded on short lateral branchlets, variable in size, $\frac{1}{5}$–$\frac{3}{4}$ inch long, $\frac{1}{10}$–$\frac{1}{4}$ inch wide, obovate-lanceolate, linear-obovate, or oblong-obovate, more rarely cuneate-oblong, obtuse or sub-acute, patent or recurved, rigid and coriaceous, often concave above, almost veinless, margins often slightly recurved. Stipules short and broad, when young with the margins densely fimbriate or ciliate. Flowers solitary, terminating the branchlets, sessile. *Males:* True calyx wanting, but the base of the corolla invested by one or two involucels. Corolla $\frac{1}{4}$–$\frac{1}{3}$ inch long, broad campanulate, tube short and narrow, lobes widely spreading, 4 or 5. *Females:* Calyx-limb 4-lobed, lobes rather long, blunt, unequal. Corolla shorter and narrower than the males, $\frac{1}{5}$–$\frac{1}{4}$ inch long, 4-lobed to the middle or below. Drupe globose, $\frac{1}{8}$–$\frac{1}{6}$ inch diameter.

One of the most variable species of the genus, but well-marked off from any other by its dense and leafy habit, broad fimbriate stipules, coriaceous recurved linear-obovate or cuneate leaves, which are often concave above, and by the rather large terminal flowers. It varies exceedingly in size, and when high up on the mountains is often reduced to a bush little more than a foot in height, the leaves, etc., being correspondingly reduced. It is exceedingly abundant on the slopes of Mount Egmont, near the upper limit of the forest, forming a leafy shrub 12 feet in height, or even more, and with leaves sometimes $\frac{3}{4}$ inch in length. Further up the mountain it forms a dense scrub, 2–3 feet high, with close and matted branches. North Island specimens appear to have stouter branches and broader leaves than the majority of those from the South Island.

28. C. microcarpa.

Hook. fil., Flora Nov. Zeal., i., p. 110; Handbk. N.Z. Flora, p. 118.

North Island.—"Tops of the Ruahine Mountains, *Colenso*" ("Handbook").

I am either unacquainted with this species, or have not identified it, and can consequently add nothing to Sir Joseph Hooker's description. It appears to differ from *C. cuneata* in its slender habit, and narrower thin and flat leaves.

29. C. depressa.

Colenso; Hook. fil., Flora Nov. Zeal., i., p. 110; Handbk. N.Z. Flora, p. 118.

North Island.—Lake Taupo, and Ruahine Mountains, *Colenso;* Mount Egmont, *T.F.C.*

South Island.—Mount Arthur plateau, Nelson, altitude 4,000 to 5,000 feet, *T.F.C.*

A low, densely-branched, often prostrate bush, 2–4 feet high. Branches leafy, trailing or prostrate, puberulous; bark greyish. Leaves opposite or in opposite fascicles, linear-lanceolate, about $\frac{1}{5}$ inch long by $\frac{1}{15}$ inch wide, acute or obtuse, rigid and coriaceous, veinless, somewhat concave, glabrous or with a few scattered hairs towards the margins, sub-erect patent or recurved, narrowed into very short stout petioles. Stipules short and broad, ciliate on the margins. Flowers terminating the branchlets, solitary, sessile. *Males:* True calyx wanting, but the usual calycine involucels present. Corolla $\frac{1}{10}$ – $\frac{1}{8}$ inch long, campanulate, deeply 4-lobed. Stamens, 4. *Females:* Invested by involucels similar to those of the males. Calyx-limb 3–4-toothed. Corolla $\frac{1}{10}$ inch, deeply 4-lobed. Styles 2, short and stout. Drupe globose, $\frac{1}{8}$ inch diameter, yellowish-red.

The plant described above is not uncommon on the Mount Arthur plateau, Nelson; and is, I think, identical with Colenso's *C. depressa.* It is principally separated from *C. cuneata* by its smaller size, more slender and prostrate habit, and by the smaller narrower leaves. Small forms of *C. cuneata*, however, approach very close to it, and it may prove to be a variety only.

30. C. repens.

Hook. fil., Flora Antarct., i., p. 22, t. 16A; Flora Nov. Zeal., i., p. 110; Handbk. N.Z. Flora, p. 119. *C. pumila*, Hook. fil., Flora Antarct., ii., App., p. 543; Flora Nov. Zeal., i., p. 110; Handbk. N.Z. Flora, p. 119.

North and South Islands.—Common in alpine localities, altitude 2,500 to 6,000 feet.

Auckland and Campbell Islands.—Common from sea-level to the tops of the mountains. *Sir J. D. Hooker* ("Flora Antarctica").

A small alpine creeping species. Branches glabrous, long or short, 4–18 inches, often closely matted together, prostrate and rooting, bark pale or dark grey. Leaves usually close-set, but sometimes distant, sub-erect or patent, bright-green, coriaceous and somewhat rigid, $\frac{1}{8}-\frac{1}{3}$ inch long, linear-oblong or linear-obovate to broad oblong or broad obovate, acute or obtuse, narrowed into very short broad petioles or nearly sessile; veinless. Stipules short and broad, obtuse, often ciliate. Flowers greenish-white, solitary, terminating short erect branchlets. *Males:* Large for the size of the plant, $\frac{1}{3}-1$ inch long. Calyx present, small, cupular 4–8-toothed. Corolla tubular, often curved, shortly 4–8-toothed. Stamens, 4–8; filaments often twice as long as the corolla; anthers narrow, large. *Females:* Much smaller, seldom more than $\frac{1}{3}$ inch long. Calyx-limb 4–8-toothed. Corolla tubular, 4–8-lobed to about one-third way down. Styles 2–4 or 5. Drupe globose, $\frac{1}{4}-\frac{1}{3}$ inch diameter, red; nuts, 2–4.

C. repens is easily distinguished from all the New Zealand species of *Coprosma*, except *C. petriei*, by its small size and creeping and prostrate habit. From *C. petriei* it is separated by the rather larger and broader always glabrous leaves, much larger tubular male flowers, and red globose drupe. It will be noticed that I have treated *C. pumila*, Hook. fil., as a synonym of *C. repens*. This I have done on the authority of Mr. N. E. Brown, of the Kew Herbarium, who informs me that, after a careful examination of the specimens on which the species was based, he can find no sufficient characters to separate it from *C. repens*. As I understand that Sir Joseph Hooker accepts this view, and as I have had no opportunity of examining the types, I am inclined to follow it also. There is a probability, however, that a closely-allied species exists, differing from *C. repens* to a certain extent in habit, in floral characters, and in the much larger purple drupe. I understand that Mr. Kirk considers this to be the true *C. pumila;* but this view is not supported by the description given in the "Handbook," where the fruit is described as orange-yellow. It does not follow that, because a species allied to *C. repens* probably exists, it must of necessity answer to Hooker's *C. pumila*.

31. C. petriei.

Cheeseman, Trans. N.Z. Inst., xviii., p. 316.

South Island.—Mount Arthur, Nelson, altitude 4,000 to 6,000 feet, *T.F.C.* Mountains near Lake Tekapo, Canterbury, 4,000 feet, *T.F.C.*; uplands in the interior of Otago, common, *D. Petrie!*

A small species, with prostrate and creeping stems. Branches 6–18 inches long, usually densely matted, creeping and rooting, glabrous or puberulous. Leaves close-set or distant, erecto-patent, $\frac{1}{10}$ – $\frac{1}{4}$ inch long, linear-oblong or linear-obovate, acute or obtuse, narrowed into short petioles or sessile, veinless, glabrous, or margins and both surfaces sprinkled over with short white hairs. Flowers solitary, terminating short erect branchlets. *Males:* $\frac{1}{5}$ – $\frac{1}{3}$ inch long. True calyx wanting; but the usual calycine involucels investing the base of the corolla. Corolla tubular at the base, campanulate above, 4-lobed. *Females:* smaller, $\frac{1}{10}$ inch long. Calyx-limb irregularly toothed. Corolla short, broadly tubular, 4-lobed to below the middle. Drupe globose, $\frac{1}{6}$ inch diameter; red in Mount Arthur specimens, but blueish in Otago, according to Mr. Petrie.

Apparently a very distinct little plant, at once separated from *C. repens* by the shape of the male corolla.

Art. XXXII. — *A few Observations on the Tree-Ferns of New Zealand; with particular Reference to their peculiar Epiphytes, their Habit, and their manner of Growth.*

By W. Colenso, F.R.S., F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 9th August,* 1886.]

Plate XIX.

I.—General, or Common.

Not being acquainted with the living botany of the South Island, my remarks will be necessarily confined to the tree-ferns of the North Island: at the same time I think that many of those plants are nearly as common there as they are here.

Tree-ferns are general throughout the North Island, in forests, on the edges of woods, and on the banks of streams; they are found in dry hilly woods as well as in the low wet ones, but are more numerous and gregarious in the latter. Mostly growing singly, scattered among the trees of the forest; not unfrequently, however, in small clumps, especially on low alluvial flats or tongues of land in the woods bounded on two sides by watercourses; and, more rarely, in tolerably large and continuous groves in wet situations between hills, in forests.

The number of species at present known of tree-ferns is 11.* These are classed under 4 genera, viz., *Cyathea, Hemitelia, Dicksonia,* and *Alsophila.* Of those 4 genera, *Cyathea* has 5, and *Dicksonia* 4, species; *Hemitelia* possesses 2, and *Alsophila*

* Of these, 7 are described in the "Handbook, Flora of New Zealand," and "Synopsis Filicum;" and 4 (since discovered) in "Trans. N.Z. Inst.," vols. xi., xv., and xviii.

but 1. This last fern is much more rare, and affects a higher altitude than the others, having been only met with by me in the *Fagus* forests of the Ruahine mountain range, 2,000 feet altitude and upwards. Of all the genera, *Dicksonia* is the most common, especially in the southern parts of this island. Most of the species are endemic; one or two of them are stated to inhabit Tasmania and Australia; and the most striking and distinct one of all, *Cyathea dealbata* (the "Silver-tree-fern"), is said to be found in Lord Howe Islands, in latitude 32° S., between the North Cape of New Zealand and Sydney.

They are usually of a single stem, erect and columnar, and devoid of branches, with a spreading crown of large regular and elegant palm-like fronds, gracefully radiating from the top and forming a living circle. In some species, especially of *Cyathea*, (*e.g.*, *C. medullaris*, Forst., and *C. polyneuron*, Col.,) their fronds attain to a very large size; I have measured them 15–20 feet long and proportionately broad; when large they are gracefully arched; when small are often extended, and nearly plane. Sometimes, however, their stems are inclined, others are gradually curved, and others drooping — particularly when springing from the sides of a declivity or ravine, or when overhanging a stream. They are of various heights and thicknesses, some species being taller and slenderer than others, ranging in height from 6 to 45 feet, and in thickness from 4 inches to 2 feet: only one species, however, (*Dicksonia fibrosa*, Col.,) attains to the maximum thickness; while *Dicksonia squarrosa*, *D. gracilis*, and most of the species of *Cyathea* and of *Hemitelia* are among the tallest. Our single known species of *Alsophila* is the shortest, and is sometimes stemless.

They are very rarely met with bearing branches; I have, however, seen a few 2-branched, and two specimens 3-branched; and occasionally 2, 3, or 4 springing closely together from the ground, as if fascicled below at the base.

Sometimes their trunks are quite clean, and devoid of epiphytal vegetation; more commonly, however, they are clothed with a dense mass of epiphytes; the stems of some species, when clear, often present a neat appearance throughout, from the regularity of the broken bases of their stipites, which add much to their beauty; while others show no such remains, but, instead, a dense and ever-increasing mass of hardened surface rootlets, which generally assume a pretty even appearance, growing circularly around the stem after the manner of bark, but now and then shooting downwards irregularly in long shaggy masses; this last feature, however, generally pertains to the lower side of curved stems. And while on some trunks there are few or no withered fronds hanging from above beneath the living crown of the fern-tree, others are completely enveloped in their old pendulous fronds, the growth of many years, presenting a curious bushy spectacle, appearing in the quiet sheltered recesses of the ancient forests as if no disturbance had ever there taken place, for not one old frond had fallen from above! As a natural consequence, in such cases the stems underneath are clean and free from epiphytes.

The epiphytal vegetation common to the stems of the tree-ferns is in some respects peculiar and worthy of notice. For, while such is mainly composed of some of our smallest and most delicate ferns, (of *Hepaticæ*, and one or two species of mosses, and not unfrequently a small *Astelia*,) some of the larger trees of the forest are often seen springing from their stems; these not unfrequently flourish in their peculiar situations, and sometimes grow to a large size, lofty, overtopping the fern-tree itself, and sometimes, though rarely, killing it by its close embrace; more usually, both seem to flourish and enjoy their curious reciprocal attachment. The trees that are commonly found so combined with the fern-tree are *Weinmannia* (sps.), and *Panax arborea*, and *Ackama rosæfolia* in the forests at the North, the peculiar locality of this genus.

The ferns that often clothe and completely hide the trunks of the tree-ferns comprise the smaller species of *Hymenophyllum*, as *H. nitens*, *H. tunbridgense* (and its varieties), and *H. rarum*; also, *Trichomanes venosum*, and its near ally *T. venustula*; indeed, such may truly be called the proper home of these two *Trichomanes*, as well as of *Hymenophyllum tunbridgense*, for nowhere else are these pretty little ferns to be found growing so luxuriantly. It is a beautiful object to contemplate the whole stem of a large tree-fern so dressed and decorated by Nature! often extending completely and closely around the trunk, and that for several feet; their little elegant glistening light-green fronds, so very regular, too, in their manner of pendulous growth, overlapping each other and imbricating like scales. Here is also the home of that highly curious fern *Tmesipteris*, never found growing on the earth, and rarely found on any other plant; and very recently a small and new species* of the closely-allied genus *Lycopodium* has been detected growing thereon; while a small elegant moss, *Hymenodon piliferus*, (the only New Zealand species of that genus,) is sure to be found deeply ensconced between the numerous dead stipites, and growing freely in its dry abode. Two or three species of delicate small frondose *Hepaticæ* (*e.g.*, *Symphyogyna sub-simplex*, *S. brevicaulis*, *S. simplex*, *Podomitrium*, *Phyllanthus*, etc.,) are also at home there, snugly nestling deep in the crevices of the stems, from which it is a difficult matter to dislodge them without breaking; while some of the larger *Hepaticæ*, as the dendroid *Plagiochilæ*, are often found growing

* A full description of this little novelty has been prepared, and will be iven in a following paper.

luxuriantly upon their trunks, completely enwrapping them below, especially in low, wet, shaded woods.

Other and larger ferns than those mentioned are not unfrequently to be met with, depending from the trunks of the tree-ferns, as *Hymenophyllum dilatatum*, *H. demissum*, *H. multifidum*, *Asplenium falcatum*, *A. flaccidum*, and *Polypodium* (species); also *Lycopodium varium*; but then these are much more common and plentiful elsewhere, both on trees and on the ground.

II.—PARTICULAR, OR UNCOMMON.

Under this heading I wish to state what I have more recently seen, which, indeed, is the main cause of my writing this paper. During the last three to four years I have noticed some extraordinary things pertaining to the tree-ferns.

1. *As to their great number in one spot, and their manner of growth there.*—In certain unfrequented localities in the dense forest of the Seventy-mile Bush, which I explored at different times, I suddenly came upon two or three groves of tree-ferns: one in particular I will attempt to describe. On a flat in the heart of the forest, in a deep hollow lying between steep hills, the bottom of which for want of drainage was very wet and uneven, and contained much deep vegetable mud and water even in the driest summer season, I found a large and continuous grove or thicket of very tall tree-ferns, chiefly *Dicksonia squarrosa*, and *D. fibrosa*, with a few of *Cyathea dealbata* intermixed, with but few forest trees and shrubs growing scattered among them. I suppose they occupied about 3 roods of ground, and I estimated their number to be from 800 to 1,000. They were all lofty, from 25 to 35 feet high, and in many places growing so close together that it was impossible to force one's way through them. Their trunks were most profusely covered with the usual epiphytal ferns (those smaller ones already mentioned). Conspicuous, however, among them, was that very rare fern in these parts, *Hymenophyllum subtilissimum*, Kunze, (*H. frankliniarum*, Col.,*) which literally clothed their trunks from top to base, intermixing below in the more humid spots with a fine dendroid *Plagiochila* (sp. nov.) of most luxuriant growth.† The ground, too, with rotting logs and stumps below, was densely covered with various fine *Hepaticæ* of several genera, (as *Plagiochila*, *Gottschea*, *Lepidozia*, *Mastigobryum*, *Podomitrium*, *Symphyogyna*, etc.,) while here and there among them were several lovely and rare mosses of the genera *Hypopterygium*, *Cyatrophorum*, and *Hookeria*; and on the higher and drier stumps and mounds grew graceful undisturbed cushions of *Leucobryum candidum*, plentifully in fruit, rather a rare occurrence.

* *Hymenophyllum æruginosum*, Carm., of "Handbook N.Z. Flora."

† The description of this fine species will be given in a following paper.

A few of those tree-ferns were 2-branched; one, I noticed bearing three branches; all of the branches were at some height from the ground, and rose just as high as the parent stock. Several of those tree-ferns grew in little clumps of 3, 4, or 5, arising from small mounds 2 feet high or so, with deep watery muddy holes between them; their stems were very close together, and appeared as if fascicled or springing from one root-stock below; while above they not unfrequently diverged from the perpendicular.

Familiar as I have long been with our New Zealand forests and their denizens, I gazed with astonishment in this deep and secluded grove of tree-ferns! for I had never before witnessed such a grand display of them; neither had I seen for upwards of 40 years* this pretty species of soft silky *Hymenophyllum* that was here so exceedingly common. Very certain I am that it does not grow in those several and many scattered parts of that same extensive forest which I have so frequently visited during these last 10–12 years.

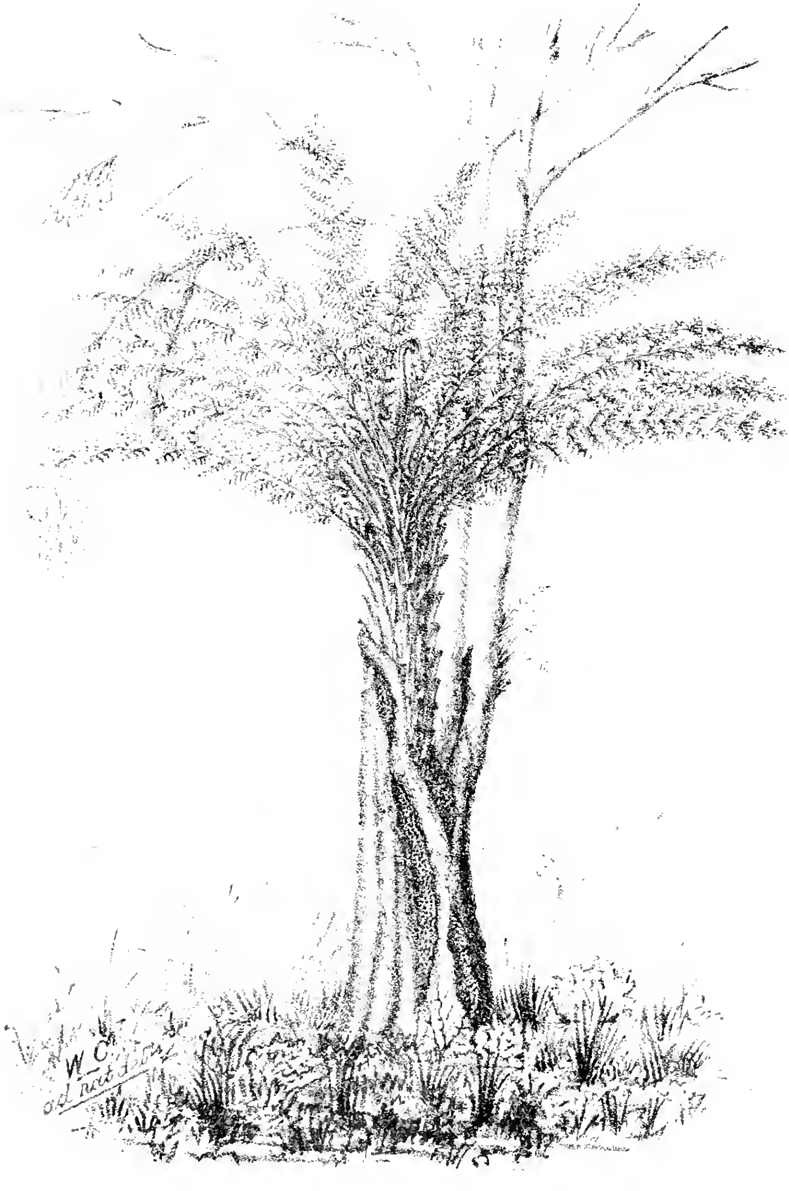
From this wet wood I brought away several fine *Hepaticæ;* particularly that superb *Gottschea, G. dichotoma,* Col.,† the largest known New Zealand species. This fine plant (which I have only detected in this locality,) completely and thickly covered a large old stump, hanging gracefully down around its top, reminding one of a rich-looking fringed circular cushion or hassock. The ground or mud in many places was thickly covered with long irregular patches of an erect species of *Symphyogyna,* which I believe to be new.‡ This genus is mostly gregarious in small lots, but I never before saw it growing in such profusion, and so very compact and large, somewhat resembling beds of curled cress or parsley. Places and spots of botanical beauty or novelty, however, (like all other things,) have their drawbacks or opposites: the worst feature here was the very bad footing, causing much tumbling about and splashing and sinking, between slippery and hidden rotting roots and branches, into deep black vegetable mud up to one's knees; and then there was the haunting fear of some accident happening, through which I should not be able to get out of this tangled labyrinth; and, as a matter of course, in that distant and unfrequented spot, should not be easily or early found, if ever found at all!

2. *As to the very peculiar growth of some tree-ferns, caused by*

* Originally discovered in the mountainous woods of the interior, N.W. of Lake Waikare, in 1841, and published in 1842 in the "Tasmanian Journal of Natural Science," vol. i., p. 378; also vol. ii., p. 183.

† See "Trans. N.Z. Inst.," vol. xviii., p. 281.

‡ Since ascertained to be such: a description of this plant will also be given in a paper to follow.



SKETCH (UNFINISHED) OF A FERN TREE (CYATHEA DEALBATA.) ENCIRCLED IN GROWTH BY A PANAX ARBOREUM.

their own epiphytes.—Some novel instances of this nature I have occasionally met with, a few of them being very strange.

(1.) I have already said tree-ferns are often found with young plants of *Weinmannia* (sps.), and of *Panax arborea*, springing from their stocks at some distance above the ground. These trees also grow to a considerable size—of 3, 5 and 7 feet, and are well-branched and flourishing, although their roots do not reach down to the earth. A few of them, however, of a much larger size, 14–16 feet high, that I have seen and examined, send down their trunks (I can hardly term them roots) from the place where they had sprung from seed on the stock of the fern-tree into the ground, (sometimes in two or three branches or ramifications,) closely adhering to the fern-tree and partly intertwining its stem.

(2.) In a dry wood on the bank of the River Mangatawhainui I saw several specimens of this nature. One aged fern-tree had its base completely surrounded at the surface of the ground by a large *Weinmannia racemosa*, that had originally sprung from its stock, which also adhered to it above on one side for several feet. Another fern-tree had a *Weinmannia* embracing it on the one side, and on the opposite side a *Panax arborea*, (this latter very largely and closely,) and both trees had originally sprung from the trunk of the fern-tree, and thence descended to the earth. I noticed one tree-fern in particular, that was wholly separated below from the earth, having its caudex closely hugged for 2–3 feet by a large branching *Panax arborea*, whose branches or divided stem (I cannot call them roots) descended from the original point of first growth above in the stock of the fern-tree, and enwrapping it at intervals had held it fast, wholly immovable, as if the two trees had coalesced into one. This was on the side of a dry hill, and the rains, etc., in past years, had completely washed away the soil and small vegetation from beneath and around the base of the fern-tree; the fern, however (a *Cyathea dealbata*), was of a large size and most luxuriant growth. I had detected two or three instances of that nature before, but those fern-trees were only partially severed from the earth at their bases, while this one was wholly separate, and from its appearance had been so for many years, as no fresh rootlets were emitted there.

(3.) Strange, however, as that instance may appear, I have still a more curious anomaly to mention, which, as far as I know, is quite unique. Four years ago, while botanising in the high and dry woods near Matamau, I came upon a fine tree-fern (*Cyathea dealbata*), whose caudex below was almost wholly surrounded by its former epiphytal foster-child—a stout spreading specimen of *Panax arborea*, from which, or out of which! the fern-tree luxuriously grew, as if it were springing from a large vase! On the one side (or, rather, speaking correctly, on three sides,) the fern-tree was wholly enclosed; and this was all the more plainly to be seen, from the fact of the trunk of the *Panax* being bare of epiphytal vegetation, so that its light-coloured and clean bark showed in strong relief against that of the darker fern-tree in the few narrow interstices on the one side where it still slightly appeared. Another great curiosity was the entire unbroken appearance of the *Panax* on the one side of the fern-tree, which was completely covered by it; there was no trace discernible of any cicatrices or joinings in its bark, which was even. The tree, or pair so strangely conjoined, stood in a small glade or open space among the trees of the forest that were densely thick around, which circumstance, together with the dark-green foliage of the very large leaves and sprays of the *Panax*, above and around the delicate pure white fronds of the fern (viewed from beneath them and looking up), with the blue sky here and there in the background seen through their branches, caused the two trees to be seen to a great advantage. The *tout ensemble* was both unusual and charming, and served to bring to mind portions of Ovid's metamorphoses of trees.

Another pleasing thought arose from the consideration of this tree (*Panax*), in its so clasping and sending out and down its root-like branches, (which it never does when growing in the earth in its native woods,) thus showing its real natural affinity in latent habit to those other genera of that same natural order in which it is placed, (*e.g.*, *Hedera*, *Gunnera*, etc.,) which so largely and constantly grow and adhere by their climbing rootlets; and yet the ivy (*Hedera helix*) sometimes grows as a standard.

I visited that spot on several occasions during two years, and always with feelings of admiration; and was so much surprised and pleased with my "find," that on two of those visits, having taken my portfolio with me, I attempted to take a drawing of it; (in one of those times, however, being caught in heavy rain!) but, owing to the loss of drawing and writing power in my thumb, I made a poor job of it. Still, such as it is, and unfinished, I bring it before you, as by it you may be the better able to know somewhat of the relative sizes and appearances of the two curiously-entwined and coalesced plants.

I took accurate measurements of this botanical phenomenon, and the following is the result:—

1. Height of caudex of *Cyathea* from the ground to the springing of its living fronds, 7ft. 6in.
2. Height of *Panax*, about 18ft.
3. Girth of both, taken together at base, 6ft.
4. At 5ft. 3in. from the ground the *Panax* tree forked into two stout, erect main branches.
5. Girth of both plants under the forking of the *Panax*, 5ft. 3in.

6. Girth of main branch of *Panax*, 2ft. 10in.; of the other, 2ft. 3in.
7. Girth of *Cyathea*, immediately under its crown of fronds, 5ft.
8. Breadth of the narrow interstices of the stem of the fern-tree not yet covered by the *Panax:* at the base, 2in.; above, in the widest part, 3in.
9. The fronds of the fern extended about 9ft. each way, forming a flattish arch.
10. The lower horizontal branches of the *Panax* extended nearly equal with the fronds of the fern.
11. The trunk of the *Panax* below was quite bare of epiphytal vegetation (only a small young creeping plant of *Metrosideros scandens* just climbing up at one corner), but large fronds of *Polypodium billardieri* and other ferns hung pendulous from between the two upright limbs of the *Panax* and the *Cyathea*.
12. The longitudinal edges of the root-like descending lower limbs of the *Panax* showed exactly the appearance of the back of a healthy tree from which a limb has been clean cut off, growing-in with thick round advancing margins over the wound.

ART. XXXIII.—*A Description of some newly-discovered and rare indigenous Phænogamic Plants, being a further Contribution towards making known the Botany of New Zealand.*

By W. COLENSO, F.R.S., F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 11th October*, 1886.]

Class I.—DICOTYLEDONS.

ORDER I.*—RANUNCULACEÆ.

Genus 1. **Clematis,** Linn.

1. *C. aphylla*, sp. nov.

A slender prostrate trailing plant. Stems 2–4 feet (or more) long, cylindrical, very narrow, 1 line diameter, green, glabrous, striate, few-branched; nodes at pretty regular distances, 5–6 inches apart. Leaves, 0. Peduncles slender, hairy,

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* The numbers in this paper attached to both orders and genera are those of "The Handbook of the New Zealand Flora."

1½–2 inches long, a 2-lobed connate densely hairy bract at base, and another about the middle; hairs brown. Flowers hermaphrodite, axillary, opposite, single, small, greenish with a brown tinge, about 1 inch diameter, (?) monœcious; sepals 4, broadly-lanceolate, or sub-ovate lanceolate, sub-acute, 6 lines long, conniving, very silky on both surfaces, many nerved (6–7), nerves branching; margins uneven at tips, sub-ciliate. Stamens 10, sub-lanceolate-linear, rather broad, green; anthers long, linear, very narrow, with a minute blunt connective; achenes (immature) slightly silky; styles shorter than sepals, green, silky, tips recurved.

Hab. Trailing and hanging down on cliffy spots, Puketapu, near Napier; 1885–6: *Mr. H. Hill.*

Obs. This is a very peculiar plant, widely differing from the other New Zealand species of this genus, as well as from those of Australia and Tasmania. We have now known it for two years, and it always presents the same appearance—long trailing slender green stems, no leaves, and single 4-sepaled hermaphrodite flowers. I have examined several specimens, and they do not vary; only one of them had three flowers, all on separate peduncles and with separate basal bracts springing from one axil, as if fascicled but distinct. It would have been described by me last year, but I had a suspicion that it might prove to be identical with *C. fœtida*, var. β *depauperata*, or a variety of it; which, however, I do not now believe, after re-examining several fresh specimens.

Order IV.—VIOLARIEÆ.

Genus 2. **Melicytus,** Forst.

1. *M. microphyllus*, sp. nov.

A tall, slender shrub or small tree, 12–15 feet high, trunk 5 inches diameter; bark pale drab-brown, much and densely mossed, etc.; branches long, slender; branchlets many, sub-erect, pubescent. Leaves small, numerous, sub-coriaceous, glabrous, scattered, single and sub-fascicled 2–4 together, 1–3 (rarely 4) lines long, oblong-orbicular, sub-panduriform, and orbicular, reticulately and coarsely veined, green, margin purple, sinuate, acutely toothed with a small red curved tooth at extremity of each primary vein (usually 6 on a leaf); apex very broad, obtuse, and retuse, with a small central tooth; base tapering; petiole short, under 1 line long, slightly puberulous, with small scarious stipellæ at base. Flowers pretty numerous, rather small, orbicular, 1½–2 lines diameter, axillary and lateral, solitary, sometimes in pairs; peduncle longer than petiole, 1–1½ lines long, stout, slightly puberulous, bracteate; bracts generally above, rarely below. Calyx purple, glabrous, veined, acutely 5-lobed, lobes spreading, tips sub-laciniate. Petals (sometimes 6) sessile, rather large, spreading, broadly ovate and sub-orbicular, with a single middle vein, pale, streaked and tipped with purple; tips slightly erose or sub-laciniate, sub-apiculate and recurved. Anthers (sometimes 6) sessile, large, gibbous, didymous, with a large thickish clavate connective a little higher than the anther. Stigma very small, sessile, conical, slightly sub-trifid. Fruit 0.

Hab. Forests, banks of River Mangatawhainui, near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. This species certainly approaches very near to *M. micranthus*, Hook. fil., but it differs in several characters, as well as in its much larger size, with larger flowers and smaller leaves. I suspect this plant is diœcious, and the above description of the *male* flowers only. I first detected it in full flower in March; and on again visiting the same tree in May (end of month), hoping to obtain fruit, there was not a berry to be found, but the plant still bearing a few flowers. I have for many years noticed young plants of upright growth, and 5–7 feet high, in those woods, but always in leaf only, although frequently diligently examined by me. This tree is the only one I found bearing flowers.

Order VI.—CARYOPHYLLEÆ.

Genus 3. **Colobanthus**, Bartling.

1. *C. repens*, sp. nov.

A small quite glabrous low creeping perennial plant, about ¾-inch high, forming a short densely matted turf; branches 3–4 inches long, procumbent, rooting at nodes. Leaves about ½ inch long, narrow-linear, subulate, sub-acute with acicular tips, thickish, not rigid, nerveless, green, shining, spreading, recurved; the lower dilated and largely membranous at base, the upper connate; minutely ciliate on lower margins; ciliæ fugacious. Scapes solitary, axillary, slender, erect, straight, 6–7 lines long, longer than leaves. Perianth 1 line long; sepals 4, broadly ovate, obtuse, shorter than capsule, green, concave, 3-nerved, slightly margined; margins translucent. Stigmas 4, strongly recurved, stout, papillose, brown. Capsule pale, longer than perianth, valves obtuse, tips rounded. Seeds light-brown, sub-triangular-orbicular, finely granulate.

Hab. On low alluvial banks, (growing intermixed with *Pratia* and *Hydrocotyle*,) sides of River Mangatawhainui, near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species possessing affinity with *C. quitensis* and *C. billardieri* (both New Zealand plants), but differing in habit and in several particulars.

Order XXXIII.—UMBELLIFERÆ.

Genus 1. **Hydrocotyle**, Linn.

1. *H. involucrata*, sp. nov.

Plant procumbent, trailing. Stems 10–00 inches long, slender, glabrous, with a few weak scattered hairs; nodes 3–5 inches apart, each having a large clasping sub-orbicular-reniform stipule, the margins irregularly and minutely lobed and toothed, pellucid and highly cellular; cells large oblong. Leaves few, distant, membranous, somewhat roughish from raised bases of hairs, dull light-green, reniform, 1–1¼ inches broad, 6-lobed; lobes rounded, cut into one-fifth of leaf, their sinuses overlapping; margins irregular, sub-crenate-toothed; basal sinus very broad, the margins more acutely toothed; 8-veined, veins (and margins) light-reddish; hairy on both sides, but much more so below; hairs short, thickish, acute, white; petioles very long 3–5 inches, slender, weak, hairy below with long scattered weak 1-nerved reflexed hairs that increase in density upwards towards the apex. Peduncle one-third length of leaves, 1–1½ inches long, hairy. Umbels 8–14-flowered, in a compact sub-globular head. Involucre in 2 rows, composed of 10–12 convex incurved membranous leaflets with darkish-brown centres and pellucid margins; the outer, ovate, margins laciniate; the inner, linear-oblong, margins entire. Flowers rather large, pale-brown, pedicelled; pedicels erect, glabrous, 1 line long, with sometimes a small bracteole near the apex; petals valvate, broadly ovate, 1-nerved; tips sub-acute and obtuse, their margins finely crenulate-toothed (*sub lente*); stamens largely exserted, curved; anthers orbicular (a little broader than long), pale; styles stout, long, at first converging, afterwards very divergent. Fruit rather large, pale-greenish-brown, nearly orbicular, $\frac{1}{10}$ inch broad, straight below, apex very slightly notched, flat, glabrous, shining, thickest at centre, intermediate ribs obscure, dorsal edge of carpels obtuse; seed narrow, linear-ovate, obtuse.

Hab. Low wet spots in forests, hilly country north of Napier, County of Wairoa; 1886: *Mr. A. Hamilton.*

Obs. A species having some affinity with *H. novæ-zealandiæ*, D.C., *H. pterocarpa*, F. Müell., and *H. vagans*, Hook. fil., (an Australian species,) but differing from them (and from all the species described in the "Handbook, Flora N.Z.,") by its involucral leaflets; in this respect, however, it approaches a few of the Australian species; also, the two newly-described species (mihi), *H. colorata* and *H. alsophila*,* in their floral bracteoles.

* "Trans. N.Z. Inst." vol. xviii., pp. 260-261.

ORDER XXXVIII.—RUBIACEÆ.

Genus 1. **Coprosma**, Forst.

1. *C. autumnalis*, sp. nov.

Plant, a small tree, or tall slender shrub, erect, 12–16 feet high, few-branched; trunk 3–5 inches diameter, clear of branches; branches distant, slender, long, drooping; bark thin, light-brown, with a fine scaly silvery-white epidermis; inner bark orange. Leaves large, membranous, not numerous, sub-terminal on branchlets, 1–1¼ inches apart, broadly lanceolate, 5–6½ inches long, 2½–3½ inches broad, acute, narrowly margined; margins sub-crenulate, especially towards tips; dark-green and shining above, much paler below, coarsely reticulated on both sides, deeply and largely foveolate in main axils; foveolæ ciliate; petioles stout, 1–1¼ inches; stipules large, sub-conical, cuspidate, hard, black, glossy. Peduncles axillary; (*fem.*) stout, sub-compressed, 1–1½ inches long, trichotomously branched; the 3 sub-peduncles fascicled, each ½ inch long; stipules at base 4-fid. Flowers—*Male:* Peduncles ½–¾ inch long, rather slender, 3- sometimes 5-branched, with a pair of small leafy bracts at base; sub-peduncles 4–5 lines long; heads of flowers large, densely compact, outer heads each 6–9, middle head 8–16 flowers; calyx small, cup-shaped, with 5–6 stoutish teeth; corolla campanulate, 3 lines long, 5-lobed; lobes rather large, one-third length of corolla, sub-acute, erect; anthers 6 (sometimes in outer flowers 5), large, stout, 2 lines long, linear, obtuse, purple-tipped, base much hastate, very pendulous; stamens ½ inch long, filiform, minutely papillose. *Female:* outer 2 sub-peduncles, each 3–4, and the central one 6–9 flowers; involucral or floral bract large, with 6–8 coarse teeth; calyx greenish, purple spotted, sub-urceolate, with 5–6 stout teeth; teeth conniving; corolla pale green, infundibuliform, 2½ lines long, 5- sometimes 6-lobed; lobes large, obtuse, spreading, sub-recurved; stigmas 2, ½ inch long, stout, divergent, much crumpled, very pubescent. Fruit 3–4, sometimes 5–6 (rarely 9), drupæ, clustered, sessile, broadly elliptic, 4–4½ lines long, bright red (red-currant-colour), very glossy. Seeds large, oval, sub-acute, 3½ lines long, 2 lines broad, convex on the outside, flat within, white, somewhat silvery.

Hab. Forests near Norsewood, County of Waipawa; 1881–6: *W.C.* Flowering in May and June.

Obs. I. The near affinity of this fine species is with *C. grandifolia*, Hook. fil., from which, however, it differs in several characters: as the larger number of its flowers in heads, both male and female, in its corollas, anthers, and large elliptic fruits. It is a curious and novel sight to see in the autumn the female plant loaded with both ripe fruit and the new opening flowers of the coming spring-summer season; at such time, too, the ground is covered with the glossy red fruits, which are also juicy and sweet. The pleasing phenomenon served to remind me of the poet Thomson's ideal of vegetation in the beginning—the Golden Age of man,—

> "Great Spring before
> Green'd all the year; and fruits and blossoms blush'd
> In social sweetness on the self-same bough."
> —SEASONS: *Spring*, l. 319.

The male flowers likewise, at the same time, are really handsome, with their large heads of fringe-like anthers.

Obs. II. I have long known this plant *in fruit* only; this, however, was owing to its *autumnal* flowering (different to the other species of this genus), for which I was not prepared.

ORDER LIII.—SCROPHULARINEÆ.

Genus 4. **Gratiola**, Linn.

1. *G. concinna*, sp. nov.

Plant procumbent, creeping, matted, sub-ascending. Stems 7–10 inches long, stout, purple-spotted, simple or slightly branched, puberulous with long white flattish-jointed glandular hairs. Leaves distant, sub ½-inch apart, orbicular and orbicular-elliptic, 2 lines long, membranaceous, of a pleasing green, glabrous, reticulately veined, with 4–5 small obtuse teeth each having a coloured spot at its base, petioled; petioles short, broad. Flowers rather few, axillary, solitary, peduncled; peduncles 1–2 lines long, stoutish, hairy. Calyx coloured, hairy, leafy, 5-parted to base; lobes long, unequal, 3-nerved, pellucid-dotted, toothed, recurved, tips obtuse; with two long similar bracts at base. Corolla 4 lines long, white, somewhat hairy; tube slightly curved, much veined; veins purple and branched above; limb spreading, 4-lobed; upper lip large, sub-bilobed, thickly clothed with yellow glandular hairs; lower lip 3-fid, each lobe emarginate. Stigma sub-rhomboid, dilated, flattish. Capsule sub-orbicular, turgid, green, glabrous, shining. Seeds brown, conical, very obtuse, a little curved.

Hab. Edges of a swamp in forest, south bank of the River Mangatawhainui, near Norsewood, County of Waipawa, where it thickly covers the ground in large spreading patches, presenting a very pleasing and neat appearance; March, 1886: *W.C.*

I have not noticed it anywhere else.

Obs. This species is evidently allied to *G. nana*, Benth., but it is a much larger plant, and is very distinct in several of its characters.

Genus 10. **Euphrasia**, Linn.

1. *E. tricolor*, sp. nov.

Plant perennial, sub-shrubby, 8–12 inches high; erect, compact, branched above. Stems and peduncles densely puberulous. Leaves numerous in opposite pairs, mostly small, under 3 lines long (a few scattered lower ones 8–9 lines long), sub-rhombic-ovate, or obovate, impressed underneath as if stamped (sunk) within margin and between veins, once or twice toothed, the smallest entire. Flowers rather numerous, showy, solitary, axillary in opposite pairs; peduncle 1 line long. Calyx 2½ lines long, glabrous, sub-campanulate, 4-lobed; lobes large, obtuse, coarsely and prominently veined. Corolla ringent, inflated, pilose without, 9 lines long; white, with straight dark-pink veins (usually 8 above and 9 below), with a large orange spot at base of lower lip, and also of filaments; tube rather short; lower lobes large, spreading, sub-rectangular, with straight lateral margins; apices deeply emarginate and sinuous; upper lip recurved, lobes notched. Anthers glabrous, very obtuse, dark-umber; edges of valves largely ciliate with stiff white hairs; spurs of posterior pair equal, white, acute. Stigma sub-globose and (with style) finely pilose. Capsule oblong, 3½ lines long, obtuse, sub-compressed at top, with base of style persistent, puberulous. Seeds white, membranaceous; testa very lax, winged above, produced below, striate with minute transverse bars.

Hab. Bases of high wooded cliffs forming the banks of the River Mangatawhainui, near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. I. This plant is nearly allied to *E. cuneata*, Forst., but differs from that species in several particulars: as in its larger lobes to both calyx and corolla, the latter spreading, richly coloured, with straight lateral margins; in its glabrous and coloured and largely ciliated (almost crested) anthers, with equal spurs, etc. But, as both Hooker and Bentham have each separately remarked (the former on our New Zealand, and the latter on the Australian species), "the several species are very variable"; and this I have also often proved.

II. A small variety of this plant (*α. microphylla*) is found 20 miles further south, in the open plains between Tahoraiti and Woodville; it closely resembles this one, only it is very much smaller in all its parts, its numerous leaves being only 1–1½ lines long; *E. tricolor*, var. *microphylla*, Col.

Class II.—MONOCOTYLEDONS.

ORDER VII.—LILIACEÆ.

Genus 5. **Astelia**, Banks and Solander.

1. *A. hastata*, sp. nov.

Leaves very long, sub-coriaceous, linear-acuminate, 4 feet long, 1½ inches broad at middle, tip filiform; many nerved, with 2 very prominent and coloured narrow ones; upper surface glabrous, thickly pubescent underneath, as if minutely and regularly pitted (very apparent under a lens), sharply keeled; base much dilated and clasping, 4½ inches broad, black, shining, margins thin; veins spreading laterally, largely and coarsely reticulate. *Male:* Scape 2 feet long, stout, triquetrous, 1¾ inches circumference at base, composed of 7 nearly equal equidistant long single drooping racemes, the lowest 9 inches long, ¾ inch wide, each about 3 inches apart on scape; peduncles 1 inch long, each with an excessively long bract at its base, ovate, very acuminate, caudate, drawn out into a very long narrow tip, the lowest being 2 feet 6 inches long and 3 inches wide at the broadest; the upper portion light-green, sub-coriaceous and glabrous, the lower white, soft, and densely silky on both sides; the pubescence adpressed in stippled dots. Flowers yellow-brown, numerous, crowded, spreading, above 1 inch diameter; segments cut to base, narrow, linear, obtuse, ½ inch long, much longer than anthers, reflexed, with 1 central nerve running to tip and 2 lateral nerves ending half-way; all shaggy below on the outside (with pedicels and bracteoles), but the 3 inner have only a narrow central shaggy line to tip, with membranous glabrous margins, the 3 outer being hairy, with ciliated edges; pedicels 2 lines long, each with a small linear 1-nerved bracteole the length of pedicel. Stamens 3 lines long, spreading, rumpled; anthers, $\frac{1}{10}$ inch long, triangular, obtuse, emarginate, largely hastate, their basal extremities curved and divergent, corrugated, somewhat bladdery. Stigma rather large, slightly produced, 3-fid. *Female:* Scape 15–18 inches long, very stout, composed of seven long narrow cylindrical simple flaccid racemes; much more compact on scape than male, each 9–10 inches long and ½ inch wide; peduncles very short, 2–4 lines, but the lowest 1½ inches; bracts much as in male, very silky below, the lowest 2 feet 6 inches long, and 2 inches wide at base. Flowers light-brown, exceedingly numerous and compact, very small, scarcely 2 lines long including ovary; segments not split to base, very small, about ½ line long, somewhat linear-ovate, reflexed from middle, the 3 outer more shaggy and ciliate, 1-nerved to tip; tips obtuse; the lower part of perianth forming a cup around the base of ovary; pedicels about 3 lines long, erect, close, but not crowded, sub-verticillate, patent, very shaggy, each with a narrow-linear bracteole at base the length of the pedicel; hairs flat, membranous, glossy, sub-ovate-lanceolate, nerved, white. Ovary (immature) ovate, beak produced; stigma, large, spreading, very pubescent; anthers (abortive) minute, triangular, acute, hastate, adhering closely to ovary, and with a part of the stamen appearing above the reflexed segment.

Hab. Forests, hilly country north of Napier, County of Wairoa; January, 1886: *Mr. A. Hamilton.*

Obs. This very fine species is naturally allied to *A. solandri*, A. Cunn., and to *A. microspermum*, Col.,* but differing largely from them both in several important characters, particularly in size, length, and shape of sub-panicles (racemes), in its extraordinarily long bracts, its different yellow-brown flowers, its very peculiar large corrugated and hastate anthers, and its curiously flattened broad and nerved hairs.

2. *A. graminifolia*, sp. nov.

Plant slender, few (7–8) leaved; apparently of simple distinct habit of growth. Leaves sub-membranaceous, largely drooping, 15–21 inches long, $\frac{1}{4}$ inch wide, linear-acuminate, tips filiform; the upper surface glabrous, dull greyish-green; the lower pubescent-hoary; hairs small, greyish, very closely adpressed; many nerved, with small distant transverse veinlets between them, and 2 very prominent narrow equidistant reddish nerves on the upper surface; margins slightly recurved and ciliate with fine shaggy white hairs; the base spreading, gradually dilated, 1 inch wide, very membranous, with fine silvery shining hairs thick on both surfaces. Scape (*female*) 6–7 inches long including panicle, erect, densely shaggy with white shining hairs, as also pedicels and outsides of floral bracts and bracteoles; panicle loose, 2 inches long, composed of 2 distant erect racemes and 3 intermediate solitary flowers; flowers in racemes close-set, pedicelled; pedicels $\frac{1}{10}$th inch, patent; the upper raceme of top about $\frac{1}{2}$ inch long, composed of 17 flowers; the lower raceme, distant about $1\frac{1}{2}$ inches from the upper one, about $\frac{3}{4}$ inch long, composed of 20 flowers, with peduncle $\frac{1}{2}$ inch, and a long leaf-like membranaceous and very acuminate bract, $6\frac{1}{2}$ inches long at base; each of the solitary flowers having a long bract at base of pedicel. Flowers: perianth rather large, reddish-brown, glabrous, somewhat scarious, forming a very loose globular cup around ovary; segments free, $\frac{2}{5}$th of perianth, narrow, linear-ovate, acuminate, 1-nerved, the nerve extending to base of perianth; a long very narrow linear sub-erect reddish 1-nerved bracteole at base of each pedicel. Ovary (immature) broadly ovoid-acuminate, rather suddenly contracted towards apex in forming a long beak; style 0; stigma 3-lobed, puberulous; anthers (abortive) opposite segments, arising from segmental nerve at edge of cup, minute, long, filiform, sub-hastate.

Hab. Woods, hilly country north of Napier, County of Wairoa; 1886: *Mr. A. Hamilton.*

Obs. A very peculiar species, unlike all others of the genus known to me; yet possessing near affinity to *A. spicata*, Col.,†

* "Trans. N.Z. Inst.," vol. xvii., p. 251.

† "Trans. N.Z. Inst.," vol. xiv., p. 335.

from which it differs in habit, length of leaves, panicle, pedicelled flowers, large loose perianth, and shape of ovary. Unfortunately I have had only *one* female specimen (all that was collected) to examine; this, however, was perfect and in good condition, except its immature fruit.

3. *A subrigida*, sp. nov.

Plant epiphytal, perennial, densely cæspitose. Leaves, about 20 to a single tuft or plant, rather short, equitant, diverging fan-like regularly and distichously from the base, which is sub-cylindrical, not triquetrous, linear-acuminate, 9–11 inches long, 4 lines wide, erect, sub-rigid, tips sharp, sub-coriaceous, glabrous, yellowish-green, striate, 10–12-nerved; nerves strong; the upper portion of the under-surface closely appressed with short greenish-grey glossy hairs, having a minutely pitted appearance; dark-brown, gradually dilated and largely clasping at base, with white shining hairs at the extreme base only. *Female*: Scape (including panicle) 12–14 inches long, rather slender, trigonous, woody, hard, thickly pilose above with appressed hairs, and shaggy at the base; hairs white, glossy; panicle very compact, short, sub-ovate, 5 inches long, composed of 7 sub-panicles; the lower three being compound, each containing 3 small racemes, the middle one longest, 2½ inches long, and the two laterals short, about 1 inch; the upper four being short simple racemes; each sub-panicle with a long membranous bract at base, the lowest one being 7 inches long, broad below, but soon very narrow, and much acuminate. Flowers very compact, brownish; pedicels stout, short, about $\frac{1}{10}$ inch; perianth rather small, spreading, 6-fid to base, the three outer lobes larger than the three inner ones. Fruit small, globular, 1½ lines diameter, dull glaucous-green; style short, thick; stigmas 3, large, coalescing; seeds small, 12–18, sub-lunate-pyriform, thickest at apex, black, shining, minutely and thickly tuberculate (*sub lente*), gibbous on one side, slightly obtusely angled on the other, testa produced at funiculus end, sub-trifid.

Hab. High up in the upper forks of large forest trees, where the plant forms large dense masses; woods near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. This species of *Astelia* I have long known in its leafing state, but failed (until this year) in obtaining it in flower and fruit, and then only perfect female scapes; the male scapes being similar in size, etc., but old, or too long past flowering for accurate description. From the great quantity of barren plants that I have seen and examined at various seasons, I should suppose this species to flower but rarely. It seems to be widely different from all known and described species; approaching, however, on the one hand *A. spicata*, Col.,* (which also very rarely flowers,) and serving to unite that small species in a natural and progressive series with the larger species of the genus. I yet hope to succeed in obtaining the perfect male flowers during the approaching summer.

ORDER IX.—JUNCEÆ.

Genus 1. **Juncus**, Linn.

1. *J. luxurians*, sp. nov.

Plant perennial; stout, tall, dark-green, forming thick bushy tufts and patches, that are sub-erect, drooping, and prostrate; rhizome creeping, with many small scale-like bracts, and sending up numerous new shoots every year; roots fibrous. Culms terete, leafless, 6–8½ feet long, 2 lines diameter below, smooth, minutely striate, upper portions soft and tender; tips very acuminate and sharp; the bases brown, glossy, with 3–4 adpressed sheathing bracts, the longest about 12 inches long; tips of bracts thin, very obtuse, sometimes acute; pith soft, woolly, and not continuous, yet not regularly broken or jointed. Panicle lateral, 8–12 inches from tips, large, effuse, pale-green, fascicled, sub 20 branchlets mostly compound; 1–3 being very large, stout, compressed, 2–3 inches long, each bearing at tip sub 10 compound branchlets; involucral bracts 1½ lines long, ovate-acuminate, very acute, membranous, white with a brown central nerve. Flowers $\frac{1}{10}$ inch long, bibracteolate at base; bracteoles ovate, acute, membranous, white; pedicelled, pedicels long slender; perianth segments lanceolate-acuminate, very acute, rather longer than capsule, their centres bright green with broad white membranous margins. Stamens, 3; anthers small, yellow, oblong, with a minute connective; filaments short, rather broad. Stigmas 3, long and spreading, rumpled, plumose, dark-red. Capsule sub-prismatic, turgid, obtuse, very light brown, or dirty-white, shining, less than 1 line long. Seeds small, numerous, bright yellowish-brown, convex, oblong, sub-clavate; testa not produced.

Hab. In wet swampy hollows between hills, in a dense forest south of Norsewood, County of Waipawa; 1885–6, *W.C.*

Obs. This remarkably fine rush is found growing in middle-sized tufts, and also in very large and dense patches, with the ground thickly strewed with them in a prostrate state, forming several layers, all living and dark-green. It is rather difficult to force one's way through a large sub-erect patch, owing to their height, their very close growth, and their being so greatly

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* *Vide* "Trans. N.Z. Inst.," vol. xiv., p. 335 (female); and vol. xvi., p. 340 (male).

entangled. Its extreme softness and tenderness (for a rush), its great length, and its prostrate habit, led me to suspect its being a *species nova* when I first saw it; but at that time (winter) I could not procure any good specimens. Through its being so soft and tender it is much browsed on and trampled by cattle, so that it is rather difficult to obtain whole and perfect specimens. Hitherto I have only noticed it growing in that one undisturbed forest swamp, where, however, it is plentiful.

Order XI.—CYPERACEÆ.

Genus 13. **Uncinia,** Persoon.

1. *U. polyneura*, sp. nov.

Plant perennial, clear green, densely cæspitose, forming large bushy tufts, with numerous brown ovate bracts at base, deeply costate. Culms erect, 20 inches long, smooth, unequally triquetrous, the upper portion channelled on the two narrower sides; usually with 4 sheathing leaves nearly together at base, Leaves sub-erect and drooping, linear, long and narrow, 22 inches long, 2 lines wide, very acuminate; tips obtuse, thickened and very closely serrulate; their bases much sulcated; striæ broad, smooth, dark-brown; the upper surface glabrous, regularly striate, many and finely nerved (sub 24), with 3–5 stout whitish nerves equidistant between mid-rib and margin on each side; the lower surface finely scabrid; mid-rib narrow, smooth, slightly keeled in upper portion but very prominently so in the lower; margins closely serrulate; vagina entire, crescent-shaped, membranous; ligula small, sub-lunate, extending from midrib to margin. Spikelet 5–6 inches long, rather slender, lax; the upper 1½ inches male, dark-brown, cylindrical and narrow; the denticulation of rhachis very deep, with raised and thickened edges; bract 0. Glumes closely imbricate, nearly 2½ lines long, narrow, ovate-acuminate, obtuse, margin of tip irregular (*sub lente*), dark-brown, obscurely striped, striate and prominently so at sides. Utricle 2½ lines long, a little longer than the glume, narrow, spindle-shaped, dark blackish-brown, glossy; bristle 2 lines long, slender, pale, much thickened and rugulose at the curve, tip of hook reflexed. Stigmas 3, long, lax, very shaggy, dark-brown.

Hab. Edges of forests and glades near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. This plant in its general appearance has some affinity with *U. alopecuroides*, Col.,* but differs in the culms being twice as long, differently angled, smooth, and bractless; in the leaves not being scabrid on both surfaces, and the midrib smooth; in

* "Trans. N.Z. Inst.," vol. xv., p. 335.

the spikelet being much more slender; in the glume being shorter than the utricle, and dissimilarly coloured and marked; in the utricle being longer than the glume and very dark brown; and in the bristle being shorter than the utricle.

ART. XXXIV.—*A Description of some newly-discovered Cryptogamic Plants, being a further Contribution towards the making known the Botany of New Zealand.**

By W. COLENSO, F.R.S., F.L.S., etc.

[*Read before the Hawke's Bay Philosophical Institute, 11th October*, 1886.]

INTRODUCTION.

ON this occasion, the last night of ordinary meeting of our Society for this year, I am again permitted to bring you our usual annual botanical offering, in a small basket of Crytogamic plants obtained from our inland woods and glens.

I have called it "*our*" offering; and this may require a few words in explanation. This plural pronoun is here used in a double sense: (1) To let you know that I have again been largely assisted by kind and liberal, hearty and active, co-workers in this part of the botanical field, who all work *con amore* in this matter: among them I would particularly mention with thanks three of our active members—Messrs. H. Hill, A. Hamilton, and D. P. Balfour—to whom not only myself and our local branch auxiliary Society, but the New Zealand Institute as a scientific body, are largely indebted. And (2) that this offering or tribute is one made *by*, as well as from, our New Zealand woods. For, privileged as I am to present and make known this, their free gift, and thus for a short time briefly occupying the position of their herald or ambassador unto you—coming hither directly from them, and from long and oft-repeated sojournings in their homes and company, and understanding their thoughts and quiet reasonings, and silent yet the more expressive language—I would beg permission to say a few words respecting them.

Among the many and varied congenial homes of the great Crytogamic family, in those deeply secluded glens and mountain woods, far away from the busy life of towns, and even the solitary haunts of the isolated "bush" woodman, is the place *par excellence* for the disciple of Nature to study, to admire, to learn, to know; and so learning, so knowing, to hold converse with her and her beauties; and, through their teachings, with

* In continuation of paper on same subject, read in the previous year. See "Trans. N.Z. Inst.," vol. xviii., pp. 219-255.

the one Great Mind and Author of all! One of our esteemed British classical poets, Thomson, in writing on this subject, has truly said,—

> "Here wandering oft,
> I solitary court
> Th' inspiring scene: and meditate the book
> Of Nature ever open."

For (as I have said to you on a former occasion) I believe in the universal language of Nature: and it is with feelings such as those that I have not unfrequently detected new and hitherto hidden and unknown novelties; and when thankfully gathering them have sometimes said, *solus*, or spoken out to them: "Come out of your obscurity, and be seen in society. Come and be introduced to science. Come and add your tribute also, however small, to the further display of the many great and wonderful perfections of Nature; and, in so doing, more openly fulfil the imperative injunction made to you two thousand years ago, in the words of that very ancient song: '*Benedicite universa germinantia in terra Domino; laudate et superexaltate eum in sæcula.*'" And then, at such times, I have further thought: How many thousands of years—may be, myriads of ages—since this wee little wondrous delicate and frail yet perfect form first appeared, whether created or evolved; and how, in spite of all opposing and powerful elemental influences, and cataclysms, and volcanic eruptions, has this little microscopical plant held its own, fructifying, and shedding its tiny seeds in their proper season, and so overcoming and riding triumphant over all opposition and every adverse power? Moreover, when I have also occasionally found a little Cryptogam which I knew to be also a denizen of another part of the globe—it may be of the Antarctic islets furthest South, or of Tasmania, or Australia, or the Islands of Polynesia; or of the far-off specks in the vast Southern Ocean, the Crozets, or Kerguelen's Land; of the Cape of Good Hope, or Cape Horn; of the Peruvian Andes, or of the European Alps; of the riparian banks of the Amazon, the Thames, the Tweed, or the Shannon; of the summits of our own Ruahine Mountains, or of the Scottish Highlands—what a further theme for thought! Where the commencement, the outset, the *Alpha*, the origin? or were there originally more than one such? And, if so, did such embryos, situated at the antipodes of each other, commence life together?

Possibly, or rather very likely, some of the younger portion of my audience here this evening may think these remarks of mine strange, aberrant, or at all events peculiar; pertaining, it may also be thought, to the garrulity of old age, and following as a fitting sequence to my expressed belief in the universal language of Nature. To all such, (if there be any,) I would merely reply that thoughts like those I have touched on are (1) not unreasonable; (2) are eminently pleasing, illuminating, and informing; (3) are qualified to raise our human nature; and (4) to lead us on to more correct views of the Great Father and Author of all. Once more will I quote a few highly expressive lines from my favourite poet Thomson:—

> "Nature, attend! join every living soul,
> Beneath the spacious temple of the sky,
> In adoration join; and ardent raise
> One general song—to HIM!
> Soft-roll your incense, herbs, and fruits, and flowers,
> In mingled clouds to HIM, whose sun exalts,
> Whose breath perfumes you, and whose pencil paints."

But to leave the mountain-tops, first gilded by the sun, and the purer air of the balmy pine forests and heights, not to mention their kindred poetical musings, and to descend to the plains—to the technical and prosaic facts and descriptions of our few little Crypts.—I have to observe that four of the orders of the great Linnæan class *Cryptogamia* are here represented—viz., *Filices*, *Lycopods*, *Musci*, and *Hepaticæ*. Of the first order, or ferns, I have only one novelty, a species of *Lomaria*; of the second, or *Lycopodium*, I have also but one new species; of the third, or mosses, I have five new species, belonging to three genera—viz., *Polytrichum*, *Hypopterygium*, and *Hookeria*, all fine mosses and well represented here in New Zealand; and of the fourth, or liverworts, I have 40 species, pertaining to no less than 11 genera, some of which, as *Jungermannia*, *Plagiochila*, *Mastigobryum*, and *Frullania*, were already remarkably large and cosmopolite. In the "Synopsis Hepaticarum," published 40 years ago, *Plagiochila* possess 189 species, *Jungermannia* 195 species, *Mastigobryum* 64 species, and *Frullania* 155 species; and these large numbers of species have been subsequently increased with many more; indeed, out of this present small collection there are no less than 5 species of *Plagiochila*, 16 species of *Mastigobryum*, and 6 species of *Frullania*; while others of those smaller and rarer genera now added to by me are still very limited, both as to the number of their known species and their area.

The total number of Cryptogamic novelties described in this paper is 47; and while all will prove interesting to the working botanist and devoted disciple of Nature, some of them, it is believed, will prove no less so to the cultivated and cursory, though less technically skilled, observer.

Lastly, and in conclusion, (as I do not wish to repeat my former observations over again, though equally applicable here,) I would respectfully beg my hearers, being members of the Institute, to read and note what I have said in my introduction in my paper of last year on this subject, in connection with this present paper.

Class III.—Cryptogamia.

Order I.—FILICES.

Genus 16.* **Lomaria,** Willdenow.

1. *L. intermedia*, sp. nov.

Plant small; caudex $\frac{1}{2}$–$\frac{3}{4}$ inch, indistinct, formed of the bases of old stipites and wiry roots; tufted, few fronded; fronds sub-erect and spreading, pinnate; stipes rather slender, blackish-brown, glabrous, succulent, somewhat brittle, deeply channelled above, as also is the rhachis. *Sterile* fronds, 7–8 inches long, (including short stipe, $\frac{3}{4}$ inch,) 1 inch wide, linear-lanceolate, rachis, flexuous, green; pinnæ 16–18 pairs, alternate, distant, membranous, light-green, glossy, thickly dotted beneath with minute red scales, oblong, sides straight, very obtuse, margins crenate, adnate, the lower base much excised and sub-truncate, the upper base slightly sub-auriculate or produced, but not extended on rhachis, 3–4 lobes at top confluent, the uppermost lobe broadly ovate, obtuse; the lowermost 5–6 pairs of pinnæ small, sub-orbicular, and sometimes opposite; veins 4–5-jugate, obscure, the lower forked, upper simple, extending nearly to margin, tips clavate, the lowest basal vein always 3-branched, and proceeding from the rhachis, not the midrib: *fertile* fronds much longer and more slender, 9–11 inches (including stipe, 2 inches), pinnæ 16–18 pairs, alternate, very distant, sub $\frac{1}{2}$ inch, narrow linear almost filiform, 6–7 lines long, $\frac{1}{2}$ line wide, obtuse, margins sub-crenulate, presenting a regular knobbed or beaded appearance, arising from the clavate tips of the veins, adnate, slightly decurrent, ultimate lobe long and very narrow, the lowermost segments exceedingly small; rich red-brown; margin of indusium finely lacerate, as obtains in *L. filiformis*, A. Cunn.

Hab. Scattered in damp shaded localities, Seventy-Mile Bush, County of Waipawa; 1880–86: *W.C.* In forests near Palmerston, County of Manawatu; 1886: *Mr. A. Hamilton.*

Obs. I. This species is allied to several of our smaller *Lomariæ*,—as, *L. lanceolata*, Spr., *L. pumila*, Raoul, *L. membranacea*, and *L. oligoneuron*, Col.,†—but more closely to *L. membranacea*, from which species it differs in its larger size, its crenate (not "dentato-serrate") sterile pinnæ, which are also of a different shape, more obtuse and distant, excised at their lower and produced at their upper bases, much fewer veined, and minutely dotted with red scales beneath; while the fertile

* The numbers attached to the orders and genera in this paper are those of them in the "Handbook Flora of N.Z."

† *Vide* "Trans. N.Z. Inst.," vol. xvi., p. 346.

pinnæ are also very much narrower, and adnate, with sub-crenulate margins. Those four species form a compact little natural group.

II. After long search, I found 4 small scales at the bases of 2 stipites. These are very short, about 1 line long, black, subulate, with a broad membranous and entire base, and large black oblong cells.

ORDER II.—LYCOPODIACEÆ.

Genus 2. **Lycopodium**, Linn.

1. *L. novæ-zealandicum*, sp. nov.

Plant small, dependent, lax, soft; main stem slender, 3–4 inches long, single, leafy to base, once forked at top; forks ½–1 inch long, cylindrical. Leaves sub-trifarious, glabrous, shining pale-green, spotted with brown dots, lowermost rather distant, loose, spreading, recurved, sub-linear-spathulate, 4–6 lines long, ½ line wide, transversely wrinkled, narrowed at base and slightly decurrent; tips sub-acuminate, obtuse, thickened, nerve broad and strong; margins entire, pale, sub-cartilaginous; upper leaves much smaller, closer, imbricate, sub-appressed, nerve obsolete. Capsules axillary in upper leaves of main stem and on forks, large for plant, orbicular with a deep sinus, broader than base of leaf, yellow; valves gaping, thickened at margins; spores sub-orbicular, minutely roughish. Scale- or capsule-leaves on forks, sub 2 lines long, subulate, erect, very obtuse at tips, much dilated at base, clasping.

Hab. Epiphytical on fern-trees, open marshy glades in low forest, bank of River Mangatawhainui, near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. I. Of this little plant I obtained five specimens from three fern-trees, two of them in full fructification and nearly alike in size and shape; two of the barren specimens were a little larger (4–5 inches, main stem), but much the same in form; their colour greener.

II. This is a small species of the *Selago* section; apparently pretty closely allied to *L. taxifolium*, Sw., (*ap. fig.* Hook. et Grev. *Gen. Filicum*, tab. lxxxviii.,) a Jamaica and St. Helena species; but that plant is much larger, and its leaves are sub-sexfarious, rigid, and acute, and its capsules reniform. This plant is also nearly allied to *L. gnidioides*, Linn., a Cape and Mauritius species. It differs much from its nearest New Zealand congener, *L. varium*, Br., in its much smaller size, in its narrower leaves of a different shape, being more lax and remote, and not so thickly set around the stem, in the total absence of quadrangular spikes, its differently-shaped capsules, and its softness. Sir J. D. Hooker has given no less than five drawings of different forms of that variable species in his "Flora

Tasmaniæ," (tab. clxx.,) but all without fructification. Another drawing of that species, with fruit and dissections, is also given by Sir W. J. Hooker, (*Ic. Filicum*, tab. 112,) which is more in accordance with the New Zealand states of *L. varium;* but all differ widely from this plant.

Order IV.—MUSCI.

Genus 46. **Polytrichum**, Linn.

A. *Calyptra nearly glabrous.*

IV. Polytrichadelphus, C. Müell. (*Cyphoma*, Hook. fil. and Wilson.)

1. *P. polycarpum*, sp. nov.

Stems erect, 2 inches high, rather stout, once forked, bare at base. Leaves 3½ lines long, thickly set from near base, sub-patent, spreading and decurved below on stem, subulate, acute, glabrous, flat on upper surface not canaliculate, sub-rigid, opaque, narrowly margined, serrate, nerved throughout, dark-green with brown tips, lurid in age; bases broad, sub-quadrate, 1 line wide, amplexicaul; cells very minute, sub-orbicular distinct and transverse in the margin of leaf near contraction, narrow linear-oblong in the basal portion; perichætial shorter than stem-leaves. Fruit-stalks lateral, slender, erect, 1½ inches long, slightly flexuous, twisted at top, light-red, shining, 4–5 to a branch. Capsule broadly oblong, a little contracted at mouth, sub-horizontal and inclined, 2 lines long, somewhat strumous, flat and slightly concave above, conspicuously 2-angled at the sides (sometimes obscurely 4-angled), semi-terete below; light-brown (becoming darker in age), shining, mouth orbicular; teeth 64, rather short, hyaline, acute, sinuses broadly rounded; the circular epiphragm radiate, margin uneven. Spores circular, transparent at centre. Calyptra longer than capsule, narrow linear, 2½ lines long, straight, red, glabrous, tip obtuse, hirsute at extreme apex; hairs very short and thick; membranous and lacerate at base.

Hab. Hilly woods, east bases of Ruahine Mountain Range, County of Hawke's Bay; 1885: *Mr. A. Hamilton.*

Obs. This species will range under *Polytrichadelphus*, C. Müell., and is allied to *P. magellanicum*, Hedw. It differs however, from that species in its more simple stems, in its leaves being margined and more serrate, with much larger sub-quadrate bases, (resembling those of *P. giganteum*, Hook., as given by Schwaeg., tab. cccxxv.), and in their not being canaliculate and lamellate; also, in its slender seta, the sub-strumous form of its capsule with circular mouth, its shorter and more acute teeth with broader sinuses, and its longer calyptra.

Genus 67. **Hypopterygium**, Bridel.

1. *H. hillii*, sp. nov.

Plant closely cæspitose in small tufts. Stems about ½ inch high, thickly tomentose throughout with dark brown tomentum. Frond sub-deltoid-orbicular, pale yellowish-green, 5–6 lines broad, the lower branches 2-pinnate, the upper simple. Leaves: on the stem, deltoid-acuminate, nerveless, margins entire slightly uneven, cells long and narrow; on the primary branches, distichous, spreading, close and slightly imbricate, broadly ovate, much apiculate, dimidiate, very thin almost pellucid, stoutly margined; margins serrate; nerve extending about three-fourths of leaf; cells small and sub-orbicular at tips, larger and oblong at centre and base with minute interstitial cellules; dorsal leaves orbicular, very largely apiculate, the mucro stout and acute and nearly half the length of the leaf, margined, slightly denticulate near apex; nerve stout, extending beyond middle; cells as in those of the primary branches; perichætial narrow-ovate, much acuminate, acute; cells very long and narrow. Fruit-stalk, 5–7 to each plant, about ½ inch long, reddish, erect, tip slightly curved. Capsule a little drooping, oblong, red, minutely and regularly papillose, broadest and tubercled near base; cells large, sub-orbicular-quadrate; outer teeth dark-brown, subulate, acuminate, with no median line but a dark line at margins, transversely sulcate; the inner teeth nearly as long as the outer, pale, subulate, acuminate, bifid, tips almost capillary, dark jointed. Calyptra as long as the capsule, dimidiate, narrow, subulate, acute, a little curved, whitish below, tip brown.

Hab. Forests, Daneverke, County of Waipawa; 1885; *Mr. H. Hill:* forests near Norsewood, same county; 1886: *W.C.*

Obs. This elegant little fern-like moss is allied to the smaller species of *Hypopterygium*, ("Sec. I. *a*. Leaves not mixed with bristles; ** branches 2-pinnate;") of which we have some half-dozen or more known and described species, but it is very different from them all. I have, with much pleasure, named it after its discoverer, Mr. Henry Hill, B.A., Inspector of Government Schools for the Hawke's Bay District, whose ready zeal and care in collecting, and kindness and liberality in imparting botanical specimens of rare plants, I have long thankfully experienced, as my published botanical papers will abundantly testify.

2. *H. pachyneuron*, sp. nov.

Plant, rhizome stoutish, creeping, 2–3 inches long, brown, slightly hairy. Stems single, distant on rhizome, erect, 1 inch high, rather slender, glabrous, leafy and green above, bare and brown below. Frond sub-orbicular-cordate in outline, ½ inch long, green, inclining to pale-green at tips of branches; branches bi-pinnate throughout, very close set and overlapping. Leaves: lateral, distichous, spreading, imbricate, ovate, acute, slightly and distantly serrate at tips, margined; nerve very stout and broad at base and extending beyond middle; cells rhomboidal, larger at base; the dorsal leaves broadly orbicular, apiculate, margined; margins entire, slightly uneven; nerve vanishing beyond middle; cells oblong, small at tip and margins, larger at centre and base; stem leaves similar to dorsal; perichætial narrow oblong-lanceolate, very acuminate, entire; cells narrow oblong rectangular. Fruit-stalk: 8–9 on one plant, each singly arising from the base of a branch on the main stem, or from a fork of the primary branches, slender, erect, red, 5 lines high, shorter than frond; base very filiform, vaginant; vagina large, cylindrical, dark-brown. Capsule sub-erect and horizontal, about 1 line long, oblong, reddish, smooth, slightly rugose at base; outer teeth dark-brown, subulate, with a dark median line, very closely transverse-sulcate, edges much roughened (sub-denticulate) with numerous dark teeth, greatly acuminate, tips flexuous, curved; inner teeth just as long as outer, pale, remotely barred with a median line, acuminate, bifid for one-third of length from tip, with three filiform jointed ciliæ, shorter than teeth, alternate between them.

Hab. Near Wairoa, Hawke's Bay; 1885: *Mr. A. Hamilton.*

Obs. This is another species of the same subsection as the preceding, and is also pretty closely allied to its known New Zealand congeners.

Genus 71. **Hookeria**, Smith.

Section 2. Mniadelphus.

a. Leaves with thickened margins.

** Leaves entire.

1. *H. cataractæ*, sp. nov.

Plant growing in large spreading patches, 2–3 inches long, fragile, soft; stems stout, thick at top, dark, leafy throughout, branched above; branches long, divaricate, distant, flat, compressed, hairy, $\frac{1}{10}$ inch wide. Leaves small, $\frac{2}{3}$ line, sexfariously disposed, obovate-oblong, very obtuse, slightly narrowed at base, imbricate, very thin, glossy, of a pleasing bright-green (lighter in age), wavy, tips recurved, margin entire, thickened, and (with nerve) red in age; nerve extending $\frac{5}{6}$ of leaf, diverging near tip with a very short branch at divergence, stout at base, fine at top; cells orbicular, small, particularly at apex and sides, larger and oblong at lower centre and base; perichætial leaves smaller and narrower, sub-apiculate, enclosing numerous cylindrical paraphyses, cells larger. Fruit-stalk arising from near base of branchlet, ½ inch long, erect, flexuous, slender, shining, dark-red, thickened at base and vaginant; vagina tubercled. Capsule smooth, shining, oblong, equal, rather less than 1 line long, brown, slightly tubercled at base, sub-erect and horizontal; cells small, oblong-orbicular; outer teeth much acuminate, dark-brown, closely trabeculate, free, with stout thickened margins, rough at edges with bars largely protruding towards tips, and two dark stout longitudinal medial lines close together; inner teeth long, very acuminate, finely hair-pointed, white, with distant trabeculæ and a single median line. Operculum half the length of capsule, rostrate, reddish, smooth, shining, acuminate, acute, black-tipped, centre reddish-brown, base much fimbriate; fimbriæ recurved, light-brown, obtuse, of unequal lengths.

Hab. Close to a waterfall, wet dripping sides of shaded cliffs, banks of the River Mangatawhainui, near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species allied to *H. concinna*, Col.,* but much larger, and of a different habit, form of growth, and texture.

β. Leaves without thickened margins.

** Leaves serrulate.

2. *H. telmaphila*, sp. nov.

Plant sub-erect, 1–1¼ inches high, simple and slightly branched; stems stout, dark-coloured, hairy at bases with long red wiry hairs. Leaves pale dusky-green, quadrifariously disposed, imbricate, not margined, minutely serrulate (*sub lente*); lateral spreading, 2½ lines long, broadly ovate, very obtuse, the base contracted and with the stout nerve presenting a sub-petiolate appearance; nerve extending ⅔ of leaf, very stout at base, ending abruptly with a short branch from the tip; cells large, orbicular, smaller at apex and sides; dorsal and ventral leaves adpressed, smaller, sub-orbicular, ovate; perichætial numerous, small, very thin, ovate, acute, apex sharply serrulate, the margins entire; cells oblong. Fruit-stalk (immature) ½ inch long, black, stout, flexuous, twisted, much thickened at base. The leaves when dry are distant and much crisped, but soon expanding in water.

Hab. On the ground, edges of a swamp, dense forest near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species near to *H. pseudopetiolata*, Col.,† but differing from that species in its larger size and very much larger and broader leaves, that are only very minutely serrulate and imbricate; their cells also are unequal, with a stouter and longer nerve.

* "Trans. N.Z. Inst.," vol. xviii., p. 229.

† "Trans. N.Z. Inst.," vol. xviii., p. 231.

ORDER V.—HEPATICÆ.

Genus 2. **Jungermannia**, Linn.

1. *J. pygmæa*, sp. nov.

Plant minute, erect, 2 (rarely 3) lines high, of close, compact growth, pale-green. Stems highly cellular. Leaves sub 20, orbicular, narrowed at base, semi-amplexicaul, not decurrent, imbricate, vertical, sub-recurved at tips, margin entire but slightly uneven; cells small, orbicular, and minutely beaded at apex of leaf, larger and oblong, with minute triangular cellules in the interstices in the centre and at the base, and minute subquadrate and regular at the margin, giving the leaf a margined appearance. Stipules 0. Perianth obovate, 6-lobed, and plicate, each lobe 3-toothed, the central tooth largest and ciliate with 5–6 short ciliæ; cells large, oblong-quadrangular. Seta slender, capillary, flexuous, 4½ lines long, highly cellular; cells narrow, longitudinal. Capsule small, brown; valves oval, obtuse, slightly margined, striate with dark-brown wavy lines and numerous minute transverse ones; cells oblong.

Hab. On wet sides of clayey and sandstone cuttings, closely intermixed with a minute *Fissidens*, and forming one compact and spreading mass; Glenross, County of Hawke's Bay; 1886: *Mr. D. P. Balfour.*

Obs. A species very near to *J. humilissima*, Col., ("Trans. N.Z. Inst.," vol. xviii., p. 236, and to other small allied species mentioned there), but differing mainly from that species in the form of its perianth and its capsule, in the cells of its leaves, and in its smaller size.

Genus 3. **Plagiochila**, Nees and Mont.

1. *P. polycarpa*, sp. nov.

Rhizome creeping, long, much branched. Stems dendroid, erect, 6–9 inches high, woody, sub-rigid, bare and compressed below cylindrical above, black, glossy, bipinnately branched; branches ascending and horizontal, very numerous, especially above, irregular in length—sometimes a branch as large and as thick as the main stem proceeds horizontally from it near the base. Leaves light-green when young, olive-green when old, much crisped when dry, closely set, imbricate, largely decurrent, ventral margins cilio-denticulate; teeth few, distant, but closer and smaller at apex; dorsal margin entire and very oblique; cells sub-orbicular. Main stem 2½ lines wide (including leaves), leaves large, somewhat elliptic-orbicular, apices round, their ventral bases much produced and clasping; branches (with leaves) 1½ lines wide, their leaves smaller and somewhat deltoid in outline; involucral sub-obovate, narrow, sub-vertical, ciliate on ventral margin and at apex, dorsal margin entire.

Perianth terminal on short lateral branchlets, green, broadly-elliptic, apiculate, sub-inflated, mouth large, gaping, lips entire, thickened, incurved, with 3–4 very minute ciliæ (*sub lente*) at tip, the mucro sometimes split or minutely bifid; seta short, slightly exserted, nodding; capsule oval, dark red-brown, small for plant; valves oblong, obtuse; elaters bi-spiral, adhering largely to margins. The male plant is more slender, with smaller leaves, narrow spikes, and much attenuated apices.

Hab. In wet dark woods in deep gulleys between hills, growing luxuriantly and thickly in very large continuous patches of several feet, on rotten logs, roots and bases of trunks of large trees, completely covering them; near Norsewood, County of Waipawa; 1885-86: *W.C.*

Obs. This fine species will rank with those other known New Zealand dendroid *Plagiochilæ*, — viz., *P. gigantea*, Lind., *P. stephensoniana*, Mitt., *P. sub-similis*, Col.,* etc. It also has affinity with them all, mostly, perhaps, with *P. stephensoniana*, but differing from that species in its perianth and involucral leaves, colour, and manner of growth, being much and largely branched at the top. The form of its leaves on the ventral side in their upper basal portion is much like those of *P. deltoidea*, and *P. cristata*, Lind., (and of some others,) being largely-produced and sub-amplexicaul.

2. *P. obscura*, sp. nov.

Rhizome creeping, long, stout. Stems dendroid, erect, 5–6 inches high, semi-depressed and sulcated below, dark, stout, leafy from base, much branched above; branches sub-tripinnate, reddish-brown. Leaves very numerous, close, imbricate, cordate, amplexicaul, sparsely ciliate-dentate at apex and apical portion of ventral margin; the dorsal base of leaf wavy and largely decurrent, and nearly meeting on the stem that of the opposite leaf; the base of the ventral margin much produced beyond the stem; the young leaves light-green, the old ones dark-green; cells minute, orbicular; guttulate, sub-opaque. Involucral leaves similar, but smaller and obovate; teeth coarse, each containing many cells. Perianth terminal on very short lateral branchlets, green, elliptic-orbicular, obtuse, apiculate, entire, the mucro having 4 short teeth (*sub lente*); seta exserted, very short; capsule small, oval, dark-brown; valves sub-acute.

Hab. On decaying logs and branches, wet dark woods near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species allied to the preceding, *P. polycarpa*, but a smaller, coarser, and darker plant, with differently shaped and opaque leaves.

* "Trans. N.Z. Inst.," vol. xiv., p. 340.

3. *P. suborbiculata*, sp. nov.

Plant dendroid, 3–4 inches high; stem (and main branches) black, bare at base, leafy above, tripinnately branched at top; branches long, irregular, spreading; sometimes a branch, with its numerous upper and close bushy branchlets, is larger than that whence it sprang; branchlets clear greenish-brown, curved, drooping, 2½ lines wide (including leaves). Leaves alternate, distant on main stem and branches, closer on branchlets, but not much imbricate; green when young, dusky-green when old; those on main stem sub-reniform-orbicular, 2 lines diameter, horizontal, patent, slightly amplexicaul; on branches orbicular or orbicular-cordate; margins largely denticulato-ciliate (almost spiny), except the basal portion of the dorsal margin; teeth or spinous ciliæ reddish, irregular, coarse, jointed, the largest with 2–3 lateral cells at their bases; marginal interstices between teeth curved and rounded; cells large, orbicular, and oblong, with thick double walls and clear triangular dots in the interspaces, smaller and more compact in a regular line on the margins. Involucral similar, but larger and spreading. Perianth terminal, free, obovate, 3 lines long, curved, compressed; lips semicircular, much produced, ciliate-toothed, extending round apex and slightly down the sides; base cylindrical, peduncled.

Hab. Dry hilly forests near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. This species is very near *P. gigantea*, Lind., which it much resembles in form and general appearance, though a smaller plant. It differs, however, from that species in its larger and more orbicular leaves and in their areolation, their margins being much more coarsely toothed and sub-spiny, and their dental interspaces rounded; its perianths, too, are much more round and produced at their tips, with longer, more numerous and extensive ciliate teeth; and its involucral leaves are more distant and spreading.

4. *P. exilis*, sp. nov.

Plant creeping at base, sub-erect, 3–4 inches high, excessively slender, few and loosely branched; branches diffuse, distant, long, often 3 branchlets opposite and near each other spring from near the top of the main stem, and a sub-horizontal one from close under perianth; stem (with leaves) $\frac{1}{10}$ inch wide, red, smooth. Leaves light-green, small, alternate, distant, obovate, apices very obtuse and truncate, closer and very slightly overlapping at tops of branches, ventral margin and apex coarsely and irregularly denticulate, (mostly 10 teeth on ventral margin and 2–3 at apex,) dorsal margin entire, an oblique ridge or thickening near the margin extending to stem (giving the appearance of a nerve), and this slightly decurrent on the stem parallel with the proper margin ; cells minute, of various shapes and sizes (mostly oblong), rather opaque. Involucral leaves similar, but laciniate on both margins, the laciniæ larger, curved, and bi-laciniate. Perianths few, terminal on tips of main branches, free, peduncled, obovate-oblong, compressed, sides straight, mouth largely cilio-laciniate; lips scarcely rounded; cells as in leaves. Capsule slightly exserted, small, oval, reddish-brown; valves oblong, obtuse. *Male* plant still more slender, wiry, attenuated and diffuse; 3–4 small branchlets of spikes near the top of main stem, sub-fasciculate, the branchlet continued above the spike with the spikes double on it; spikes very narrow, 2 lines long; scales 3–4-toothed at apex, tips recurved.

Hab. On wet logs, etc., forming closely-growing loose tangled masses; low wet woods near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. In general form and habit this species will rank near to *P. tenuis*, Lind., (an East Indian and West Indian species,) and the male plant with that of *P. deltoidea*, Lind. It is also pretty closely allied to the following species, *P. distans.*

5. *P. distans*, sp. nov.

Plant creeping, slender, wiry, procumbent, and sub-erect. Stems delicate, 1½–2 inches high, leafy to base, simple, forked at top and sometimes sub-fascicled with 2–4 branchlets; tops of stems sub-flabellate; stems (including leaves) mostly about 1 line wide, the largest sometimes 1½ lines; stems light reddish-brown. Leaves on stems small, alternate, very distant, sub-obovate, dimidiate, flat, spreading, ventral margin much arched, dorsal straight, a few large distant teeth (4–7) at apex and on anterior portion of ventral margin, generally 3 spinous teeth at apex, the one at the outer anterior angle being the longest, dorsal margin entire; leaves generally larger at tops of branchlets and about the perianth, light green; cells orbicular, with thick walls and minute circular cellules in the interstices. Involucral leaves similar, erect. Perianths terminal on branchlets, obovate, $\frac{1}{10}$ inch long; mouth narrow; lips largely ciliate-dentate; teeth few, flexuous; cells as in leaves. *Male* plant still more slender, sometimes 3 spikes on a branch, with leaves in the interspaces, each spike about 1½ lines long; scales sub-erect, tips 2-fid. The tips of the branches are sometimes flagellate and scaly; some of the stems are also exceedingly fine and slender, being only ½ line wide, including their pinnate leaves.

Hab. On trees, in low wet woods, forming rather large and densely compact patches; near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species nearly allied to the preceding, *P. exilis*, mihi; and also to *P. distinctifolia*, Lind., a West Indian and South American species, (and also said by Lindenberg* to have been "found in Dusky Bay, New Zealand, Herb. Hook."; but it is not included by Sir J. D. Hooker in the "Flora N.Z.," nor the "Handbook Flora N.Z."; hence, I suppose, some slight error in the Dusky Bay *hab.*, possibly an error for Staten Land, near Cape Horn). This species differs from *P. exilis* in its leaves being less toothed with rounded apices, and without the oblique and decurrent ridge, so striking in the leaves of that plant, and also in their widely different areolation: the spikes, moreover, of the male plant of this species are much smaller, with only 2 teeth to their sub-erect (not recurved) scales. This species is also shorter and much more slender and filiform, and of a different habit of growth.

Genus 7. **Gottschea**, Nees.

* Leaves stipulate.

1. *G. ciliistipula*, sp. nov.

Plant gregarious, procumbent, imbricate in growth, creeping, soft, of a pleasing bright-green. Stems 1 inch long, 3–4 lines wide, simple, sometimes 1–2–3 short branches near top, flat, leafy throughout, with numerous dark-red rootlets below. Leaves very thin, all margins finely and closely serrulate; ventral lobe long, narrow, sub-acute, much finely plaited, the lower basal margin ciliate; dorsal lobe much shorter, broadly ovate, dimidiate, largely-arched, tip acute. Stipule quadrate, $\frac{1}{20}$ inch wide, quadrifid; lobes long, narrow, sinuate, sub-acute, largely ciliate; ciliæ long, subulate, acute, flexuous, 5–9-jointed, very glossy; sinuses large, round, broad and clear, plaited or ridged longitudinally downwards from base of each sinus, the ridges ciliate. Cells large, of various shapes and sizes—hexagonal, oblong, and quadrate. On the stem, in the axils between the two lobes, are 2–3 minute narrow highly-cellular ciliated phyllodia, their ciliæ also long-jointed and flexuous.

Hab. In large patches on rotten logs and trunks of trees, in a deep dark wood near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species having affinity with *G. læte-virens*, *G. nitida*, and *G. trichotoma*, Col.,† but differing from them all in its beautifully plaited and cut stipules, ciliated with long, wavy, glossy ciliæ, as well as in other characters.

2. *G. compacta*, sp. nov.

Plant procumbent, obovate, tapering, light-green, 1–2 inches long, 8 lines wide at top; stems flat, branched, stout, rooting,

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* "Species Hepaticarum": fasciculus i., *Plagiochila*; appendix, p. 156.

† "Trans. N.Z. Inst.," vol. xviii., pp. 238, 240.

hairy and scaly beneath at bases. Leaves alternate, distant on stem below, close, and slightly imbricate at their bases above, oblong, spreading, plaited about the tips, which are very thin, laciniate-lobed; lobes largely and sharply serrate; tip of the ventral lobe sub-acute, of the dorsal broad and obliquely truncate, and both finely serrate; axils clear; cells large, oblong, of various sizes, minutely and regularly papillose, but clear and orbicular at tips. Stipule large, free, $1\frac{1}{2}$ lines wide, sub-cuneate-quadrate, narrowest at base, much cilio-laciniate on three sides; laciniæ long, flexuous, very acute, bifid; sinus long, margins subsinuate and laciniate.

Hab. Among mosses, on rotten logs in wet shaded woods, near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species having pretty close affinity with *G. macroamphigastra*, Col.*

2. *G. compacta*, sp. nov.

Plant small, compactly gregarious, nestling together in little tufts or cushions, procumbent and sub-erect, with a profusion of dark-red rootlets below. Stem stout, leafy to base, simple, but often with 2–3 minute branchlets at top, $\frac{1}{4}-\frac{3}{4}$ inch high, 3–8 lines wide at tip including branchlets; lower leaves green, but very pale-green at tops bearing the appearance of whitish round buds. Leaves amplexicaul, closely imbricate; ventral lobe very thin, ovate-acuminate, acute, much plaited with fine short plaits or ridges running diagonally to margins, the upper margin finely serrate, the lower margin largely laciniate; cells large, oblong, clear, with minute orbicular interstitial ones; dorsal lobe broad, much arched, apex obliquely truncate and finely and sharply serrate, anterior margin slightly serrulate, the basal portion entire and overlapping; cells much as in the ventral lobe, but more crowded and not so clear. Stipules large (for the plant), bilobed half-way through, laciniate on all margins; laciniæ large, very cellular; cells large, oblong and clear below, orbicular and double-walled above.

Hab. On rotten logs, forming little dense closely-compacted patches, in low wet woods, near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A peculiar-looking little species, well marked, by its habit of growth and its handsome largely-laciniate stipules.

Genus 11. (**Gymnanthe**, Taylor.)

(1.) *Tylimanthus*, Mitten.

1. *T. furfuraceus*, sp. nov.

Plant gregarious; rhizome creeping, much and intricately branched, succulent. Stems or fronds rising erect from rhizome,

* "Trans. N.Z. Inst.," vol. xviii., p. 238.

½–1 inch apart, stoutish, usually simple, (sometimes once branched, branch patent, horizontal,) 2 inches high, 4 lines wide, flexuous, succulent, decurved, pale-green, the base of stipe bare with small distant leaflets above increasing in size upwards to the leaves. Leaves, sub 20 pairs on stem, alternate, pinnate, close-set, imbricate, wavy, somewhat quadrilateral-elliptic, apex truncate, rounded, and slightly retuse, sub-sessile, attached to stem only at posterior corner, slightly decurrent, tips and margins sub-recurved, closely serrulate on anterior margin, apex, and upper half of posterior margin, remainder entire; anterior margin arched, posterior nearly straight, the entire portion thickened; teeth irregular in size, broad at base, 2–3 cells in each; colour clear dark-green; cells various, oblong, triangular, etc., scattered; cell-walls thick, double. Involucre terminal, vertical, pendulous, cylindrical, 3 lines long, very narrow, obtuse, light-green, covered with a fine, minute, light-reddish scaly scurf.

Hab. On rotten logs, growing in large compact patches, in wet shaded forests near Norsewood; 1885–86: *W.C.*

Obs. This species has close affinity with *T. saccata*, (*Gymnanthe* of "Handbook N.Z. Flora," and of "Species Hepaticarum,") but differs from it in its smaller size, more numerous, larger, closer, imbricate and wavy leaves, which are also of a different shape, as are also their cells, their margins more denticulate, and only adhering by the lower corner to the stem, and in its furfuraceous torus. I have very rarely found it in a fruiting state, and then only after long and diligent search.

2. ? *T. perpusillus*, sp. nov.

Plant very small, delicate, pale-green; rhizome creeping, short, very slender. Stems erect, $\frac{1}{2}$–$\frac{3}{4}$ inch high, densely compact and gregarious, slender, sub-succulent, simple, flexuous, slightly thickened at tips, 1 line wide including leaves, usually leafy to base. Leaves minute, alternate, usually distant, (sometimes close and sub-imbricated at the middle,) pinnate, mostly 12–14- (rarely 20-) jugate, sub-quadrate-orbicular, truncate, deeply notched or sub-bifid, the upper lobe larger, apices acute, sinus very broad, sometimes minutely toothed, sessile, clasping, slightly decurrent, a little twisted and convex, patent, margins entire; anterior margin arched, slightly uneven at apex; posterior straight, or slightly excised at base. Cells minute, crowded, sub-orbicular, their walls thickened, with scattered very minute cellules within them. Fruit not seen.

Hab. In shady damp niches, in the summit or peak of a high hill named "Cook's Tooth," near Porangahau, County of Waipawa; 1886: *Mr. H. Hill.*

Obs. A species having affinity with the preceding, *T. furfuraceus*, Col., to which it bears a striking general resemblance, although a very much smaller plant. Notwithstanding my having received some scores of specimens, I have not found any bearing fruit; therefore it is only provisionally placed under this genus, at the same time I have no doubt of it belonging to it.

Genus 13. **Lepidozia**, Nees.

1. *L. latiloba*, sp. nov.

Plant small, prostrate, recurved, spreading in patches; colour dusky-olive-green. Main stems 1–1½ inches long, bipinnate, leafy to base; branchlets numerous, alternate, ¼–¾ inch long, patent, irregular, curved, drooping; tips acuminate and flagellate. Leaves numerous, very close, imbricate, concave, glossy, quadrate or sub-palmate-quadrate, 4-lobed; lobes large, half the length of leaf, very broad at base, (each containing 6 lines of lateral cells,) acuminate, tips acute, margins uneven, sinus very broad; cells distinct, minute and orbicular at margins and tips, larger and oblong in the centre and at base. Stipules same as leaves, only the lobes a little narrower and more acuminate, patent, tips incurved.

Hab. On ground or rotten wood, dark shaded woods near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species having some affinity with *L. cupressina*, Lind., a West Indian, Chilian, and Tasmanian plant.

Genus 14. **Mastigobryum**, Nees.

Section 1. Stipules quite free from the leaves.

* Leaves quite entire.

1. *M. obtusatum*, sp. nov.

Plant small, procumbent, weak, spreading, 1–1½ inches long, ½ line wide, dichotomous; branches uniform in width throughout; light-green. Leaves alternate, broadly elliptic, the dorsal slightly overlapping at the middle, the lowest smaller and distant, margins entire and somewhat irregular, the dorsal margin arched, the ventral nearly straight; apices of upper leaves entire, rounded, and very obtuse, of the lower leaves various, truncate, and 1–2–3 obsoletely dentate; cells orbicular, excessively minute, sub-opaque, contiguous in regular parallel lines, with a band of 3 longitudinal rows of larger and clearer cells near the ventral margin. Stipules minute, wider than stem, quadrate, largely 4-fid; laciniæ long, spreading, acute; cells oblong-quadrate, very clear, brown. Flagellæ few, long.

Hab. Woods near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species very near to *M. convexum*, Lind. The band of 3 rows of large cells closely resembles a similar band in the leaves of *M. monilinerve*, Nees.

** Leaves 2-dentate or 2-fid.

2. *M. amœnum*, sp. nov.

Small: stems 1–2 inches long, spreading, decurved, loosely dichotomous; branches leafy, equal, about $\frac{1}{2}$ inch long, $\frac{1}{20}$ inch wide (including leaves), cellular. Leaves very distinct, not imbricate, alternate and sub-opposite, oblong-quadrate, margins slightly sinuous, dorsal edge arched, ventral nearly straight, truncate, largely bidentate, the upper lobe larger, sinus nearly one-third length of leaf, broad, sinuate; colour pleasing light grass-green; cells large, orbicular, alike throughout. Stipules excessively minute, free, adpressed, composed of 4–5 capillary cellular fimbriæ. Flagellæ numerous, 3–4 to a branchlet, long, capillary. *Male* inflorescence from upper axils of stipules, single and geminate, sub-pedicelled, highly cellular; perianth campanulate, 5–7 fissured, laciniæ ovate-acuminate, enclosing an orbicular head of 10–12 minute cylindrical reddish sacs.

Hab. In dense forests near Norsewood, County of Waipawa; 1886: *W.C.* Running over and into cushions of *Leucobryum candidum*.

Obs. A species having affinity with *M. colensoanum*, Hook. fil., but differing from that species in its leaves not being imbricated, and in its stipules being minute and capillary-laciniate.

3. *M. minutulum*, sp. nov.

Plant very small, 4–5 lines (rarely $\frac{1}{2}$ inch) high; dark green. Stems rather stout (for the plant), cellular, usually once forked; branches few, short, leafy, sub $\frac{1}{25}$th inch wide, including leaves. Leaves distant below, close and loosely imbricated above, narrow oblong-quadrate, sub-falcate, slightly curved at dorsal margin, contracted at base, margins narrowly thickened and irregular, truncate, bidentate, tips somewhat obtuse, the upper lobe larger, sinus large, wide, edges irregular, cells perfectly orbicular, with minute interstitial ones. Stipules distant, excessively minute, laciniate, appressed. Flagellæ short, stoutish, scaly.

Hab. On the ground, but mostly confined to decaying dry vegetable matter; in dense wet woods near Norsewood, County of Waipawa; 1886: *W.C.*

*** Leaves 3-dentate or 3-fid.

4. *M. elegans*, sp. nov.

Plant compactly tufted, erect; stems 2–4 inches high, dichotomous; branches simply forked above, 2 lines wide, uniform throughout; tips recurved; light green, margins often tinged with pink. Leaves numerous, close-set, opposite, slightly imbricate at dorsal bases, spreading, convex, broadly ovate or sub-orbicular, truncate, trifid, teeth long and sharp, with minute teeth between them; dorsal margin largely rounded at base and overlapping stem; ventral margin sub-sinuate, slightly denticulate near apex, waved, with 1 large regular plait near the base to meet the stipule; cells small, orbicular, with minute interstitial cells, larger and oblong at base. Stipules free, large, 1 line wide, distant, quadrate, patent, recurved, in a regular line with bases of leaves and apparently connate, but really distinct, though approaching very close, somewhat 6–8-lobed on three sides; lobes irregular, laciniate; laciniæ acuminate, acute; cells small, oblong-orbicular. Flagellæ rather numerous below, few above, about 3 to a main branch, short, stout, scaly, issuing from above a stipule in the centre of the stem.

Hab. In dry craggy *Fagus* woods, growing compactly together on the ground with *Bartramia readeriana*, but only observed in two or three spots; banks of the River Mangatawhainui, near Norsewood, County of Waipawa; 1881–86: *W.C.*

Obs. A very elegant and striking species; scarcely allied to any of its numerous New Zealand congeners, and much more resembling *Isotachis* in its general appearance. The lower single stems with their leaves are always of a light-brown colour, presenting a dead appearance.

5. *M. macro-amphigastrum*, sp. nov.

Plant rather stout, firm, 2 inches long, 2–3 inches wide, dichotomous, spreading, of a pleasing dark-green colour; branches equal, 1½ lines wide, leafy throughout, much flagellate. Leaves opposite, closely imbricate, oblong, falcate, convex, truncate, trifid, sinuses very large and minutely and irregularly toothed, margins entire; dorsal margin much arched; ventral margin slightly sinuate at tip, dilated at base, largely incised in the middle, and abruptly truncate at extreme base to meet the stipule, which it does very closely though not connate; cells minute, orbicular, distinct at tips, crowded in the body of the leaf, each cell containing 2–3 pellucid dots. Stipules free, large, sub-deltoid-truncate, produced, patent, set slightly above where the two opposite leaves meet the stem, margins coloured brownish-red, recurved, and much laciniate; laciniæ sharp; cells irregular, oblong-rhomboidal at apex, smaller and orbicular at base. Flagellæ short, stout, scaly, branched, thickened at tips, by which they adhere rather strongly.

Hab. In low wet shaded woods near Norsewood, County of Waipawa; 1886: *W.C.* On close, compactly-growing mosses, and on other *Hepaticæ*, overrunning them.

6. *M. imbricatistipulum*, sp. nov.

Plant small, delicate, of close compact growth, erect, $\frac{1}{2}$–$\frac{3}{4}$ inch high, simple and forked, sometimes branched at base and dichotomous; branches short, about 1 line wide; pale green; flagellæ few, short. Leaves opposite, slightly imbricated, obovate-oblong, truncate, trifid, teeth large, acute, sinuses entire, margins slightly irregular, the ventral more so and slightly incised in the middle: the dorsal margin arched near base; cells minute, orbicular, crowded, distinct at tips, larger and clearer in body of leaf and base. Stipules free, close, quadrate, sub-adpressed with the upper margin overlapping the stipule above, and laciniate-toothed, the sides usually straight and entire; cells orbicular.

Hab. Among mosses on rotten logs, in wet forests near Norsewood, County of Waipawa; 1886: *W.C.*

7. *M. pusillum*, sp. nov.

Plant creeping, delicate, small, sub $\frac{1}{2}$-inch long, dichotomous; branches spreading, arched, light-green. Leaves opposite, close-set, regular, slightly imbricate near their bases, narrow-oblong, broadest at base, falcate, margins entire and slightly uneven, truncate, trifid; teeth large, spreading; sinuses broad and clear, the upper one usually larger; apical cells small, oblong, distinct and regularly disposed, the central appearing as if compound, or composed of the figure "8" within each cell, the basal crowded and opaque. Stipules large (for plant), sub-quadrate, irregularly toothed on their three sides; teeth sometimes bi-cuspidate; cells oblong, distinct, regular, and clearer at margins and teeth. Flagellæ few, short.

Hab. On trunks of fern-trees, forests near Norsewood, County of Waipawa; 1886: *W.C.*

8. *M. olivaceum*, sp. nov.

Stems $1\frac{1}{2}$ inches long, dark-brown, stout, loosely forked above with few branches; branches $\frac{1}{2}$–$\frac{3}{4}$ inch long, $1\frac{1}{2}$ lines wide. Leaves closely set, imbricate, dark-olive, rather opaque, oblong-linear, falcate, arched above, slightly narrowed at tip, truncate, largely 3-dentate with minute intermediate teeth or points, which also extend on lateral margins for some distance from apex, especially on the dorsal margin; cells minute, orbicular or orbicular-oblong, discrete (guttulate) as in *M. novæ-zealandiæ*. Stipules large, wider than stem, patent, membranaceous, semi-orbicular-quadrate, much laciniate with 6–7 long teeth or laciniæ, and several smaller ones between them; cells oblong-rhomboidal at margins, small at base. Flagellæ short, rigid, dark-coloured.

Hab. Forests near Norsewood, County of Waipawa; 1886: *W.C.*

9. *M. polyodon*, sp. nov.

Plant creeping, $1\frac{1}{2}-2$ inches long, leafy to base, stout, decurved, dichotomous; branches short, $\frac{1}{10}$th inch wide including leaves; of a pleasing dark-green colour. Leaves, opposite, recurved, broad, sub-quadrilateral, (or somewhat equilateral-triangular excluding the tip,) dorsal margin much arched, the ventral nearly straight, their bases overlapping on stem, truncate, trifid, with 2–3 small teeth in each sinus, and several minute distant teeth on each margin below apex, but more on the ventral margin; cells oblong, crowded, distinct in regular rows, very minute at apex and margins, larger in centre and at base, apparently compound, each being dark with an orbicular light centre. Stipules free, quadrate, broadest at base, wider than stem, recurved, much toothed on three sides; teeth acute and bi-cuspidate, each composed of 2 clear longitudinal cellules; the apical and marginal cells large, clear, rhomboidal rectangular and oblong; the central and basal cells minute, orbicular and crowded. Flagellæ short, thickish.

Hab. On the ground, in dry shady forests near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. The stipules of this plant are a strikingly beautiful object under the microscope.

10. *M. compactum*, sp. nov.

Plant creeping and sub-erect, firm, short, $\frac{3}{4}-1$ inch high, simple and shortly branched above; stems, including leaves, $\frac{1}{10}$ inch wide; light-green with an olive tint. Leaves opposite, close-set, lower half largely imbricate and overlapping stem at their bases, ovate, truncate, margins irregular and slightly sub-denticulate, the dorsal margin arched, the ventral nearly straight, sinus broad, the lower smaller and more acute, sometimes a minute tooth in either; cells small, sub-orbicular, distinct, guttulate in regular sub-parallel lines, much larger and clearer in the middle and on to the base. Stipules free, but posited close to bases of leaves as if connate, oblong- or reniform-quadrate, recurved, much toothed or jagged; teeth 6–10, short, acute, irregular; the upper cells adjoining each other and clear, but distinct and smaller below.

Hab. On trunks and large limbs of trees, forming small thick cushion-like patches; forests near Norsewood, County of Waipawa; 1886: *W.C.*

11. *M. heterophyllum*, sp. nov.

Plant procumbent, creeping, $1-1\frac{1}{2}$ inches long, spreading, simple and forked, light-green; branches few, capillary, $\frac{1}{20}$ inch wide, including leaves. Leaves fugacious, minute, opposite, oblong, close-set, sub-imbricate, the largest sub-quadrate, broadest at base; margins entire, sinuate, the dorsal margin arched; truncate, trifid, and bifid on branchlets intermixed; teeth long, acute; sinuses broad and somewhat irregular; cells oval-orbicular, distinct, guttulate, uniform. Stipules free, quadrate, rather large, wider than stems, 4–6-toothed; teeth reddish, very cellular, reticulate; cellules minute, clear and adjoining above, oblong-orbicular, distinct, and crowded at base. Flagellæ few, stoutish, very scaly.

Hab. On trunks of fern-trees, forming large thick patches; dense forests near Norsewood, County of Waipawa; 1886: *W.C.*

12. *M. macrodontum*, sp. nov.

Plant procumbent, small, sub 1-inch long; stems stoutish, forked; branches short, $\frac{1}{10}$th inch wide with leaves, dusky dark-green. Leaves opposite, close-set and imbricate, oblong, almost sub-quadrilateral, very broad at ventral base to meet stipule; the dorsal bases completely covering the stem and overlapping each other, slightly arched and falcate; margins entire and slightly uneven near apex, trifid; teeth irregular, large, broad, each containing several lateral cells, with usually 2 smaller teeth in each sinus; cells minute, broadly oval, distinct (guttulate), uniform, regularly disposed in lines. Stipules free, rather large, sub-quadrate, broadest at base, irregularly toothed on three sides, highly cellular; apical and marginal cells large, clear, rhomboidal and oblong (parallelogrammic); those at base and one-third through towards centre orbicular, minute, and regular. Flagellæ short, stout.

Hab. On bark of trees in woods, hill country between Mohaka and Lake Waikare, County of Wairoa; 1886: *Mr. A. Hamilton.*

Obs. A species pretty near *M. olivaceum.*

13. *M. obscurum*, sp. nov.

Plant gregarious, procumbent, creeping, pale green. Stems slender, weak, 1–1½ inches long, scarcely 1 line wide with leaves, flexuous, branched; branches rather long for plant. Leaves fugacious, alternate, thickish, opaque, close but scarcely imbricate above on stems, distant below, oblong-quadrate, truncate, trifid; teeth irregular and coarse; margins entire, the dorsal slightly arched; cells not discernible. Stipules free, small, adpressed, transparent and highly cellular, sub-quadrate, 4-fid; lobes very obtuse and rounded; cells large, sub-orbicular-quadrate, conjoined, uniform, each lobe containing 4 cells in a line laterally. Flagellæ 0 (sought, but not seen).

Hab. In woods, forming small compact patches; hill country between Mohaka and Lake Waikare, County of Wairoa; 1886: *Mr. A. Hamilton.*

14. *M. nitens*, sp. nov.

Plant procumbent, creeping, pale yellowish-green, glossy. Stems 2 inches long, flexuous, wiry and bare below, stout above and very leafy, 1½ lines wide (including leaves), dichotomous, tips recurved. Leaves opposite, close, slightly imbricated, very regular, falcate, sub-oblong-quadrate, dimidiate, the basal portion more than twice as broad as the apical but not overlapping stem, truncate, trifid; teeth long, acute; sinus broad with sometimes a minute toothlet; narrowly margined, margins uneven, minutely and sparsely toothed on both sides near apex, dorsal margin much arched, ventral excised. Cells minute, oblong-orbicular, distinct, nearly alike throughout, but large at basal centre. Stipules free, but as close as possible to bases of leaves as if connate, rather large, wider than stem, quadrate, patent, recurved, the margin coloured dark purple, laciniate-serrate above with 4–6 acute irregular teeth, those at the two angles largest; sides sinuous with generally 1 large tooth above the middle. Cells: central and basal very minute, oblong, distinct, ranged regularly in longitudinal rows; the marginal larger, clearer and united. Flagellæ very numerous; upper short, stout and scaly; lower, very long and filiform with hairy ends.

Hab. Woods near Norsewood, County of Waipawa; forming large thick patches on bark, and on dry vegetable débris; 1886: *W.C.*

Obs. A species near *M. olivaceum*, also *M. compactum* (supra).

15. *M. parasiticum*, sp. nov.

Plant stoutish, creeping, dull pale-green; stems 1–1½ inches long, 1 line wide, dichotomous, much decurved at tips. Leaves opposite, close, imbricate, very regular, sub-convex, oblong, falcate, dimidiate; base twice the width of apex, sub-amplexicaul, truncate, trifid; teeth long, spreading, acute; the lower sinus larger, with occasionally a minute toothlet in it; margins slightly sub-sinuous, the dorsal much arched and overlapping stem, the ventral somewhat excised with the lowest portion adjoining stem wholly truncate. Cells: at lateral margins very minute oblong, closely compacted in longitudinal lines; larger sub-orbicular and distinct at apex; the central still larger, sub-quadrangular, and increasing in size to the base. Stipules free, rather large, very cellular, patent, recurved sub-reniform-quadrate, mostly 4-toothed at apex, and 1 tooth (sometimes 2) at sides; cells large, of various sizes and shapes, quadrangular, rhomboidal, and oblong. Flagellæ numerous, short, stout, and scaly.

Hab. In forests with the preceding species, *M. nitens;* growing luxuriantly on clumps of *Leucobryum candidum;* 1886: *W.C.*

16. *M. obtusistipulum*, sp. nov.

Plant prostrate, small, slender, repeatedly overlapping itself in growth; stems brown, stoutish, wiry, 1–1¼ inches long, ⅔ line wide (including leaves), simple, loosely and sparingly forked at top. Leaves small, pale brownish-green, alternate, distant, tender, fugacious, opaque, very slightly adhering to stem, narrow oblong, broadest at base, truncate, trifid; teeth rather coarse, large and blunt; margins slightly uneven; dorsal margin much arched, the basal portion falcate; ventral margin nearly straight. Cells sub-orbicular, very obscure, but regularly disposed in rows between dark longitudinal lines, appearing as if each cell was composed of 5 cellules, separated by a star-like division, and as if there were two layers of superimposed cells. Stipules free, rather large (for plant), as broad as the leaves at their bases, distant, appressed, highly cellular, cuneate-quadrate, 4-lobed; lobes short, broad, and very obtuse. Flagellæ 0.

Hab. On the ground, thickly overrunning loose dry vegetable débris; low damp spots, forests near Norsewood, County of Waipawa; 1886: *W.C.*

Genus 19. **Polyotus**, Gottsche.

1. *P. smaragdinus*, sp. nov.

Plant prostrate; stems creeping, 3–4 inches long, 2-pinnately branched; branches spreading, upper ones very long; branchlets numerous, alternate, diverging, irregular in length, 3–15 lines long. Leaves, a pleasing emerald-green, distichous, regular; stem leaves close, patent, not imbricate, broadly cordate-ovate, dimidiate, apiculate, margins entire but slightly uneven, with usually 4 large lacinia-like ciliæ at the base on each side; cells sub-orbicular, distinct; leaves on branches imbricate, orbicular-elliptic, largely apiculate, margins entire, auricles clavate, dark-red when mature, with a minute subulate fimbria at the base; cells large, hexagonal, with minute interstitial cellules. Stipules on main stems 4-partite, segments ciliato-laciniate all round, ciliæ jointed; sinuses long, clear; cells oblong; stipules on the branchlets similar but very minute, bearing 2 very small claviform appendages, similar to those on leaves but much smaller.

Hab. On bark of trees, and among mosses on the ground; dark woods near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. This truly elegant species has affinity with both *P. claviger* and *P. palpebrifolius*, Gottsche, but differs from them and from all other known species in several particulars, especially in colour and in form of leaves and stipules.

2. *P. fimbriatus*, sp. nov.

Plant prostrate, creeping; stems stout, flexuous, pendulous, 4–6 inches long, 3-pinnately branched; branches straggling, very irregular in length, overlapping each other; branchlets numerous, close-set, alternate. Leaves mostly pale yellowish-brown, the upper layer and more exposed dark-orange and rich bright red-brown; main-stem leaves sub-imbricate above on stem with crisp sub-vertical margins, having a fissured scaly appearance, orbicular-cordate, very apiculate, margins entire but slightly uneven, largely amplexicaul, the sinus broad and circular, with several long irregular-curved fimbriæ and ciliæ at base; branch leaves imbricate, distichous, sub-orbicular, apiculate (sometimes sub-acute and obtuse), margins entire with long irregular laciniate fimbriæ at base; auricle clavate, dark-purple in age with several long flexuous fimbriæ at base; cells clear, orbicular, with minute interstitial cellules. Stipules on main stem large, sub-quadrate, 4-partite; segments largely ciliate on all sides; ciliæ long, recurved, flexuous, jointed; stipules on branchlets similar but smaller, with a dark boss or blotch at central base, and bearing two small dark claviform appendages similar to those on leaves, and ranging with them: cells oblong-orbicular, very clear, each of the segments having a narrow marginal line of compacted minute cells.

Hab. On trees, often overrunning mosses, etc., Seventy-mile Bush, between Norsewood and Woodville, County of Waipawa; 1885–86: *W.C.*

Obs. A species allied to the preceding, *P. smaragdinus*: but more nearly to *P. claviger*, and *P. taylori*, Gottsche. It is, however, a much larger, robust, and coarser plant; differing from them, and from all known species, in its large clasping and fimbriate stem-leaves, its largely fimbriate and ciliate stipules, and in its rich striking colours.

Genus 21. **Madotheca**, Dumort.

1. *M. latifolia*, sp. nov.

Plant prostrate, creeping, diffuse. Stems stout, brown, 3–4 inches long, $2\frac{1}{2}$ lines wide, bipinnate; spreading irregularly over each other in loose horizontal layers, and so forming small cushioned tufts; branches alternate, short, flat, patent. Leaves darkish-green when fresh, (young leaves and branchlets light-green,) closely and uniformly set, much imbricated, convex, reniform-orbicular, decurved, dorsal margin entire, the apex or outer angle much incurved, base waved; the ventral lateral margin on stem very uneven; lobule sub-orbicular-elliptic, larger than stipule, crisp; cells orbicular, with thick walls and minute interstitial cellules; involucral 4, oblong-ovate, (2 of them being smaller and narrower,) largely ciliate; ciliæ jointed; cells as in leaves, only larger and clearer at centre and base; a dark-green outer leaf largely produced and sub-vertical, much incurved and enwrapping the apical margin, finely ciliate; capsule (immature) enclosed, globular, dark-green. Stipule oblong, recurved, apex retuse, margin entire, much waved, especially at the base.

Hab. On branches of trees, slightly adhering to their bark, and to foliaceous lichens, and to its own under-branches; Seventy-mile Bush, County of Waipawa; 1882–86: *W.C.* Forest near Palmerston, County of Manawatu; 1886: *Mr. A. Hamilton.*

Obs. This species much resembles *M. stangeri*, Gottsche, (and its *vars.*), but it differs from them in the shape of its leaves, which are much more reniform or transversely elliptic, in its largely ciliated involucral leaves, in its oblong and retuse stipules that are not gibbous, and in its orbicular cells, as well as in its size and colour. It is a fine and pretty plant, and though its stems and branches are not so large and long as those of *M. stangeri*, they are quite as wide as the widest of them.

2. *M. amœna*, sp. nov.

Plant pendulous; stems 5–6 inches long, 2¾ lines wide, pinnate, mostly simple, few-branched and forked at tips; bases bare, black, wiry, sub-rigid; colour a lively light-green. Leaves closely regularly and largely imbricated, but not overlapping their opposite bases on stem, broadly elliptic, margins entire, the lateral sparingly and finely toothed towards stem, apex decurved; lobule very slightly affixed to leaf, oblong, broader at apex, ciliate; ciliæ irregular, jointed; cells small, orbicular, with minute interstitial cellules (much as in the preceding species *M. latifolia*, but smaller). Stipules small, rather distant, sub-deltoid-cordate, with rounded tip, and basal angles produced and clasping, tip recurved; narrowly margined, marginal cells minute, uniform; margins entire, but irregular at base; cells remarkably minute, and of various sizes and shapes, mostly oblong.

Hab. On trunks of trees, hilly forests, Glenross, County of Hawke's Bay; 1886: *Mr. D. P. Balfour.*

Obs. A species near to the preceding; and also to *M. stangeri*, and its vars.; but differing in its usual long simple form, in appearance and in colour, in the size of its cells, and particularly in the shape and structure of its small margined stipules, and in its different lobule.

Genus 23. **Frullania**, Raddi.

1. *F. novæ-zealandiæ*, sp. nov.

Stems slender, 1 inch long, wiry, flexuous, dark-coloured, pinnate, rarely bipinnate; branchlets few, alternate, irregular in length. Leaves pale-green, very slightly imbricate, broadly ovate, sub-acute and obtuse, margins irregular, ventral base patent not inflexed, those on the main stem larger than on branches; lobule brown-purple, rather large and prominent, galeate with a long acuminate depending tip that is often recurved. Stipules: on main stems, sub-rhomboid-quadrate, deeply bilobed; lobes divergent, tips acuminate, with 2 teeth on each lobe outside; on small branches, ovate, deeply bilobed; lobes lanceolate, entire. Cells minute, orbicular, regularly disposed in longitudinal lines.

Hab. On bark of trees, intermixed with other *Hepaticæ* and mosses; forests, Glenross, County of Hawke's Bay; 1886: *Mr. D. P. Balfour.*

Obs. A species belonging to Section 1, Division ***, p. 536 of "Handbook N.Z. Flora;" and having affinity with *F. hampeana*, Nees, and with *F. spinifera*, Hook. fil. et Tayl., but differing from them both in several particulars.

2. *F. delicatula*, sp. nov.

Plant very minute, delicate pale-green. Stems slender, 1–1½ inches long, $\frac{1}{30}$ inch wide (including leaves), bipinnate, irregularly and sparingly branched; branches rather long for the plant. Leaves round (longer than broad), close but not imbricate, margins entire and slightly recurved, basal portion not inflexed; lobule small, arched, slightly deflexed, tip obtuse, not produced beyond margin of leaf, pale purple. Cells minute, sub-orbicular, crowded, indistinct. Stipules reniform-orbicular, entire, adpressed.

Hab. Hilly woods at Pohue, north-west from Napier, County of Hawke's Bay; 1885. (A few fragments, found mixed among larger *Hepaticæ* collected there by *Mr. A. Hamilton.*)

Obs. A very filiform, delicate, tender plant, remarkable for its whole entire stipules.

3. *F. rotundifolia*, sp. nov.

Plant small, erect, not ½ inch high, but growing thickly together in densely-compacted patches; dark green, but appearing blackish together in the mass.

Stems creeping, 2 inches long, bipinnate, wiry black and bare below, but stout, and of same colour as leaves, and very much branched at top; branchlets alternate, very short. Leaves very close-set, imbricate, patent, sub-vertical, wavy, recurved, rather opaque, orbicular; margins entire, but slightly irregular (*sub lente*); basal portion not inflexed, sub-amplexicaul; lobule small, sub-galeate, same colour as leaf, tip obtuse, not produced; involucral lanceolate, acuminate, very acute, margins entire. Stipules orbicular, with a small broad sinus at apex, which is broadest and rounded at base, and margined; tips somewhat conniving. Cells very small, sub-orbicular, with numerous exceedingly minute interstitial cellules. Perianth sub-terminal, sub-cylindrical, slightly clavate, apiculate, smooth. Capsule oval, whitish; seta produced, nodding; valves oval, membranaceous, spreading, not cut to base; elaters as in *gen. descr.*

Hab. On upper branches of tall trees, adhering to bark and overrunning lichens (*Sticta*); forests, Norsewood, County of Waipawa; 1886: *W.C.*

Obs. This species is rather peculiar; small though it is, it makes a show from its densely clustered habit of growth and patent sub-transverse leaves; it has also a pretty appearance when in fruit, with its spreading white 4-valved capsules peering above the tips of its dark leaves, resembling minute starry flowers. It is also singular from the curious sinus of its stipules, which, as far as I know, is quite a unique character.

4. *F. minutissima*, sp. nov.

Plant very small, about 2–3 lines high, erect, thickly gregarious, appearing black in the mass. Stems procumbent, sub $\frac{1}{2}$-inch long, much implexed, bipinnate; branchlets alternate, very short. Leaves on main stem distant, on branches close and touching but scarcely imbricate, sub-orbicular and broadly elliptic, margins entire, tips rounded and recurved, basal portion inflexed in a minute triangular interlobule or lobelet between lobule and stem, brownish, the young leaves and branchlets light-green; lobule large (for plant), nearly $\frac{2}{5}$ths of leaf in size, distant from stem, elliptic-clavate, broadest at apex, erect a little inclined, produced at base slightly beyond margin of leaf, dark-purple; involucral leaves oblong-ovate, apiculate, entire. Stipules orbicular, sinus large, angle acute at base and very broad at margin. Perianth obovoid, triangular, sides slightly concave, apex truncate, mucronate, mucro obtuse, dark brown, shining. Cells excessively minute, orbicular-oblong with microscopical interstitial cellules.

Hab. On branches of trees, forming thickly compact and spreading patches; banks of River Mangatawhainui, near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. This very minute species is readily distinguished from all other known New Zealand species by its large erect lobule.

5. *F. scabriseta*, sp. nov.

Plant procumbent, creeping, spreading. Stems stout, 1–1$\frac{1}{2}$ inches long, brown, 3-pinnate, much branched; branches long, leafy throughout. Leaves alternate, close-set on main stem, slightly imbricate on branches, broadly oval, light-green, margins entire but slightly uneven, recurved; lobule same colour as leaves, small, arched, tip short, obtuse, scarcely produced beyond leaf; involucral leaves sub-obovate, entire; cells small, sub-oblong-angular, with thick walls composed of a chain of very minute cellules. Perianth sub-inflated, narrow-oblong, triangular angles sharpish, apex rounded, mucronate, mucro obtuse, lips entire. Calyptra broadly clavate, green; seta white, nodding, sub-rugulose; valves broadly oval, obtuse, spreading, recurved, brown with a rather large white circular base; elaters numerous, reddish, stout, truncate, the tip of the hollow tube containing the elater closed and capitate by the elater, and broader than the tube.

Hab. On trees, in low wet woods near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. A species having some slight affinity with *F. spinifera*, Hook. fil. et Tayl., in its general appearance; but differing in leaves and lobules, in its more sharply-angled perianth with entire involucral leaves, in its scabrid seta, and in its peculiar capitate elaters.

6. *F. implexicaulis*, sp. nov.

Plant minute, much implexed and compact in small dark-coloured masses. Stems $\frac{3}{4}$–1 inch long, 2-pinnate, flexuous, black, wiry. Leaves alternate, oblong-orbicular, (sometimes broadly ovate and sub-acute on the branches,) dimidiate, margins entire, sub-vertical and recurved on the main stem, convex and very close-set yet scarcely imbricate on the branches, brownish-green, the young leaves and branchlets bright-green; lobule large, set close to stem, prominent, hooded, the arch high, tip acute but not acuminate nor decurved, and scarcely produced beyond margin of leaf, brown-green; involucral leaves sub-obovate-oblong, entire; cells small, sub-orbicular with minute interstitial cellules. Stipule small, convex, sub-orbicular, broader than long with apex produced, narrowly margined, bifid; sinus large and deep, and wide at tips. Perianth oblong-obovate, sub-inflated, rugulose, plaited above, tip produced and obtuse with a mucro, mouth shortly fimbriate; calyptra turbinate; spores large, sub-angular, light-brown.

Hab. On pendent branches of living trees, forming small scattered much implexed dark clusters; edges of forests near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. This species in its general appearance resembles *F. minutissima* (supra), although it differs widely in the habit of growth, as well as in several important characters (*vide descript.*).

Genus 25. **Noteroclada**, Taylor.

1. *N. longiuscula*, sp. nov.

Plant pale yellowish-brown, prostrate, creeping, adhering on ventral surface by numerous fine pale rootlets. Stems 3–4 inches long, $\frac{1}{10}$ inch wide (including leaves), simple below, few-branched above, leafy throughout; branches alternate, long, irregular, tips involute. Leaves regular, very close, largely imbricate, sub-vertical, broadly oval, wavy, decurrent, margined; margins entire, but slightly irregular with a very narrow marginal line; leaves when dry secund, vertical above stem and closely appressed to each other. Cells minute, orbicular, guttulate, smaller at margin, larger and clearer at base, with minute interstitial cellules. Involucre (or perianth) terminal from a short stout branch near base, sessile, erect, sub-oblong-ovate 2 lines long, plaited at top, mouth large, tips finely lacerate. Two short scaly flagellæ depending from branch a little below the involucre.

Hab. Hilly woods at Pohue, north-west from Napier, County of Hawke's Bay; 1885: *Mr. A. Hamilton.*

Obs. A species widely differing from the few other known ones. I have received several leafing specimens of this plant, but only one of them bore an involucre (old) and flagellæ; more and perfect ones are wanted.

Genus 30. **Symphyogyna**, Mont. and Nees.

1. *S. platycalyptra*, sp. nov.

Plant diœcious, terrestrial, highly gregarious; stipitate, erect, rising from a short stout simple or few-branched succulent subterraneous rhizome, that is slightly hairy with fine weak hairs; generally 3 stipes, each about 1 inch apart, spring from one rhizome, the rhizomes being thickly matted. Frond circular, 1 inch diameter, of a pleasing green, divided into two main branches, that are again equally divided and largely overlapping, each flabellate division containing 3 branchlets, which are again dichotomous, and broadly margined to their bases; the main branches, however, are not margined; margins entire, slightly sinuous; main sinuses broad, open; ultimate sinuses narrow; lobes short, overlapping, broad in middle, not linear, much waved, apices retuse; cells small, orbicular; the nerve broad and strong, but not extending to apical margin. Stem stout, succulent, 1–2½ inches high, cylindrical below, compressed above. *Female* plant: fructification regular, generally 2–4, solitary at upper forks beneath, sometimes, but rarely, 1 at the main forking; involucral scale large, 2 lines wide, sub-reniform, slightly bilobed, undulate, somewhat plaited, recurved, with a glossy knobbed protuberance at the base; margin sub-sinuous, entire; cellules large, orbicular; 1–2 minute scales behind, and so enclosing calyptra. Calyptra very broad, $\frac{1}{10}$th inch wide, 1½–2 lines long, flat, membranous, smooth, shining, slightly laciniate at apex, very light-green; cellules quadrangular-oblong. Capsule (immature within) globular, large, smooth, green, surrounded by 8–10 large cellular pistillidia that spring from beneath. *Male* plant: fructification irregularly scattered beneath in sub-globular tubercular lumps on upper portion of stem and on the branches.

Hab. Plentiful in a muddy swamp, in a deep low dark shaded forest near Norsewood, County of Waipawa; 1886: *W.C.*

Obs. I. This species is peculiar from its wide, flat, strap-shaped calyptra and its globular capsule, also from its strictly diœcious manner of growth. It forms dense compact patches or small beds, something like thick beds of young cress (*Lepidium sativum*) or parsley: and these are generally of two kinds or sizes: the larger (taller and bigger fronds and finer patches) contain only male plants, and the smaller and shorter the female ones, and these never appear to intermix. Indeed, I was a very long time (parts of two days,) before I found a single female plant bearing fructification, and was about giving it up in despair, as I had confined my search to the finer masses; and it was only by chance that I happened to look among the smaller-sized plants.

II. This species has pretty close affinity with *S. longistipa*, *S. fetida*, and *S. megalolepis*, Col.,* and with *S. flabellata*, Mont., ("N.Z. Flora,") but is distinct from them all.

ART. XXXV.—*An Enumeration of* Fungi *recently discovered in New Zealand, with brief Notes on the* Species Novæ.

By WILLIAM COLENSO, F.R.S., F.L.S.

[*Read before the Hawke's Bay Philosophical Institute, 13th September*, 1886.]

LAST year (1885,) I again sent a lot of Fungi to Kew, London, which I had for the greater part discovered during the preceding twelve months, in my several visits to the dense forests and deep glens of the Seventy-mile Bush, County of Waipawa; a few of them also being from Napier. Most of them were forms that were new to me, although I knew some of their genera and allied species. Altogether they comprised about 400 separate packets, containing, however, a much larger number of specimens. I sent them to Kew, to the kind care of the late Director of the Royal Botanic Gardens, Sir J. D. Hooker, K.C.S.I., etc., in order to get them determined (if possible) by the eminent fungologist, Dr. Cooke, who had so very kindly done as much for a smaller lot, collected in the same localities, and sent thither by me in 1883. I have very recently received from the

* "Trans. N.Z. Inst," vol. xvi., pp. 353-365.

present Director at Kew (J. T. Thiselton-Dyer, C.M.G., etc.,) a long, complete, and valuable list of the same, as again kindly determined by Dr. Cooke; and this (under separate heads) 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 supplementary paper of newly-discovered Fungi, read before the Wellington Philosophical Society in 1884.* 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.*

The remainder will consist of species already described as inhabiting New Zealand—incomplete and imperfect specimens of *Mycelium*, etc., that cannot at present be determined; (on some of these, however, Dr. Cooke has observed, "it is possibly new;") specimens of minute Lichens† having a semi-fungoid appearance; and a few species of small and allied terrestrial Algæ.

From these classified lists you will learn that out of the large number of species sent to Kew, (several of them being in duplicate and some in triplicate, arising from some species of Fungi being perennial, and to their varying states and ages, and to the different seasons in which they were collected,) a total of 179 species are new to the New Zealand flora; and of these only 18 species have been determined as new to science.

FUNGI.

Section I.—Foreign Fungi already described, but not before found in New Zealand.

* Of genera known to inhabit New Zealand.

Genus 1.‡ **Agaricus**, Linn.

1. *A.* (*Amanita*) *vaginatus*, Fr.
2. *A.* (*Pleurotus*) *serotinus*, Fr.
3. *A.* (*Pleurotus*) *atrocæruleus*, Batsch.
4. *A.* (*Pleurotus*) *chioneus*, P.
5. *A.* (*Pleurotus*) *affixus*, B.
6. *A.* (*Collybia*) *radicatus*, Fr.
7. *A.* (*Collybia*) *xanthopus*, Fr., vel. prox.
8. *A.* (*Collybia*) *raphanipes* v. *glaucophyllus*.

* Art xxviii., "Trans. N.Z. Inst.," vol. xvii., p. 265.

† These, however, were not sent as Lichens; of which order there are also a large number of specimens collected, to be hereafter examined. The same may also be said of the few packets of minute terrestrial Algæ contained in that parcel.

‡ The numbers in this paper attached to genera are those of "The Handbook New Zealand Flora."

9. *A.* (*Collybia*), sp. uncertain.
A. *A.* (*Mycena*) *lacteus*, Fr.
11. *A.* (*Mycena*) *galericulatus*, Fr.
12. *A.* (*Mycena*), perhaps *polygrammus*, Fr.
13. *A.* (*Mycena*) *corticola*, Fr.
14. *A.* (*Mycena*), *capillaris*, Fr.
15. *A.* (perhaps *Mycena*), uncertain.
16. *A.* (*Omphalia*) *epichysium*, P.
17. *A.* (*Leucospori*), insufficient.
18. *A.* (*Pluteus*) *umbrosus*, P. (?)
19. *A.* (*Claudopus*) *variabilis*, Fr.
20. *A.* (*Pholiota*) *præcox*, Fr.
21. *A.* (perhaps *Pholiota heteroclitus*, Fr.)
22. *A.* (*Pholiota*), sp., destroyed by insects.
23. *A.* (*Flammula*) *penetrans*, Fr.
24. *A.* (*Flammula*) *fusus*, Batsch.
25. *A.* (*Crepidotus*) *alveolus*, Fr., vel prox.
26. *A.* (*Crepidotus*) *pezizoides*, Fr.
27. *A.* (*Naucoria*) *vervacti*, Fr.
28. *A.* (*Naucoria*) *pediades*, Fr.
29. *A.* (*Naucoria*) *erinaceus*, Fr.
30. *A.* (*Naucoria*) *cerodes*, Fr.
31. *A.* (*Tubaria*) *inquilinus*, Fr.

Genus 2. **Coprinus**, Persoon.

1. *C. ephemerus*, Fr.
2. *C. plicatilis*, Fr.

Genus 4. **Marasmius**, Fries.

1. *M. fœtidus*, Fr.
2. *M. ramealis*, Fr.
3. *M. androsaceus*, Fr.

Genus 5. **Lentinus**, Fries.

1. *L. pygmæus*, Fr.

Genus 7. **Panus**, Fries.

1. *P. viscidulus*, B. & Br. (?)

Genus 9. **Lenzites**, Fries.

1. *L. betulina*, Fr.

Genus 10. **Polyporus**, Fries.

1. *P. lentus*, B.
2. *P.* (*Mel.*) *picipes*, Fr.
3. *P.* (*Pet.*) *petaloides*, Fr.

Genus 12. **Favolus**, Fries.

1. *F. hispidulus*, B. & C., var.

Genus 13. **Hydnum**, Linn.

1. *H. farinaceum*, Fr.
2. *H. mucidum*, Fr.
3. *H.* (*Res*) *membranaceum*, Bull.
4. *H.* (*Res*) *tabacinum*, Cooke.

Genus 16. **Stereum**, Fries.

1. *S. sanguinolentum*, Fr.
2. *S. acerinum*, Fr.
3. *S. ferrugineum*, Fr.
4. *S. frustulosum*, Fr.
5. *S. illudens*, B.

Genus 17. **Corticeum**, Fries.

1. *C. calceum*, Fr.
2. *C. cretaceum*, Fr.
3. *C. viscosum*, Fr.
4. *C. ochroleucum*, Fr., var. *spumeum*, B. & C.

Genus 20. **Clavaria**, Linn.

1. *C. mucida*, Fr.
2. *C. flava*, Fr. (distorted.)
3. *C. muscigena*, Karst.

Genus 30. **Lycoperdon**, Tournefort.

1. *L. echinatum*, P.
2. *L. echinellum*, B. & Br.
3. *L. tephrum*, B. & Br.

Genus 35. **Stemonitis**, Gleditsch.

1. *L. fusca*, Roth.

Genus 39. **Phoma**, Fries.

1. *P. malorum*, Berk.

Genus 48. **Uromyces**, Léveillé.

1. *U. amygdale*, Pers.

Genus 49. **Ustilago**, Link.

1. *U. olivacea*, Tul.
2. *U. urceolorum*, Tul.

Genus 50. **Æcidium**, Persoon.

1. *Æ. clematidis*, D.C.

Genus 59. **Geoglossum**, Persoon.

1. *G. berteroi*, Mont.

Genus 60. **Peziza**, Dillenius.

1. *P.* (*Moll.*) *cinerea*, Batsch.
2. *P.* (*Scutellinia*) *badioberbis*, B.
3. *P.* sp. (imperfect).

Genus 65. **Asterina**, Léveillé.

1. *A. bullata*, Berk.
2. *A. reptans*, B. & C.
3. *A.* (*pelliculosa ?*)
4. *A.*, sp.

Genus 68. **Hypocrea**, Fries.

1. *H. saccharina*, B. & C.

Genus 70. **Hypoxylon**, Bulliard.

1. *H. multiforme*, Fr.
2. *H. serpens*, Fr.

Genus 73. **Nectria**, Fries.

1. *N. episphæria*, Tode.

Genus 74. **Sphæria**, Haller.

1. *S. acanthostroma*, Mont. ?

Genus 77. **Erysiphe**, Hedwig.

1. *E.* (*Martii ?*) *conidia*.

** Of genera new to New Zealand.

Phlebia, Fries.

1. *P. reflexa*, B.
2. *P. merismoides*, Fr.

Grandinia, Fr.

1. *G. granulosa*, Fr.
2. *G. granulosa*, v. *candida*.
3. *G.*, sp. (perhaps new, but insufficient for description.)

Odontia, Fries.

1. *O. scopinella*, B.

Kneiffia, Fries.

1. *K. setigera*, Fr., var.
2. *K. subtilis*, B. & C.

Hymenochæte, Fries.

1. *H. rubiginosa*, Lév.
2. *H. rhabarbarina*, B. & Br.

Solenia, Pers.

1. *S. anomala*, P.

Calocera, Fries.

1. *C. viscosa*, Fr.
2. *C. cornea*, Fr.
3. *C. furcata*, Fr.

Tremella, Fries.

1. *T. lutescens*, Fr., v. *alba*, B.

Exidia, Fries.

1. *E. glandulosa*, Fr.

Næmatelia, Fries.

1. *N. nucleata*, Fr.

Dacrymyces, Nees.

1. *D. chrysocomus*, Tul.
2. *D. deliquescens*, Fr.

Lycogala, Mich.

1. *L. epidendrum*, Fr.

Ptychogaster, Corda.

1. *P.* (sp. n., incomplete.)

Fuligo, Persoon.

1. *F. varians*, Somm.

Craterium, Trent.

1. *C. minutum*, Fr.
2. *C. vulgare*, —

Arcyria, Hill.

1. *A. punicea*, P.

Trichia, Hall.

1. *T. varia*, P.

Sphærobolus, Tode.

1. *S. stellatus*, Tode.

Phyllosticta, Pers.

1. *P.* sp. (young.)

Bactridium, Kze.

1. *B. magnum*, Cooke.

Cystopus, D'By.

1. *C. candidus*, Str.

Trichobasis, Lev.

1. *T. oblongata*, B.

Microcera, Desm.

1. *M. coccophila*, Desm.

Botrytis, Mich.

1. *B. terrestris*, P.

Verticillium, Link.

1. *V. rexianum*, Sacc. ?

Polyactis, Link.

1. *P. vulgaris*, C.

Penicillium, Link.

1. *P. glaucum*, Link.

Monilia.

1. *M. carbonacea*, Cooke.

Sporotrichum, Link.

1. *S. geochroum*, Desm.

Mucor, Mich.

1. *M. stercoreus*, Grev.

Morchella, Dill.

1. *M. conica*.

Calloria.

1. *C. vinosa*, Fckl.

Helotium, Fries.

1. *H. lutescens*, Fr.
2. *H. citrinum*, B.
3. *H. pallescens*, Fr.
4. *H. phyllophyllum*, Desm.
5. *H. aureum*, Fr., var.

Hypomyces, Tul.

1. *H. aurantius*, P. ?

Nummularia, Tul.

1. *N. exutans*, Cooke.

Phyllachora.

1. *P.* sp. (sterile).

Lasiosphæria.

1. *L. ovina*, P.

Sphærostilbe.

1. *S. gracilipes*, Tul. (?)

Rosselinia.

1. *R. mastoidea*, Sacc.

Rhizomorpha.

1. *R. subcorticalis*, Fr.

(As the proper serial classification of these *gen. nov.* to New Zealand is unknown to me (not being mentioned in any of my works on Fungi,) they are placed here somewhat irregularly at the end of this section.)

Polystictus.

1. *P. pergamenus*, Fr. (junior.)
2. *P. versicolor*, Fr.
3. *P. tabacinus*, Mont.

Fomes.

1. *F.* (*Fom.*) *fomentarius*, Fr.
2. *F.* (*Lævi*) *hemitrephus*, B.
3. *F. australis*, Fr.
4. *F.* (*Res.*) *obliquus*, Fr.
5. *F.* sp. (young specimens only.)
6. *F.* sp. (resupinate state.)

Poria.

1. *P. vaporaria*, Fr.
2. *P. mollusca*, Fr.
3. *P. fusco-purpurea*, Fr.
4. *P. mucida*, P.
5. *P. ferruginea*, Fr.
6. *P. vincta*, B. et K.

Chrysosplenium.

1. *C. omnivirens*, B.

Lamproderma.

1. *L.* sp. (old.)

Daldinia.

1. *D. concentrica*, De Not.

Xylostroma.

1. *X.* sp. (incomplete.)

Hamaspora.

1. *H. longissima.*

Dimerosporium.

1. *D. excelsum*, Cke.

Comatricha.

1. *C. typhoides.*

Hypoderma.

1. *H. ilicinum*, De Not.
2. *H. commune*, Fr.

SECTION II.—Species wholly new to science (sps. nov.) with a few remarks on each.

(Those genera that are also new to New Zealand and not found in the foregoing list (**) are marked with a star.)

1. *Agaricus* (*Naucoria*) *acutus*, Cooke.

   A small species growing closely together within a rotten log.

2. *Cyphella filicola*, Cooke.

   A highly curious little parasitical fungus, forming small whitish cups, growing thickly on *Hymenophyllum demissum*, on the marginal tips of its frond, somewhat resembling large valves or indusiums of *Lindsæa;* it is apparently scarce, only a very few fronds having been noticed. It has also been subsequently detected by *Mr. H. Hill* (1 spn.,) thickets, east base of Ruahine Range; and by *Mr. Hamilton.*

3. **Leptothyrium panacis*, Cooke.

   A small species, parasitical on leaves of *Panax arboreum.*

4. *Sphæronema solanderi*, Cooke.

   A small species, sparingly found on rotten branches.

5. **Septoria colensoi*, Cooke.

   Parasitical on lining leaves of *Myoporum lætum* ; Napier.

6. *S. coprosmæ*, Cooke.

   On dead leaves of *Coprosma lucida.*

7. **Coleosporium compositarum*, Lev.; var. *oleariæ.*

   On heads of flowers and peduncles of *Olearia colorata*, growing profusely; but not commonly observed.

8. *Æcidium hypericorum.*

   On leaves of *Hypericum japonicum*, forming small bright-yellow spots.

9. *Uromyces microtitidis*, Cooke.

On leaves of *Microtis porrifolia*.

10. *Helotium sordidum*, Phil.

Small stipitate fungus, heads circular, 2 lines diameter, of a light-drab colour ; on the underside of rotten logs.

11. *H. pseudociliatum*, Phil.

A small species, with a white centre above, red below and at margin ; margins ciliate ; on rotten wood.

12. *Patellaria torulispora*, Cooke.

On bark of a dead tree : small species.

13. *Rosellinia* (*Comochæta*) *colensoi*, Cooke.

A curious small hairy fungus, with a black tip ; found very sparingly nestling on dead wood.

14. *Xylaria pallida*, Cooke.

A curious elongated species, resembling others of this genus ; only once met with on a dead log, but in profusion there.

15. **Sphærella weinmannia*, Cooke.

Parasitical on leaves of *Weinmannia racemosa*.

16. *S. aristoteliæ*, Cooke.

On living leaves of *Aristotelia racemosa*.

17. *S.* (*Sphærulina*) *assurgens*, Cooke.

A curious little species, forming minute black spots on fronds of living *Trichomanes venosum*.

18. **Berggrenia aurantiaca*, Cooke ; var. *cyclospora*.

A small bright-red sessile fungus, found sparingly, and always singly, on the ground in forests; and almost invariably gnawed by insects.

Here I would place two other new, but little known, indigenous species—*Polyporus nivicolor*, Col., and *Nectria otagensis*, Curr., from the same parcel with the foregoing ; although both have been already described: the first one in "Trans. N.Z. Inst.," vol. xvi., p. 361 ; and the second in a paper by Dr. Lindsay, published at Home. I now insert these two Fungi here—the *Polyporus*, because of it being now confirmed by Dr. Cooke, and the *Nectria*, because of it being also found here in the North Island ; of this fungus there were three packets sent, in various stages. (Its *specific* name is another witness to the impropriety of giving such local habitats as a name for a species.)

ALGÆ.

Of the small terrestrial Algæ sent in that parcel only two species were determined, and both of genera hitherto unknown in New Zealand, viz. :—

1. *Phormidium*, or *Chthonoblastes*, sp.

A peculiar-looking plant, found overrunning gregarious and short mosses growing in patches, in rather long lines which are nearly straight, both brown and black, having a ribbon-like appearance; scarcely visible to the naked eye when dry, but very plain when wet, especially after much rain.

2. *Dritosiphon muscicola*, Kutz.

A pretty little blue hairy erect moss-like plant, found in retired holes and clefts in the cliffy banks, among grass and herbage; Scinde Island, Napier.

Total number of additional species of genera known to inhabit New Zealand	82
Total number of species of genera hitherto unknown in New Zealand	77
Total number of indigenous *species novæ*, some also belonging to genera not before known to exist in New Zealand	18
Also two additional *species novæ* of terrestrial Algæ	2
Total number of species new to our N.Z. Flora	179

Two striking facts will here immediately arrest our attention, (the same, too, as were quite as noticeable on the former occasion 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 58 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 will be largely augmented here.

If time permitted I should like to make some distinct observations, illustrating several of those new genera, for they are very heterogenous, and widely differing in appearance and in substance in all manner of ways; such, however, are the usual and common features of this vast order.

Those new species vary in shape, in size, in colour, and in substance, in hardness and in softness, in durability and in fugacity, in toughness and in brittleness. Some possess striking, brilliant, and beautifully varied colours, of which a bright-red not unfrequently predominates: others are elegantly zoned, and plaited, and frilled with varying neutral colours regularly disposed; of such are *Polyporus versicolor*, and *Stereum lobatum;* some have a rich lustrous satiny appearance, others are velvety, while others are opalescent, as *Poria vincta:* some are black, as *Daldinia concentrica* and *Antennaria* sps.; while others, as *Polyporus nivicolor*, *Fomes hemitrephus*, and *Calicium ochrolaceum* var. *spumeum*, are of the purest white, which delicate virgin unsullied appearance, unfortunately, they often lose in the most careful drying; some are of enormous size and aberrant forms (as *Fomes* sps.), 2–3 feet long and proportionately thick, and no two specimens of the same species alike in shape; while others are very regular, like little round black shining beads, as *Comatricha typhoides*; or minute cup-shaped flowers clustered together, as *Æcidium clematidis;* or miniature birds' nests with eggs, as *Cyathus*, and *Crucibulum* sps.; some are very hard, and also perennial, so that an axe makes but small impression on them; while others are very soft and, indeed, ephemeral, dissolving of their own accord in a few hours from their first sprouting into a watery mass! One or two species (notably *Fuligo varians*) resemble, when fresh, a light custard pudding, which, with careful drying, turns to dust! while others, as *Tremella lutescens* var. *alba*, assume the appearance of a delicate branching *blomange*, which, curiously enough, when carefully dried, leaves no visible residuum, save a dull shining mark on white paper as if a slug or a snail had sojourned there. Some are cancellated, hollow and light, like fine net- or lattice-work; others are solid and heavy; some take the appearance of old worn chamois-leather (as *Xylostroma* sp.; some are very tough, so that they are gathered from their matrix, or substance to which they adhere, with extreme difficulty; others are so fragile, and withal permanent, as only to be found in perfection where neither winds nor rains can reach them, and though sometimes resupinate and several inches long, can scarcely be laid hold of, or removed, with the most cautious and tender handling. For such fairy- or gossamer-like productions I usually carry a little tin box lined with silver- or blotting-paper, and so manage to cut them down and drop them into it without touching them; but even this delicate treatment is too coarse for some (*Stemonitis* sps.), which, pretty though they are in their recluse place of growth, the very slight movement of the air in putting forth one's hand towards them is often sufficient to break them up into a cloud of spores!

Three, however, of the newly detected indigenous species I should not fail to bring to your notice, if only for the peculiar matrices on which they respectively grow, two of them being only found on our delicate and elegant living ferns, *Trichomanes venosum*, and *Hymenophyllum demissum*. On the former of those two ferns, *Sphærella* (*Sphærulina*) *assurgens* is sparingly found; to the naked eye it is a minute round and slightly elevated black spot with a very small outside. The larger and far more curious species, *Cyphella filicina*, inhabits the latter fern, covering the tips of its fronds with its whitish cup-like receptacles, presenting a neat appearance somewhat resembling the indusiæ of a *Lindsæa*. This pretty and scarce fungus has also been found by Mr. Hill, and by Mr. Hamilton, in different localities, and only one specimen by each. Both of those fungi are scarce and rarely met with. The third, a very minute and almost microscopic species, *Monilia carbonacea*, is only found on the surface of burnt black and dry logs, giving them a very peculiar appearance. In form it resembles a minute and regular necklace of beads (whence, also, its name). It is far from being easily gathered.

In conclusion, I would briefly refer to another small and delicate species among those in the first list, *Mucor stercoreus*, a very common fungus at Home; but this is the first time of its being found here, or any of its sub-order. Of the non-detection of this genus (which is a large one) in these parts, Berkely wrote, saying: "No species of *Mucor* appears in the floras of the Antarctic regions and New Zealand, but I do not doubt their existence there, though none appears to have been collected by Bertero, who was a very close observer, in Juan Fernandez."* And Sir J. D. Hooker, writing in the "Handbook Flora of New Zealand" on the sub-order *Physomycetes*, to which this genus belongs, makes a similar observation: "To this tribe belong the true moulds (*Mucor*, etc.), of which species must occur abundantly in New Zealand, though they have never been collected." (p. 600.)

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* Cryptogamic Botany," p. 294.

Art. XXXVI.—*Observations on the Glands in the Leaf and Stem of* Myoporum lætum, *Forster*.

By Catherine Alexander, B.A.

[*Read before the Wellington Philosophical Society, 10th September*, 1886.]

Plate XX.

Distribution of genus.—The genus *Myoporum* is widely distributed throughout Australia and the Pacific Islands. The species *M. lætum* is common in the North and South Islands of New Zealand on the sea coasts as far south as Otago. It is also found in the Kermadec Islands (*M'Gillivray*), and Chatham Islands (*W. Travers*).*

Description of the leaves.—One character of the whole genus is the occurrence of pellucid glands in the leaves. The mature leaf is 2–4 inches long, lanceolate or obovate-lanceolate, acute or acuminate, serrulate above the middle, narrowed into petioles, bright-green and lucid.

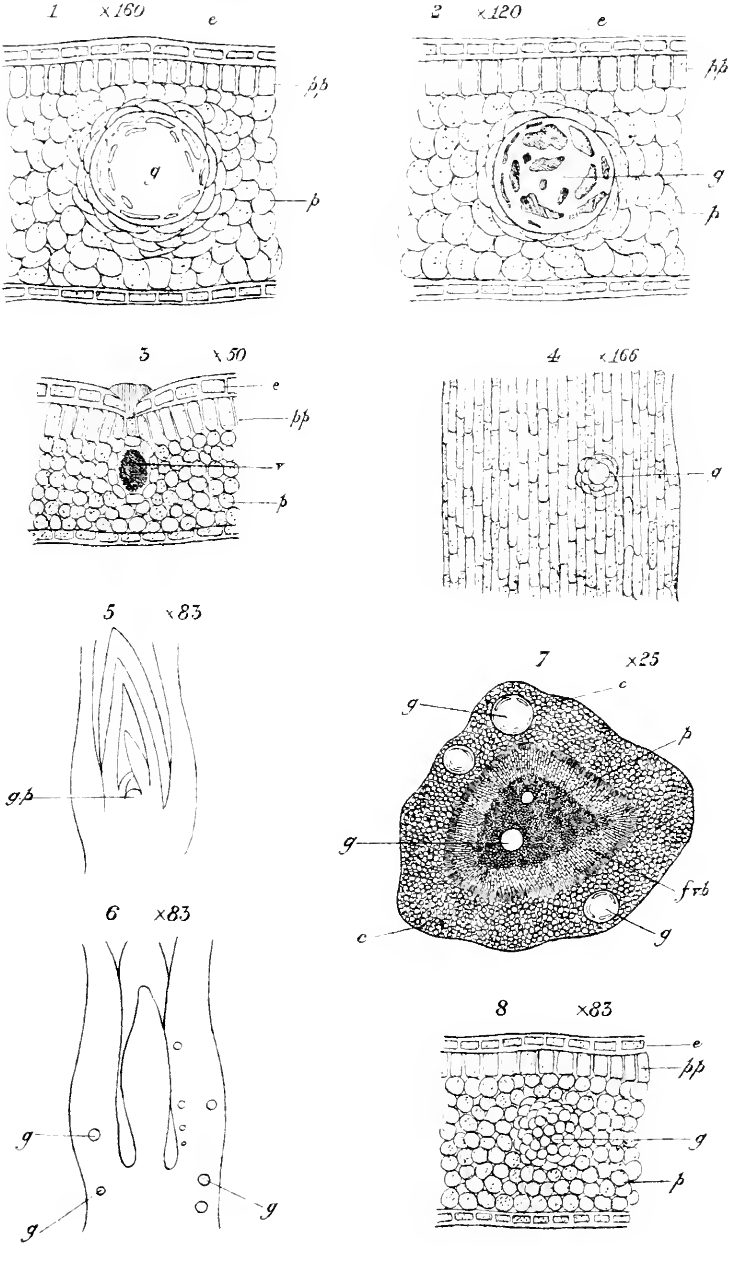
Glands in leaves.—The following I extract from the "Journal of the Royal Microscopical Society," October, 1884, page 769:—

"The various causes of transparent dots or lines in leaves are:—Secreting cells, round intercellular secreting spaces of either lysigenous or schizogenous origin, secreting passages, epidermal or parenchymatous cells with mucilaginous cell-walls, cells containing mucilage, raphides cells, cells with single crystals or clusters of crystals, cystoliths, spicular cells, branched sclerenchymatous bundles, groups of sclerenchymatous cells, depressed pits with or without hairs, crevices in the tissue, stomata. The secreting cells, spaces, or passages may contain resin, gum-resin, balsam, or an essential oil. Secreting cells are an extremely common cause of transparent dots, and are usually characteristic of whole families, or at least genera. Round intercellular secreting spaces may be lysigenous, as in *Rutaceæ*, or schizogenous as in *Hypericineæ*, the two kinds showing no difference in the mature condition. Both kinds are of great importance from a systematic point of view, furnishing distinguishing characters for entire families. Thus, lysigenous secreting spaces occur in the *Rutaceæ*, *Myoporineæ* and *Leguminosæ*; schizogenous are constant in the *Hypericineæ*, *Myrcineæ*, *Saemydeæ* and *Myrtaceæ*."

Also the following, from De Bary's "Comparative Anatomy of the Phanerogams and Ferns," p. 202:—

"Resin, ethereal oil, emulsions of gum-resin of different quality, according to the special case, and often little known as regards chemical relations, occur:—

* *Vide* Hooker's "N.Z. Flora," pp. 225 and 739.



C. A. delt.

MYOPORUM LÆTUM.

"(*a*.) . . . .

"(*b*.) In short cavities in the group *Rutaceæ*, in species of *Hypericum*, many species of *Oxalis*, *Myrtaceæ*, *Myoporeæ*."

Also, p. 209 :—

"(*e*.) Among the *Myoporeæ*, the species of *Myoporum* have numerous round oil-cavities of unequal size in the leaves and the outer cortex of the branches. The cavities are superficial and separated only by 1–2 layers of cells from the epidermis, which is arched convexly outwards; *e.g.*, *M. parvifolium*. In *M. tuberculatum*, on the contrary, according to Unger, they occur in the middle of the chlorophyll parenchyma of the leaf. They are surrounded by 1–3 layers of flattened cells. As far as investigated, their origin appears to be lysigenetic."

Observations.—I made observations on the leaf and stem of *M. lætum* through the autumn and winter, examining sections through fresh specimens and specimens preserved in alcohol, with the following results :—

In a piece of mature leaf, $\frac{4}{25}$ths of a square inch, there were 164 glands. This gives 1,025 to the square inch, so that about 1,000 to the square inch appears to be a fair average of their number. They are, however, much fewer towards the base of the leaf, near the insertion of the petiole on the stem, but are not altogether absent. In the lamina they occur both in the parenchymatous tissue and also in the midrib (see fig. 4), and are entirely surrounded by two or three layers of compressed colourless cells (see figs. 1 and 2).

The upper epidermis is often arched outwards over the glands (see fig. 1), but there are always at least two rows of cells between the epidermis and the compressed cells surrounding the gland, one of the rows being palisade cells. The cells of the palisade parenchyma above the gland are also colourless.

The glands vary in size from $\frac{1}{32}$–$\frac{1}{16}$ inch in diameter in the lamina ; in the midrib and stem they vary even more, some being found considerably smaller. The shape of the gland is spherical, and in the dried specimen which I examined the contents had all fallen away from the centre, forming a granular colourless coating round the inside of the gland, enclosing a vacuole. In the specimens preserved in alcohol, the contents had coagulated into little brownish-yellow masses, apparently of gum. (See fig. 2.)

In very young leaves there are no glands (see fig. 5), but they begin to appear when 10 or 12 leaves are formed nearer the apex (fig. 6). The rapid growth of the young leaves appears to retard the formation of the glands, but after their first appearance they are soon found in considerable numbers (fig. 6).

In the *stem* the glands appear both in the pith and cortical parenchyma (fig. 7). Their occurrence in the pith is not mentioned by Hooker or De Bary. They are scattered irregularly and vary in size throughout the secondary stems. In the younger wood of the autumn specimens I found them occurring very rarely for the space of two or three nodes, but after that they appeared both in pith and cortex, though few and irregular in size. In the older wood much larger glands are found, but these are also irregularly scattered, and usually among others considerably less in size (fig. 7). They appear to develope very late in the wood, and appear more frequently in the pith. The contents of the glands of the specimens which had been preserved in alcohol had, as in the case of the leaves, coagulated into little brownish-yellow masses, apparently of gum.

My observations on the development of these glands were imperfect, but they seem to point to a lysigenous origin, for the following reasons :—When first the glands appear in the young leaf or stem, they appear as two or three colourless cells. These cells increase in size, and appear to divide repeatedly, until they form a mass of colourless cells of the size of the mature gland (see fig. 8). [This is easily distinguishable from a vein, as the latter consists of an external bundle-sheath enclosing a bundle of thick-walled cells, slightly pear-shaped with the pointed end upwards, the whole being surrounded by chlorophyll cells (see fig. 3)]. The central cells of the colourless mass seem now to become absorbed, leaving two or three rows of flattened cells (colourless) on the outside, surrounding a vacuole with gummy contents. In the glands of the stem I repeatedly noticed ragged cells and portions of cell-walls projecting into the vacuole of the gland, as if the interior cells had been partially absorbed but the absorption had not been completed. Whether this absorption were partial or almost complete, the surrounding colourless layers in the case of a full-sized gland always assumed a spherical outline.

EXPLANATION OF PLATE XX.

Fig. 1. Transverse section through portion of mature leaf of *Myoporum lætum* × 160: *e*, upper epidermis; *p.p*, palisade parenchyma; *p*, spongy parenchyma; *g*, gland.

Fig. 2. Transverse section through portion of mature leaf preserved in alcohol × 120. Letters as before. Gland shows gummy contents.

Fig. 3. Transverse section through portion of leaf showing vein (*v*) × 50. The red substance above the vein is some apparently gummy substance, which is very common in the leaves.

Fig. 4. Longitudinal section through midrib (slightly inclined), showing gland (*g*) × 166.

Fig. 5. Longitudinal section through young bud × 83, showing growing-point, *g.p*.

Fig. 6. Longitudinal section through young bud × 83, showing young glands, *g*.

Fig. 7. Transverse section through stem × 25; *p*, pith; *f.v.b*, fibro vascular bundles; *c*, cortex; *g*, glands.

Fig. 8. Transverse section through leaf × 83, showing young gland, *g*.

Art. XXXVII.—*Observations on the Development of the Flower of* Coriaria ruscifolia, *Linn.*

By T. W. Rowe, M.A.

[*Read before the Philosophical Institute of Canterbury, 5th August,* 1886.]

Plate XXI.

The dubious affinity of the genus *Coriaria* renders its study interesting. My observations on the development of the flower of *C. ruscifolia* showed many important departures from the type given by Hooker. They were made almost wholly on preserved specimens gathered at various times between September, when the buds first appear, and March, when the fruit is ripening. The bud arises, like all flower-buds, as a little rounded cellular papilla in the axil of a bracteole. It grows rapidly, and the sepals very quickly begin to become distinct from the rest of the flower (Plate XXI., fig. 1, *s*). A longitudinal section shows them as a rounded protuberance on each side of a central cellular mass. Seen from above they have the appearance of six distinct papillæ. They begin to grow up around the rest of the bud, and the petals and stamens arise as little rounded protuberances above the upper surface of the bud (fig. 2), while the central portion remains more or less flat. This, however, soon becomes rounded (fig. 3), and in some sections seemed to be clothed with a layer of loosish cells. The sepals meanwhile grow very fast, and soon begin to close over the bud, while the petals and stamens grow rapidly also (fig. 4). All this is shown in flowers gathered on the same day, September 30th, and the buds though showing different stages of development do not vary greatly in size, as can be seen from the figures. In a bud gathered on October 3rd there is seen a great advance in growth (fig. 5). The sepals completely close in over the rest of the bud, the petals grow around the stamens, and these nearly meet over the pistil, which now shows six distinct styles. Like the sepals, the petals, stamens, and styles arise as little papillæ, seen from above to be distinct from each other. All the four whorls of the flower have six segments each, although the flower is a Dicotyledon. This renders it extremely interesting. Hooker, in his account of the *Coriarieæ*, mentions nothing of this peculiarity, but says that the parts of the flowers of the *Coriarieæ* are in 5's or 10's. In the *C. ruscifolia*, however, I have found nothing but six in all four whorls of the flower. I cannot account for the prevalence of this number in the plant: nothing I have seen has tended to show how it arises, whether by the doubling of one (or two) parts, or by the suppression of two (or four) out of an original eight (or ten); but neither of these suppositions seem at all probable.

When the styles arise they are curved over towards each other, enclosing a hollow (fig. 6), but they soon begin to grow up straight, while the ovary begins to swell out (fig. 6). The cells at the top of the style now begin to be rounded off from one another, so that the beginning of the stigma can be recognized (fig. 6, *st.*). Meanwhile the stamens have been rapidly growing, and have differentiated into a short filament surmounted by a large anther (fig. 6, *f* and *a*). The origin of the pollen, however, is not yet visible. The growth of the sepals and petals has been going on by vegetative division of the cells, and there is nothing particularly to be noticed in these whorls till after the fertilization of the flower.

The stamens soon begin to form mother-cells in the usual way, but the most interesting part of the flower is the gynœcium. The stigmatic cells, which at first were found only at the tip of the style, now spread downwards (fig. 7, *st*) and the style rapidly becomes stigmatiferous right down to the ovary. At the same time each carpel of the ovary begins to get hollow, and a single ovule arises in each as a papillary outgrowth from the central wall of the carpel (fig. 7, *ov.*). It grows rapidly and curves downwards till it assumes an anatropous form, while a coat grows round the nucellus (fig. 8, *ov.*). The ovule is now pendulous, and grows rapidly, and about this time the flower opens. I made a great many sections to try and observe a second coat growing round the ovule, but failed. I cannot say whether there is only one coat or two. I obtained many sections showing the one coat growing up, as in fig. 8, and many showing the complete ovule, but none showing a second coat growing round it.

All these forms of development may be observed between the 3rd and 27th of October. About the latter date the flower expands. Transverse sections through it just before it opens give the appearance of fig. 9, and fig. 10. In the latter the fibro-vascular bundles of the petal show like two ridges on the inner surface; the anthers distinctly show the four loculi, and the six styles are compressed into an irregular hexagonal form.

The growth of the anthers has not been noticed since the formation of the mother-cells of the pollen. These divide and give rise to four pollen grains each, before the pollen grains become separated (fig. 12). The ripe pollen grains are much larger than when first formed, and the cell-wall is thickened in three places. In each grain there is a nucleus, usually with two nucelli (fig. 14).

After fertilization the petals swell up and become juicy; when the fruit is ripe, the juice is a dark purple: the sepals remain, but the stamens wither (fig. 13). Each carpel gives rise to an achene: in the unripe fruit, shown in fig. 13, the young seed encloses a hollow. I have made no sections of a perfectly ripe fruit.

EXPLANATION OF PLATE XXI.

Fig. 1. Longitudinal section through very young bud of *Coriaria ruscifolia* × 83; *st*, peduncle; *b*, bracteole; *s*, sepal.
Fig. 2. Longitudinal section of young bud of *C. ruscifolia* × 83: *ped*, peduncle; *b*, bracteole; *s*, sepal; *p*, petal; *st*, stamen.
Fig. 3. Longitudinal section through young bud of *C. ruscifolia* × 83. Letters as in Fig. 2; *g*, gynœcium.
Fig. 4. Longitudinal section through young bud of *C. ruscifolia* × 83. Letters as in Fig. 3.
Fig. 5. Longitudinal section through bud of *C. ruscifolia* × 83: *s*, sepal; *p*, petal; *st*, stamen; *sty*, style.
Fig. 6. Longitudinal section through ovary and stamens of bud of *C. ruscifolia* × 83: *s*, sepal; *p*, petal; *f*, filament; *a*, anther; *o*, ovary; *sty*, style; *st*, stigma.
Fig. 7. Longitudinal section through pistil of young flower of *C. ruscifolia* × 83: *sta*, stamen; *o*, ovary; *ov*, ovule; *sty*, style; *st*, stigma.
Fig. 8. Longitudinal section through ovary of young flower of *C. ruscifolia* × 83: *sta*, stamen; *o*, ovary; *ov*, ovule; *n*, nucellus of ovary; *sty*, style.
Fig. 9. Transverse section through young flower of *C. ruscifolia* × 30: *s*, sepal; *p*, petal; *f*, filament: *o*, ovary; *ov*, ovule; *f.v.b*, fibro-vascular bundles.
Fig. 10. Transverse section through young unopened flower of *C. ruscifolia* × 20: *s*, sepals; *p*, petals; *a*, anthers; *st*, styles.
Fig. 11. Transverse section through ovary of *C. ruscifolia* × 25: *ov*, ovules; *f.v.b*, fibro-vascular bundles.
Fig. 12. Division of mother-cells of pollen-grains into four, × 650: *p*, pollen-grains in fours dividing.
Fig. 13. Transverse section through unripe fruit of *C. ruscifolia* × 25: *s*, sepal; *p*, petal; *ov*, ovule; *f.v.b*, fibro-vascular bundles.
Fig. 14. Ripe pollen-grains of *C. ruscifolia* × 770, showing nucleus *n*, with two nucelli.

ART. XXXVIII.—*The Medicinal Properties of some New Zealand Plants.*

By J. BABER, C.E.

[*Read before the Auckland Institute, 23rd August*, 1886.]

As this paper is the result of what I have gathered chiefly from old settlers and Maoris, and of a few personal observations, its statements are of course open to inquiry. It appeared to me that by putting this information in a tabulated form the attention of pharmacists might be attracted, and more reliable results obtained.

Poisons.

There are few poisonous plants in this part of the colony.

Tupakihi, or Tutu (*Coriaria ruscifolia*).

As cultivation and cattle spread, this plant is rapidly disappearing. The juice of the fruit, strained free from the seed, is sweet and luscious and can be taken with impunity. The seeds are noxious. Their effect on the human subject is rigidity of the spine and neck, discolouration of the face, fixity of the eyes and general tremor. If emetics be administered cases are seldom fatal.

Cattle suffer from eating the young shoots, more especially hungry working bullocks. The effects are a temporary frenzy, a disposition to rush at any object, staggering and falling. If the animal can be approached, bleeding from the ear gives relief.

Sheep are very fond of the leaves; but as they eat deliberately, and walk as they eat, they suffer little. When a sheep is attacked by eating too much tutu, it rushes a dozen steps with protruded head, stops, staggers, and falls. Raising the head above the spine, and keeping it steady for a minute or two gives relief, and the animal resumes its usual quiet state.

A carefully-prepared paper on the poisonous principles of this plant, by Mr. Skey, will be found in "Trans. N.Z. Inst," vol. ii., p. 153; and, in the same volume, p. 399, an account by Dr. Haast of an elephant being poisoned by eating tutu.

It is possible that the poison of the seeds might be used in destroying vermin, flies, and insects. As it affects the brain, its effects are probably painless.

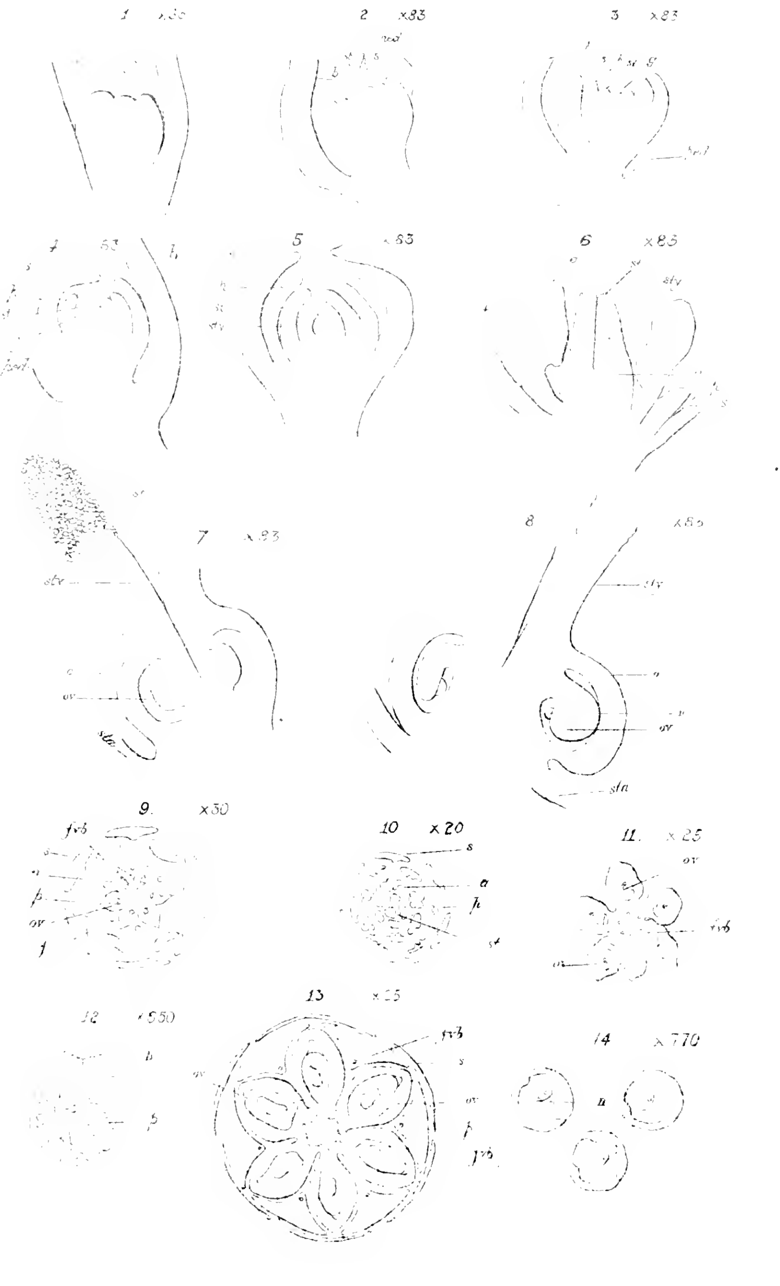
Wharangi, or Pukapuka (*Brachyglottis repanda*).

This shrub is seldom eaten by cattle or sheep, but horses are fond of it. Its effects are staggering of the legs, and falling. It is often fatal; after death the body is much distended. The only cure known as yet is to keep the animal moving, or burning rags under its nose.

Karaka (*Corynocarpus lævigata*).

Leaves and twigs are valuable forage for cattle. The pericarpium of the fruit is nutritious. The kernels of the seed are exceedingly poisonous, producing convulsions, and sometimes permanent distortion of the limbs. A graphic account of its effects is given by Mr. Colenso in Mr. Skey's paper, vol. iv., p. 316, of our "Transactions."

Cooked and steeped in water for several weeks, these kernels formed a part of Maoris' diet, and probably were nutritious. As the ripe berries fall from the trees they are greedily consumed by cattle. Mr. Palmer, of Awhitu, writes to me: "After



J.W.R. delt.

CORIARIA RUSCIFOLIA.

eating karaka berries cattle become much excited, and lose all power in or control over their hind legs. Milking-cows are more affected than store cattle, their milk rapidly drying up." Other settlers, on the other hand, tell me that their cattle eat the karaka berries with impunity. Probably this difference in report is owing to the quantity consumed, Awhitu having always been celebrated for its karaka groves. The karaka is a prolific bearer, and if a surer and better treatment than that of the Maori could be found, there appears to be no reason why, if perfectly deprived of their karakine, the seeds should not be an article of food.

WAORIKI.

This is a swamp grass, growing in the north of this Island. According to Mr. F. Maxwell, it is poisonous to sheep.

PURIRI (*Vitex littoralis*), and MANUKA.

May be classed amongst dangerous plants, from the severe inflammation caused by splinters penetrating the skin of hands or feet.

ANODYNES.

I have not heard of any native plant possessing this quality.

CATHARTIC.

Phormium tenax.

A decoction of the root is a strong purgative. In vol. 6 of "Transactions," p. 260, appea s an able paper by Mr. A. H. Church; the chapter on the "bitter principle" is instructive. This principle Mr. Church considers tonic. In an appendix is an analysis of the seed, showing that it is rich in oil, a fact not generally known; he gives the proportion of oil at 20 per cent: that is, 100lbs. weight of flax-seed would yield more than 2 gallons of oil.

DEMULCENT.

KARIAO, or SUPPLEJACK (*Rhipogonum scandens*).

A concentrated decoction of the root has a scent and flavour like that of sarsaparilla. It is sweetish, and certainly demulcent to the throat. Its qualities deserve attention.

ASTRINGENTS.

Our flora is rich in plants of this kind—used as cures for diarrhœa, or as styptics.

KOROMIKO, or VERONICA (*V. salicifolia*).

This is a well-known remedy for diarrhœa used by Natives and settlers. A few of the young leaves chewed and swallowed afford a nearly certain remedy. I have found that an infusion of its dried leaves has little or no effect, but that a decoction has; from this, I suppose the active principle differs from tannin. Mr. Fitzgerald, of Wellington, offers a preparation of this useful plant, of which it is to be hoped the public will take advantage.

Rata (*Metrosideros robusta*).

The juice of the vine, obtained by cutting and inverting it, affords a strengthening, slightly astringent, beverage; very wholesome.

Pohutukawa (*Metrosideros tomentosa*).

The inner bark is reported to be useful for diarrhœa.

Rimu (*Dacrydium cupressinum*).

The gum of this tree is excessively astringent. The bark of the young tree was used by Maoris as a styptic, to stop the bleeding of wounds.

The capsules of Manuka (*Leptospermum scoparium*), and the gum of *Cyathea medullaris* (Punga), are also useful in attacks of diarrhœa.

Stimulants.

Kawakawa (*Piper excelsum*).

Its effects are stimulating; it excites the salivary glands, the kidneys, and the bowels slightly; it is aphrodisiack. The fruit and seeds, ripe or unripe, are more powerful than the leaves, although the latter are generally used. Mr. Fitzgerald has also prepared an extract of this plant.

Tonic.

Kohekohe (*Dysoxylum spectabile*).

The leaves and bark of this tree are intensely bitter; it is not eaten by cattle or sheep. A decoction of the leaves, if not too concentrated, is agreeably bitter. I consider it a tonic, but the opinion requires confirmation.

It is not likely that a drug of specific value will be obtained from our plants; but I think there is material for the preparation of some useful medicines, to which pharmacists, following the example of Mr. Fitzgerald of Wellington, may find it their interest to attend.

Art. XXXIX.—*Descriptions of new Native Plants.*

By D. Petrie, F.L.S.

[*Read before the Otago Institute, 17th November,* 1886.]

1. *Ranunculus kirkii*, n. sp.

A small slender herb, very sparingly clothed with long soft hairs, and sending down numerous stout and long roots.

Radical leaves ternate on slightly hairy petioles, 1–2½ inches long; leaflets small, coriaceous, 3-lobed (often to the middle), glabrescent or with sparse hairs; the lobes entire or slightly cut.

Cauline leaves spathulate-oblong, on slender petioles of variable length.

Scapes very slender, 3–4½ inches long, branched or undivided, sparsely clothed with long soft hairs.

Flowers small, solitary, on the ends of the scapes, or of the scape-branches.

Sepals lanceolate or oblong-lanceolate, glabrous or with a few hairs.

Petals 5, oblong, rounded, obtuse, twice as long as the sepals, with a narrow claw and a distinct gland just above the claw.

Carpels few, flattened and discoid, smooth at the sides, with a somewhat thickened ridge round the margin, and a subulate terminal slightly hooked beak.

Hab. Paterson's Inlet, Stewart Island.

This species is most closelyallied to *R. ternatifolius*, T. Kirk.

2. *Lepidium matau*, n. sp.

A small, erect, sub-pilose diœcious herb.

Root stout, long, enlarged or subdivided at the crown, perennial.

Stems one or several, branched, leafy, 3–4 inches high.

Lower leaves numerous, 1–1½ inches long, linear, pinnatisect, the lobes rounded or cuneate, entire or incised (chiefly on the upper edge), pilose or sub-pilose; petioles short.

Cauline leaves sessile, broadly oblong, sub-acute, usually entire.

Flowers imperfect; petals, none.

Male flowers in crowded racemes often 2 inches in length; pedicels slender, pilose, ⅙ inch long.

Female flowers in shorter and laxer racemes; pedicels decurved.

Pods ovate-elliptic, similar to those of *L. kawarau* (mihi).

Hab. Alexandra South. This plant stands close to *L. kawarau*, but differs in so many respects, and, so far as I know, so constantly from that species, that I think it must be regarded as distinct. The discovery of intermediate forms may yet reduce these species to a single variable series. Unlike *L. kawarau*, this species does not appear to be eaten by sheep or cattle.

3. *Tillæa multicaulis*, n. sp.

A minute, slender, reddish, much branched glabrous herb.

Stems several, frequently branched, $1\frac{3}{4}$ inches long or less, set at close intervals ($\frac{1}{12}$–$\frac{1}{10}$ inch) with pairs of small opposite connate subulate concave leaves, bearing in their axils very short branchlets clothed with sub-connate imbricating leaves similar to those of the stems.

Flowers, few, in the axils of the uppermost leaves, rosy, shortly pedicelled.

Sepals 4, subulate, acute.

Petals 4, broadly oblong, obtuse, twice the length of the sepals.

Carpels (immature) 4, with a scale at the outer base of each.

Hab. Maniototo Plain, 1,600 feet.

This species stands near *Tillæa sinclairii*, Hook. f. It grows in drier situations, and though slightly tufted never forms dense patches, as *T. sinclairii* does.

4. *Erechtites diversifolia*, n. sp.

A slender, unbranched, strict erect herb, 15–26 inches high.

Stems swollen at the base and sending off a strong tuft of roots, terete, strongly grooved, leafy, glabrate or sparingly cottony.

Lower leaves linear-oblong, obtuse, rather membranous, with few distant blunt teeth (having a very shallow sinus between), and recurved margins, obtuse, glabrous above, glabrate or puberulous below, gradually narrowed into long flat petioles, not auricled, the whole $2\frac{1}{2}$–$3\frac{1}{2}$ inches long.

Cauline leaves narrower, more acute, with shorter petioles and less prominent teeth, the upper linear and sessile, glabrate or slightly cottony, not auricled.

Inflorescence usually much branched, lax or compact; heads numerous or rather few, $\frac{1}{4}$ inch long, on slender bracteate pedicels. Involucral scales glabrate or slightly cottony, linear, acute, with scarious margins, shorter than the florets.

Achene linear-oblong, grooved, hispid, slightly contracted below the flattened top.

Hab. Hills near Dunedin, and westwards as far as the Tuapeka District, 200 to 1,000 feet.

ART. XL.—*Descriptions of new Native Plants.*

By D. PETRIE, F.L.S.

[*Read before the Otago Institute, 8th May,* 1886.]

1. *Ranunculus berggreni*, n. sp.

Small, glabrous, glossy green.

Rootstock as thick as a crow-quill, creeping, and sending off long roots.

Leaves all radical, on slender flattened petioles $\frac{1}{3}$–1 inch long; blade orbicular-reniform, 8–11 lines in diameter, unequally 3-lobed to the middle, the lobes crenate and beautifully reticulated.

Scapes 1 or 2, 1-flowered, slender, naked, glabrous, $1\frac{1}{2}$–$3\frac{1}{2}$ inches long.

Sepals 5, ovate, obtuse, yellowish-green, with brown margins.

Petals 5, rich golden-yellow above, more or less green below; narrow-obovate, very obtuse, sometimes pink at the edges on the back; nectary near the base conspicuous.

Mature achenes not seen; in young forms the style is terminal, subulate, and recurved.

Hab: Carrick Range, near Cromwell; 4,000 feet: collected November, 1885. I visited this habitat in February of this year, expecting to get mature achenes; but in this I was disappointed, for the plants were eaten down by sheep or rabbits, no doubt in consequence of the exceptionally dry season rendering green food very scarce.

2. *Haloragis spicata*, n. sp.

A slender, erect, branched herb, 4–10 inches high.

Stems slender, wiry, grooved, sparingly scabrid, usually divided near the base into several branches.

Leaves in opposite pairs, diminishing upwards, almost sessile, coriaceous, with distinct midrib, acute, elliptic-oblong, sparingly pilose or almost glabrous, $\frac{1}{3}$–$\frac{2}{3}$ inch long, with five distinct rather deep serratures at equal intervals along the margin.

Peduncles numerous, branching off from the top of the stem, with several (7 or fewer) single or paired small sub-hispid bracts, bearing in their axils perfect or imperfect sessile flowers.

Stigmas 4, plumose, long, turned down on the ovoid 4-angled smooth nut, which is $\frac{1}{10}$th inch long and stout. Fruit, 1-celled.

Hab. Moist terraces, top of Lake Hawea, 1,150 feet.

I have not been able to satisfy myself as to the nature of some of the flowers. The upper one or two in each spike is perfect, and produces large nuts, while the others appear to be staminate only. Only a study of later and more mature fresh plants can settle whether the lower flowers are perfect. So far as I can judge from my materials, the uppermost, or two upper, flowers of each spike alone are perfect.

3. *Celmisia prorepens*, n. sp.

A species of somewhat smaller size than *C. viscosa*, Hook. fil., forming large dense patches on moist alpine situations.

Rootstock (denuded of the withered fibrous bases of the leaves) as stout as a quill or stouter, much branched, creeping and rooting, the terminal portions invested by a dense covering of the withered sheaths of the leaves or of their fibrous remains.

Leaves densely crowded, $1\frac{1}{2}-3$ inches long, $\frac{1}{2}-1$ inch broad, thin, leathery, rugose and corrugated lengthwise, glabrous above, below glabrous, or with a very thin pellicle of grey tomentum, oblong-lanceolate, acute, coarsely serrate, margins recurved, viscid, with veins distinct below. Sheaths narrower than the leaves, semi-membranous, striate, extremely viscid, reddish-brown.

Scapes 1 or 2, axillary, 6 inches long or less, flattened towards the base, slender, viscid, with sparse hairs and numerous broadly-linear entire bracts, often as much as 1 inch long.

Heads $\frac{3}{4}$ inch across; involucral scales rather few, linear, very viscid.

Pappus as long as the slender silky achene.

Hab. Old Man Range, 4,500 feet; Mt. St. Bathans, 5,000 feet.

This is a very distinct species. My flowering specimens are few, and the description of the head may need correction.

4. *Stipa setacea*, Br.

Several years ago I found this grass at Firewood Creek, Cromwell, and the Nevis Bluff, Kawarau River. As the plants were confined in these localities to small areas, and these were near an important highway, it was uncertain whether the species had not been accidentally introduced. In March of the present year I found it on the banks of the Waitaki River at Wharekuri. The discovery of this widely-distant habitat is sufficient to remove all reasonable doubt as to its being a genuine native of New Zealand. No doubt it will be observed in other stations ere long. The rare occurrence of this grass is, I believe, due to its being a favourite with sheep. At the Nevis Bluff I noticed that it was always closely cropped wherever sheep could get at it, and it was only in the clefts of rocky cliffs and inaccessible ledges that flowering or fruiting specimens could be got. At Cromwell, also, the only specimens to be found grow in spots very difficult of access. I have for years carefully looked for this plant in all likely places, and I am satisfied that it is now on the verge of extinction. It has a wide range in Australia, being found as far north as Queensland and as far south as Tasmania. I do not know whether it is readily eaten by sheep in these countries.

III.—GEOLOGY.

Art. XLI.—*Narrative of an Ascent of Ruapehu.*

By James Park, Geological Survey Department.

[*Read before the Wellington Philosophical Society, 24th February*, 1886.]

During the progress of a recent geological survey of this district, I had occasion to ascend Mount Ruapehu, and, by permission of the Director, I am now enabled to place before you an account of my trip.

Ruapehu is the highest mountain in this island, attaining a height of almost 9,000 feet above the sea. It is situated at the southern extremity of the great volcanic chain that extends north to Lake Taupo, and occupies a most prominent and central position, being almost equidistant from the sea on three sides. It reaches far above the snow-line of this latitude, and maintains immense snow-fields throughout the year, this being perhaps as much due to its huge massive character as to its height.

It is the source of many large and important rivers, the principal of which are the Waikato, which drains its eastern slopes and falls into the sea some distance south of the Manukau Harbour; the Wangaehu, with its large tributary the Mangawhero, which drains its southern slopes and discharges into Cook Strait; and the Manganui-a-te-ao, which rises on the west side of Parataetaitonga, and joins the Wanganui about 8 miles above Pipiriki.

The first ascent of Ruapehu appears to have been made by Sir George Grey,* but I am unable to ascertain the precise date; however, it must have been previous to 1867.

The present ascent was made on the 8th January of this year, or about two and a half months earlier than any previous ascent, as far as I can learn. I was accompanied by Mr. Dunnage, Mr. A. D. Wilson's cadet, who was sent with me to erect a signal on the summit for triangulation purposes, and also by Dalin, a survey hand.

We left Karioi on the 7th January, and the same evening pitched our camp at the foot of Ruapehu, at about 4,000 feet above the sea. Our intention was to have pushed on to the top

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* "Hochstetter's N.Z.," 1867, p. 378.

edge of the bush; but, as this was the highest point at which we could find water and grass for the horses, we were unable to proceed further, and made up our minds to make up the lost distance by an earlier start next day.

On the morning of the 8th we were astir at daylight, and before the sun had risen were far up the mountain's side. A sharp walk of two hours brought us to the first patch of snow, at a height of 5,500 feet. The distance travelled was about 3 miles, over low ascending rocky ridges.

The ascent so far was not steep, and only rendered difficult by the numerous deep rocky water-courses that had to be crossed. These were generally dry, but in early spring they must be roaring torrents, judging from the great size of the rock masses strewn in their channels and piled high on their sides.

At 6,500 feet we encountered permanent snow-fields. The ascent now became steeper and more difficult, and but for the sun's rays softening the surface snow we could not have proceeded. Each member of the party was equipped with a properly-shod alpenstock and heavy nailed boots, and by means of these we were able to ascend places that otherwise were impossible to us.

Our intention was to have worked our way round the south side of the mountain to the great snow-field lying between the south-east peak, facing Karioi, and the south peak, the highest part of Ruapehu, known by the native name, Parataetaitonga, and then followed up this to the summit. However, we were unable to do this, for on reaching this field we found the snow frozen so hard that we were unable to dig our alpenstocks into it, or to make steps that could be considered safe, taking into account the steepness of the ascent. In order not to lose time we proceeded straight up the south-east peak. The ascent was exceedingly steep, and very slow, as great care had to be exercised in making steps and securing a firm hold with our alpenstocks. Several narrow rocky ridges cropped out on our route, but they had to be carefully avoided, as the slightest touch was often sufficient to send a shower of loose rocks flying across the snow, to the imminent danger of the whole party.

After a slow and trying ascent of three hours, the summit of the peak was reached, and it was not without some anxiety that we hastily examined the saddle between us and the highest peak, for it was quite evident to all that it would be next to impossible to return by the way we had come, on account of the steepness of the snow.

The saddle, or more properly "*côl*," lay about 450 feet below us, and how to reach it was difficult to determine. The northern side of the peak we were on presented a perfectly perpendicular wall of bare rock, being too steep to carry snow, while on its southern side the snow was frozen too hard to obtain a foothold, and, choosing the least of two dangers, we spent an hour vainly trying to descend the rocky wall on the northern side, by zigzaging from ledge to ledge. In this fashion we succeeded in reaching within 50 feet of the foot of the precipice, but here our further progress was barred by a mass of smooth, polished pitchstone porphyry that had withstood frost and snow, and offered no ledges or projections by which to descend. Again ascending to the summit of the peak, we sat down to deliberate, and soon afterwards we found that the sun had softened the snow on the south side, so that with extra caution we were able to descend to the saddle. Once on the saddle, we made rapid progress, but a sharp lookout had to be kept for the numerous crevasses and fissures which, in places, cut the ice into an intricate network, more especially where the snow-fields were moderately flat. The saddle, being narrow, was corniced on the north side, which was the steepest, and care had to be taken not to walk too close to the edge. Having passed the saddle, we began the ascent of the main peak.

Being now able to ascend from the south side, from the great snow-field previously mentioned, we made up for lost time; but it was not all "plain sailing." When not more than 250 feet from the summit we encountered a wall of ice about 20 feet high, which we failed to surmount, although repeated attempts were made.

Without wasting much time here we turned to the north-east aspect of the mountain, and continued the ascent from that direction. The sun had left that side some time, and the snow, that an hour before was dripping under the sun's strong rays, had now commenced to freeze—not into a solid cohesive mass, but into loose icy particles. In crossing this snow-field the greatest care had to be taken not to start this layer of dry snow, which continually showed signs of sliding on the smooth surface of the hard ice below.

Proceeding rapidly, but as lightly as possible, so as not to start a snow-slip, we made for a high boss of volcanic agglomerate, near which we knew the snow would still be moist enough to adhere to the ice.

All went well till within a few yards of the rocks, when, in some way or other, Dunnage lost his footing and began to slide down the snow-field at a terrific rate. His destruction seemed inevitable, for he was rapidly approaching an immense crevasse that traversed the whole field, and had particularly attracted our attention a short time before. It was the dangerous description of crevasse well known to alpine tourists, which has one side higher than the other. In this case the drop was on the low side, and was about 20 feet. The width of the crevasse at the top was about 15 feet, and both sides were corniced, and from its concave roof and sides hung innumerable long blue icicles and sharp projections of ice. Its depth appeared to be many hundreds of feet, extending probably to the bottom of the valley. To this crevasse Dunnage was rapidly sliding, and there seemed but small chance of his recovering himself. He was sliding with his back to the snow, and his weight started the dry snow, which accelerated his speed; but he had fortunately stuck to his alpenstock, which, getting in front of him, ploughed into the ice, so that eventually he was able to swing himself clear of the sliding snow; but none too soon, for with a few feet more he would have dashed into the icy chasm below. The distance he slid was about 200 feet.

After a brief rest, the ascent was continued, but with greater care; and without further mishap we reached the summit of Parataetaitonga, which was covered with snow to a great depth, giving a fine rounded outline to the peak.

The outlook from Ruapehu on a clear day must be very extended; but, unfortunately, the whole country round was filled with black smoke from the numerous large bush fires which were then raging on the south side of the forest belt. The smoke did not rise higher than 6,500 feet, and, above this, all was sunshine and brightness, the only object standing out of the dark sea being the white shining peak of Mount Egmont, 80 miles to the westward.

Immediately below us lay the great crater of Ruapehu, encircled by high peaks from 500 to 800 feet high. The crater proper, or what was probably the former vent, is situated not in the centre of the basin, but appears to be nearer to Parataetaitonga than the northern or western peaks. The vent, as far as could be judged from our high position, is probably ten chains across. At this time it was occupied by a great sheet of ice, of a bluish colour, and there was no appearance of steam or water.

On its south-east side the great crater-basin, which is perhaps a mile across, is partially broken down, and connects with an immense snow-field, at the foot of which, at 6,000 feet, the Wangaehu as a considerable stream is first seen. The waters of this river, when they emerge from their ice-bound source, have a yellowish milky colour, and emit a strong sulphurous smell.

As there was little to be gained by a prolonged stay on the top, we hastily erected a trig. signal, which consisted of a stout birch sapling, driven into the snow several feet, and a ball of black calico. Our names, with the date of ascent, were placed in a sealed bottle, and left in a cairn of stones, on a rock-ledge about a chain to the north of the summit, and about 15 feet lower.

We now began the descent. By this time the sun's rays had left the south-east slopes, and a hard crust of frozen snow had formed; but by stamping with our heels this was easily broken through. After reaching the saddle, or "*côl*," we descended by the great snow-field between the south-east peak facing Karioi and the main peak, which we were unable to ascend in the morning on account of its frozen surface. This field reaches down to 6,000 feet, and is traversed by numerous crevasses; but these were successively avoided, and in little more than half an hour we reached the lowest limits of the snow. In descending the field "glissading" was resorted to, as on account of the steepness this rapid mode of progression was found to be the easiest and safest.

A rough, difficult walk of two hours, over a tumbled and confused mass of rocks brought us back to our camp.

For several days afterwards Mr. Dunnage and Dalin suffered severely from snow-blindness, the fierce glare of the sun on the glistening snow having induced acute inflammation of the eyes.

ART. XLII.—*Notes in reference to the Prime Causes of the Phenomena of Earthquakes and Volcanoes.*

By W. T. L. TRAVERS.

[*Read before the Wellington Philosophical Society, 25th August,* 1886.]

THE recent outburst of volcanic activity in the Lake District naturally excites our curiosity in relation to the prime cause of earthquakes and volcanic phenomena; and I propose, in this paper, to call attention to some points which appear to me materially to affect the solution of this question, but which are not referred to, so far as I have been able to ascertain, in any geological works. In order, however, that the bearing of the matters to which I am about to call attention may be understood, it is necessary that I should refer, in the first place, to the speculations of astronomers and physicists respecting the original condition of our globe as a concrete mass, because, if those speculations be well founded, it is clear that the phenomena of earthquakes and volcanoes must be associated with the continued existence of fused matter at no great depth below its surface.

Herschel long ago pointed out how, under the action of gravitation, cosmical matter "so diffused as to be scarcely discernible" might be condensed into a comparatively small mass. Kant, in his "Naturgeschichte des Himmels," (published in 1755,) assumed that all the materials composing the spheres that belong to our solar world were, in the beginning of all things, resolved into their elementary substance, and filled the whole space of the system in which these spheres now move. Laplace, who is said to have been ignorant of Kant's hypothesis, published his "Exposition du Système du Monde" in 1796, in which he referred the formation of our planetary system to a gradual cooling and contraction of the atmosphere of the sun, contending that this atmosphere previously extended, under the influence of excessive heat, beyond the orbits of the farthest planets. Mayer, in his "Celestial Dynamics," (published in 1848,) tells us that the Newtonian theory of gravitation, whilst it enables us to determine, from its present form, the earth's state of aggregation in the past, at the same time points to a source of heat powerful enough to produce such a state of aggregation, and teaches us to consider the molten state of a planet as the result of the condensation of cosmical matter, and to derive the radiant heat of the sun and the heat of the bowels of the earth from the same sources. Those who are curious as to these speculations will find a criticism of the various phases which the Nebular Hypothesis, as a cosmogenetic theory, has assumed, in Stallo's "Concepts and Theories of Modern Physics," published as vol. xlii. of the International Scientific Series, in which the objections to each of the views propounded in relation to this hypothesis are pointed out and discussed. But the general idea that our planetary system originated from the condensation of cosmical matter has been confirmed by, or at all events receives strong support from, our recently acquired knowledge of the present condition of two of the largest of its members,—namely, Jupiter and Saturn, and of that of our own satellite. As to the latter, it is abundantly proved, that it is composed of the cooled relics of a once intensely heated mass, its whole surface giving evidence of extinct eruptive action. The absence of any appreciable atmosphere around it leaves that surface permanently unchanged, the ruggedness of the ejected material in no degree effaced, or even moderated, by the distribution of light volcanic ash, if any such substance happens to exist upon it, of which I have considerable doubt. We also now know that each of the two great outer planets, Jupiter and Saturn, is still in a condition of intense heat throughout its whole mass. "We recognize," says Mr. Proctor, "in the appearance of Jupiter the signs of as near an approach to the condition of the earth, when as yet the greater part of her mass was vaporous, as is consistent with the vast difference between two orbs containing such unequal quantities of matter;" and the same author, speaking of the "great red spot" which has, for some years past, excited the attention and curiosity of astronomers, says: "It may well be that the movements by which a disturbed cloud-belt on Jupiter returns to its normal condition are sluggish, compared with the fierce action by which disturbances are brought about at, or it may be below, the fiery surface of the planet itself."

I think, indeed, that it may almost be received as a postulate, that, in whatever manner the cosmical matter of which our globe was formed became aggregated, it must, for a very long period after that aggregation had been completed, have remained in a condition of intense heat at its surface.

I have already dealt with this subject in papers on the "Cause of warmer climates which existed in high northern latitudes during former geological epochs," published in the 10th volume of the "Transactions of the New Zealand Institute," to which I may refer any person desirous of going more fully into it, and I do this without hesitation, because the views contained in those papers were received with approval by several scientific inquirers of high position and authority in Europe. In the first of those papers I remarked that geologists, including so eminent an authority as the late Sir Charles Lyell, have hitherto treated such speculations as those I have referred to as having only a remote bearing on geology; but I cannot help thinking, that so long as we continue to recognize the extent to which the surface conditions of the earth have been, and are still being modified by the action of forces operating at great depths below that surface, and especially by such exhibitions of those forces as earthquakes and volcanoes, we are bound to be guided in our inquiries by a regard to those speculations, before we can hope to arrive at any sound understanding of the phenomena in question.

I must not, however, in justice to Dr. Page, one of the most delightful writers on geology, omit to refer to some remarks which he makes in his "Advanced Text-book," in relation to these speculations. In dealing with the question of the density of our globe, he points out that it cannot, if the law of gravitation be acting uniformly towards the centre, be composed throughout of materials in the same condition as those which constitute its crust, because, in that case, a depth would soon be arrived at where the density of ordinary rocks would become so great as to give a mean density much higher than that which its astronomical relations seem to warrant. He also points out that, whilst the *ponderable* crust, calculating from precession and nutation, cannot be of less thickness than a fourth or fifth of the radius, (being about that assigned to it by Hopkins, as I mention further on,) the interior layers of that crust may consist of molten rock-matter, or even rock-matter in a state of vaporiferous incandescence. He then says that, whatever be the exact proportions and conditions of the crust and interior of the earth, we know enough of its temperature to warrant certain general conclusions—namely, that the surface temperature is mainly derived from the sun, and may, though variable and irregular, be laid down with some degree of certainty; that the heat thus derived extends to a depth of from 60 to 90 feet, and that below this stratum the temperature increases at such a rate, that a temperature must soon be reached sufficient to keep in fusion the most refractory rock-substances; that this high internal temperature is apparently the cause of hot springs, volcanoes, earthquakes, and other igneous phenomena which make themselves known at the surface. In another passage he says: "Looking at the comparative thinness of the solid crust, one can readily conceive how much it would be affected by any commotion in the interior zones, or by any contraction or expansion of the entire mass. Hence the tremors, the undulations, the upheavals and subsidences occasioned by earthquakes and volcanic convulsions; and hence, also, the fissures and fractures which everywhere traverse the rocky crust, whether they may have arisen from the efforts of local forces, or from the operations of some unknown but general law of secular contraction."

I do not propose to enter into a discussion of the causes which may have brought about the present figure of the Earth, because, except in so far as that figure adds strength to the view of its original fluidity from heat, it does not materially affect the question under consideration; but I propose to make some observations on this subject in the sequel, in order to show its connection with the special matter dealt with in this paper. It is curious, however, that amongst physicists who have accepted the nebular hypothesis as a sound cosmological theory, considerable differences of opinion have been expressed as to the mode in which the cooling of our globe commenced. As mentioned by Sir Charles Lyell in his "Elements of Geology," Poisson controverted the doctrine of the present high temperature of the central nucleus, and declared his opinion that, if the globe had ever passed from a fluid to a solid condition in consequence of the loss of heat by radiation, the cooling and consolidation of the surface would have begun at the earth's centre, or, in other words, that the aggregation was so slow as to admit of the dynamical heat generated in the act being radiated into space as fast as it was generated. Other physicists treat the cooling as having commenced at and extended downward from the surface of the completely aggregated mass, and, whilst admitting that the nucleus may still be in a fluid state, have assigned a very great thickness to the solidified crust. Hopkins has fixed this at from 800 to 1,000 miles at the least, whilst others have treated the fact, that the mean density of the earth exceeds that of the rocks which compose the known portions of the crust by $2\frac{1}{2}$ to 3, as justifying the assumption that the nucleus consists chiefly of solidified metallic substances. Dr. Page has, however, given the most conclusive reasons against the validity of such an assumption, if we are to admit that the increase in temperature found to obtain as we penetrate the crust below the stratum of invariable temperature continues beyond the depths to which our observations have extended, for it is clear that, in such case, the temperature reached at the depth of 25 miles would be sufficient to fuse nearly all the rock-material with which we are acquainted, whilst at the depth of 150 miles all such material would be reduced to a state of vaporiform incandescence.

Now it is very singular that, notwithstanding the admitted connection of this internal heat with the phenomena of earthquakes, volcanic disturbances, upheavals and subsidences which affect the outer crust of the earth, some very important investigations made by Messrs. Nasmyth and Carpenter, in connection with their long-continued and exhaustive examination of the surface conditions of the moon, appear to have been entirely overlooked by geological writers, although Nasmyth and Carpenter distinctly pointed out that the results of their investigations would most probably be found to have an important bearing on the origin of the phenomena referred to, and tend to show that the thickness of the solidified, and especially of the rigid, portion of the crust, must be very much less than that which has been generally assigned to it.

I will now proceed to give some idea of the nature of those investigations, and of their suggested bearing upon the matters referred to.

Messrs. Nasmyth and Carpenter were induced, as one of the results of their long and careful observations of the surface of the moon, to inquire into the relative densities of fusible matters in the fluid and solid conditions. They found that, with few exceptions,—exceptions having no influence upon the questions at issue,—all fusible substances solid at ordinary temperatures are densest when molten. They found that solid gold, silver, iron, copper, and other metals floated upon the same substances in the molten state; that solid slag floated on melted slag, and so forth; thus accounting, in part at all events, for the greater density of the deeper portions of the globe's mass, assuming those portions to be still in a fluid condition from heat. They pointed out, what is indeed a corollary to the first proposition, that molten material, solid at ordinary temperatures, expands to and attains its minimum density in the act of solidifying, and that this expansion is followed by contraction as the solidified matter afterwards parts with its heat by radiation. Thus, if the tire of a wheel has to be formed as a casting, the fused metal must in the first place be poured into a suitable mould, in which provision has been made for the expansion of the solidifying matter. After it has cooled sufficiently to become rigid, and to bear removal from the mould without warping, but whilst still retaining a great degree of expansion from heat, it must be taken from the mould and placed in position round the wheel to which it is to form the tire. At first it is loose, but rapidly tightens by contraction, as it gradually parts with its heat by radiation, or, as is more usual, as it is cooled by the application of douches of cold water. I am not aware to what extent the density of fusible substances can be increased when in the solid condition by the mere lowering of their temperatures, but I doubt whether the density of any such substance, whatever pressure it may be subjected to, (the heat generated by such pressure being withdrawn,) can be thus increased so as to bring it up to that which it possesses in the molten state.

It will be seen, therefore, that in proportion to the heat to which they are exposed, within the limits, in the descending scale, of the lowest degree of temperature known to us on the one hand, and the state of complete fusion on the other, metallic and earthy fusible substances undergo three well-marked changes in density—namely, they have a maximum when fused, a minimum when first solidified, and an intermediate density when their heat in the solid condition is reduced by radiation.

Now, assuming that the Earth was at one time in a molten state, it is clear that so soon as it had parted with sufficient heat to admit of the solidification of its outer surface, the material so solidified would at once expand, and in course of time would pass from the plastic to a rigid state. As radiation proceeded further, the exposed surface would cool to such a degree as to cause contraction of its substance, which would then press with great force upon the less rigid solid material between it and the still molten mass below. But that molten mass would still continue to part with its heat by conduction and radiation, and its surface would solidify; and, indeed, this process would necessarily be continuous, until the rigid crust had reached such a thickness as to oppose further solidification. Until this point had been reached, however, the consequences of the processes to which I have referred would be to create constant strains upon the contracted and still contracting outer portions of the crust, and, as a result of such strains, the production of fissures, or bulgings, or foldings, according to the degree of rigidity to which it had attained. A further effect would be to create cavernous spaces at various depths, and of greater or less extent, into which masses of molten matter would be injected by the pressure created upon the nucleus by the plastic material interposed between it and the contracted outer crust. Matter so injected would solidify with greater rapidity than that which remained in general contact with the fluid mass, and its expansion would certainly produce more violent action on the surface of the globe than would result from the more gradual solidification of films on the surface of the diminishing nucleus.

The effect of the operations referred to upon the ultimate form of a spherical mass of fused matter, occupying the position and having the motions of the Earth, would, I think, be to produce, or, at all events, materially to assist in producing, the form which the Earth now presents. Radiation from such a mass would, in the absence of any local compensating action, be equal from every part of the surface; but from the moment that a fixed axis of rotation had been established under the paramount influence of the Sun's attraction, that radiation would proceed most rapidly at the poles, diminishing gradually towards the equator.

The result of the more rapid radiation in circumpolar regions would be to reduce the sphere to a spheroid, by the pressure of the contracting outer crust within those areas upon the molten internal mass, which, in its turn, would necessarily press outwards upon the more plastic materials in equatorial regions, until equilibrium had been established. This view is supported by the distribution of volcanoes on the surface of the Earth: for, with the exception of Hecla, in Iceland, in latitude 65° North, and Mount Erebus, on the Antarctic Land, in about the same latitude South, active volcanic action is most intense within tropical regions, and extends but little into the limits of the temperate zone. This fact appears to indicate that the loss of heat which the earth originally sustained, and is still suffering, is largely compensated within the tropics, and for some distance on each side of them, by that which it receives from the sun's radiation, and, consequently, that the molten material in the interior of the earth is exposed, within that area, to pressure less effective to prevent earthquakes and resulting volcanic phenomena, than it is subject to within the circumpolar and immediately adjacent regions.

It is, no doubt, difficult to apply the mind to the consideration of operations such as these in connection with a mass of such enormous dimensions as our globe; but it is very clear that, with the exception of the cooling of its surface to such a degree as to cause any great amount of contraction, operations of this very nature must now be going on in the great planet Jupiter. I cannot say to what extent the dynamical heat, generated by the condensation of the cosmical matter of which that planet is composed, and which is being lost by radiation into space, is compensated from outer sources. Those who are curious on this subject may consult the views propounded by Mr. Mattieu Williams, in his work on "The Fuel of the Sun," and the very similar views as to the maintenance of the sun's heat propounded by the late Sir W. Siemens in the columns of "Nature." It is clear, however, that in the case of our globe, whatever retarding effect its atmosphere may have exercised upon the cooling of the outer crust, that cooling was comparatively rapid, although the straining effects which I assume to have resulted from the causes referred to were still powerful enough, in Tertiary times, to result in the elevation of nearly if not all the great mountain chains now existing upon it. Whether the forces in question are still equal to bringing about changes in the surface similar to those which are revealed to us by the investigations of geologists as having occurred since the commencement of the Eocene period, can only be determined in the far distant future, although I am inclined to doubt it.

The straining referred to has, however, certainly not ceased, and will not cease until the thickness of the earth's rigid crust has become sufficiently great to prevent further solidification of the molten interior matter. The diminution which has apparently taken place in the intensity of volcanic action since the close of the Miocene period, seems to indicate the approach of such a condition of things, and that time, when it does arrive, will certainly be the commencement of the period in which the earth will attain its ultimate surface conditions.

Art. XLIII.—*On the Cause of Volcanic Action.*

By J. Hardcastle.

[*Read before the Hawke's Bay Philosophical Society, 13th September,* 1886.]

Abstract.

The first section of this paper reviews at length the arguments in favour of the dynamical theory for the origin of volcanic force, and the opinions accepted by the author may be summarized as follows:—

The conversion into heat of the work expended on the crushing and other internal rearrangement of rocks, (generally as subordinate phenomena in mountain elevation,) by horizontal pressures produced in the crust of the earth by its sinking upon a retreating nucleus, under the action of gravity, is the efficient source of volcanic heat of all degrees of intensity. The pressures, and the effect of their conversion into heat, may be roughly calculated. A specimen calculation shows the pressures required to elevate a mountain range 120 miles wide, $3\frac{1}{2}$ miles high above its supporting base, and from a crust 56 miles thick, must be 340 tons per square inch, the work of which, converted into heat, would raise the temperature of any mass of silica within which it acted by about 4,200° Fah., and other rocks in

proportion to their specific heat. The pressures needed to lift a mountain 20 miles wide and 1 mile in average height above its base, from a crust 20 miles thick, would be about 270 tons per inch, giving a temperature, if converted into heat, within silica, of 3,348°. In neither case is the initial temperature of the rock taken into account. The fusion of rock and extrusion of lava are the more important geologically, but it is not necessary that rock should be fused to give rise to volcanic phenomena. Temperatures of 550° and 1,000°, which would not affect a rock, give steam pressures of 1,000lbs. and 4 tons per inch, respectively, either of which, but especially the latter, would have great disruptive or explosive power, provided a vent was opened for them. The writer contends that volcanic steam, or fused rock, cannot open their own way to the surface; this must be provided for them by the movements which produce the heat fissuring the rocks above. He contends, also, that volcanic steam results from the heating of a wet rock; that violent eruptive phenomena cannot be caused by the access of water to heated rocks. It is suggested that in steam eruptions, (such as that at Tarawera,) the steam in escaping tears and crumbles up the free surface of the heated rock as frost acts on a clay bank: hence the fineness of the bulk of the ejecta. A rule is found to hold good in so many cases as to be worth further study—that volcanoes only appear where upheaving forces have acted about more than one axis, the volcanoes being found, not where the lines intersect, but in one or more of the angles formed by them.

The paper then proceeds to offer a history of the recent outbreak at Tarawera, on the lines thus laid down:—

Crust pressures, acting (as shown by the great fissure-lines) upon an axis lying north-east and south-west, accumulated in the elastic compression of certain beds until they were able to bring about movements of some kind in the rocks within which they acted, and which were at no great depth beneath the surface, but whose extent and thickness I make no attempt to estimate. During a fortnight or more before the outbreak these movements were going on, as was shown by the earthquakes experienced in the locality. (That the focus of action was situated at no great depth is indicated by the fact that the shocks were merely local.) The movements affected a considerable mass of wet rock, and were only effected by the exertion of considerable force. Judging from the resulting great amount of the ejections, it is probable that the action involved such a deformation of some part of the area of rock compressed as would have amounted to crushing at the surface, and the heat developed in such a case would be proportional to the force employed in the crushing. While this was going on below, the upper rocks were being cracked and fissured by the movements. The line of crushing appears to have passed under the Tarawera, or very near it, and the first fissure *made available* for the escape of steam from the heated beds passed through one side of the mountain. (It is not unlikely that the mountain was plentifully fissured and creviced beforehand.) On a way being opened for the escape of the steam, it was promptly taken advantage of. For some time the force of the steam would be largely employed in tearing away the sides of and enlarging the vent, the product of this action being the larger stones described as underlying the sand and dust on and near the mountain. All this time, as afterwards during the continuance of the eruption, the steam in escaping from the heated rock (which was possibly crushed, certainly weakened in its cohesion,) would tear off and crumble off its "face," and carry the fragments out through the fissure, to scatter them to the winds.

There is no evidence, I understand, that any portion of the ejecta had been fused, but the fineness of the great mass indicates that the rock from which it was derived was very thoroughly crushed by the movement which heated it, by the escaping steam tearing it to pieces, or by both actions together.

The subterranean rock movements continued, as indicated by continued earthquakes; the fissure through the upper beds was extended, and a second set of eruptions set up further south, the subterranean action being similar to the first. In connection with this second eruption, I should like to offer a suggestion as to the cause of certain noises that have been described as "horrible roarings," that ceased after a time, by those who were unfortunate enough to be in Wairoa on that memorable night. These may have been common volcanic sounds, but they may not. One of the chief centres of the second eruption was Lake Rotomahana, from the bed of which very copious ejections took place. Now one of the most horrible noises I ever heard is that caused by the condensation of steam within a body of water, as when a locomotive-driver turns a steam jet into his water-tank—a measure of economy when his steam is blowing off. Exchange the locomotive-tank for a lake, or quarter-inch pipe for an aperture possibly some yards in area, and 150lbs. pressure for, say, 1,000lbs., and one can imagine a *cause* for the "horrible roarings" heard at Wairoa. This noise would cease as soon as the escaping steam had carried up material enough to construct a cone, or cones, to the surface of the lake. A great deal of the water which went to make the mud that overwhelmed Wairoa may have been carried into the air as spray by the powerful steam jets that played through the lake. At any rate, a considerable quantity of water must have been carried up in this way.

An interesting question is: What is the nett result of the eruption in the nether regions? Has a cavernous space been formed by the removal of so much solid material? I think not.

I think that by the expansion of unremoved rock by heat, and still more by its expansion by escape from the elastic compression it was previously subjected to, the place of the rock removed has been occupied. Were it not so, the extensive fissurings that have occurred in the bed of Rotomahana must have allowed the whole of its waters to sink into the cavity on the subsidence of the grand eruption. Possibly there has been some slight sinking of the ground immediately above the locality whence the rock was removed, (I have read something about the southern end of Lake Tarawera having subsided 18 inches,) but the other means of filling the gap may have been sufficient for the purpose at present. As the heated rock cools and contracts further sinkage must occur, of which the deepening the existing lakes would be one indication. The second set of eruptions has been spoken of as hydrothermal, as distinguished from volcanic. I confess I do not understand the distinction—that is, if by the second eruption so much solid matter was ejected as I understand there was. It would seem to be a proper distinction to call that action hydrothermal which seemed to arise from access of water to heated beds; but, (as contended above,) no considerable eruption could be originated in this way. There could be no solid ejections worth speaking of. For true volcanic action the water must be in the rock when heated, or, must have time to permeate a heated rock before a fissure of escape is provided, when the same results would follow. Yet it must be more difficult for steam to break up a solid rock, than one that from the effects of recent mechanical action upon it has lost much of its cohesion.

It has been remarked that there were no "warnings" of the eruption. There never are other warnings of a new outbreak than such as were given to those living in the neighbourhood. There were numerous earthquakes which indicated that movements were going on below. The springs were affected, being more copious, without meteorological cause, indicating that the movements were compressive—the water being squeezed out of the fissures in the strata. But it was impossible to gauge the extent of those movements, or foresee their actual effect.

Art. XLIV.—*Observations on the Eruption of Mount Tarawera, Bay of Plenty, New Zealand, 10th June, 1886.*

By J. A. Pond and S. Percy Smith, F.R.G.S.

[*Read before the Auckland Institute, 12th July, 1886.*]

The 10th of June, 1886, is likely ever to be remembered in the history of New Zealand as that on which the colonists first had practically brought home to them the fact that the volcanic forces for which these islands are so celebrated had still an amount of vitality in them that was unlooked for and unexpected. The eruption of Tarawera Mountain, and the conversion of Rotomahana Lake into a crater, on that date, at about 2.15 a.m. has caused widespread consternation, the loss of several lives, and a feeling of anxiety as to whether this outburst will be confined to the immediate district where it occurred, or whether it will spread to others in which the signs of thermal action have been known for long periods.

Description of Volcanic District.

The volcanic districts of the North Island have been correctly described by Hochstetter as occupying three zones: the first, as that from Tongariro to White Island; the second, as that of the Isthmus of Auckland; the third, as that of the Bay of Islands.

There are many very essential differences in the general character of the results of volcanic action in these three zones, the first-named being that in which any extent of vitality appears to have remained unto the present day; though the Bay of Islands District has still its group of hot springs, whilst that of Auckland, so intimately known to all of us, has ceased to show any sign of life at all, though exhibiting to the observer some of the most perfect examples of extinct volcanic action in its several stages known to the world. Of these essential differences, the most prominent, and those which alone require notice on the present occasion, are the characters of the rock-masses and materials which go to build up the vast accumulation of volcanic remains forming the mountains and ejected matter in the different districts. The rocks of the central or Taupo zone are composed of materials known generally under the name of "acidic" rocks, whilst those of the other two zones are—in their latest manifestation, at all events—entirely formed of basic rocks. We may take, as general names descriptive of these two classes, trachytic rocks for the acidic areas, basaltic rocks for those of the basic areas, the distinction being in the nature of the constituents and their forms of aggregation.

The researches of modern science tend to confirm the idea that there is a regular sequence in the order in which these two classes of rocks are ejected from volcanoes—the acidic, or trachytic, denoting the earlier; the basic, or basaltic, the later stages of volcanic life. There are well-known exceptions to this general rule, but, taken as a whole, the evidence tends to show that such is the life history of most volcanic districts.

It may be that some volcanoes commence their career by the ejection of acidic matter, and continue throughout the whole course up to their final extinction, terminating in the ejection of basaltic matter, without material interruption of their activity—whilst others, after making a commencement, are quiescent, or only partially active, for ages, remaining in the acidic stages for such lengthened periods, that volcanoes which can be shown to be far younger in actual age have had their day and become extinct.

Such seems to be the case with the Taupo, or central zone. It is still in the acidic stage, whilst the younger volcanoes of this isthmus appear to have run their full course, and have become extinct.

In connection with this subject and the recent eruptions, (which may happen to mark the beginning of a period of greater activity,) it is a matter of very great interest to ascertain whether they show by their action any change in the character of the ejected matter—whether, in fact, the ejecta are still acidic or trachytic, or whether, on the other hand, any basaltic or basic matter has also accompanied the outburst. We shall have something to say on this point further on.

The central volcanic district of this island is of immense extent, far larger, indeed, than is generally known, if we include in it the areas covered by volcanic matter, which spreads over a vast extent of country. Commencing in the far south, the noble mountain of Ruapehu, 8,878 feet high, which until quite recently was believed to be extinct, marks by its lava and consolidated mud streams the most southerly edge of the district. A line drawn thence in a north-east direction will pass along a belt of country celebrated all over the world for its extraordinary development of volcanic and thermal action, until it terminates in the active volcano of White Island. In this belt of country we have types of all the known forms of volcanic action. The active crater on Ngauruhoe has, within quite a recent period, (1869, and possibly 1881,) ejected hot lavas, which were seen rolling down its symmetrical cone; whilst it still constantly emits clouds of steam from the solfataras at the bottom. Tongariro, a few miles north, is still active, but in the solfatara or fumarole stage. This fine mountain, 6,400 feet high, is now but the ruin of what it must have been in former times. Its seven craters, two of which have lakelets within them, and one with steam issuing from a fissure in its side, the powerful emission of steam from Ketetahi and Te Maari—points on its flanks—and the strong sulphurous stream flowing from the former, all show that the subterranean forces are still powerful. One of its craters contains a most beautiful and instructive example of a lava stream, which has flowed from the crater wall across the floor, spreading out in fan-shaped form, and having such a look of freshness about it that it is difficult to believe it is not still flowing.

A few miles to the north we find, at the southern end of Lake Taupo, a large number of hot and boiling springs, geysers, solfataras, and mud volcanoes, all in a very active state; whilst close by are the innumerable fumaroles of Waihi, and, but a short distance away, the group of hot springs recently reported by Mr. Laurence Cussen, which are quite new to Europeans. These are situated in a recess in the Kakaramea Mountain.

Stretching along a narrow belt of country from the north end of Taupo, still in the north-east direction, we find the vast number of hot springs, fumaroles, and geysers of Tapuaeharuru, Wairakei, Ohani, and Orakeikorako, with the extinct volcano of Tauhara, on which is an old crater, now almost hidden by a growth of tall forest trees. Orakeikorako, on the Waikato River, a place seldom visited by travellers, has a very large number of hot springs, some of which are forming terraces, but greatly inferior in their present aspect to those of Rotomahana. A little further in the same line northwards rises the Paeroa Range, the wall-like western face of which is covered at its base with boiling springs and mud volcanoes, which in one part (Kopiha) occupy the face of the hill from top to bottom, and the steam from which appears to have boiled the solid rock materials into a mass of clay of various colours. It is this part that Hochstetter refers to in his work, where he points out the possibility of the clays becoming so loosened, by the thermal action, that the whole hillside may some time collapse and deluge the Ratoreka Plain below.

On the northern slope of Paeroa are more hot springs, and then rises the mountain Maungaongaonga, evidently an old volcanic hill, though the crater is almost lost to view; and immediately to the east of it is Kakaramea, or Maunga-kakaramea, of which we have heard so much lately. It is an isolated conical hill, of considerable height, whose sides are seamed by gorges, the sites of former hot springs, and on the surface of which steam still escapes in a number of places, the ground occasionally being so hot as to be unpleasant to walk over. On its southern base, and extending thence to the head of the Waiotapu River—an affluent of the Waikato—are found a large number of hot springs, fumaroles, and mud volcanoes, with some terraces in course of formation, but which, however, cannot be at all compared to Rotomahana for beauty. Two little lakes, one of the most lovely blue colour, are also seen here, both of which have been the scene of active hot springs in the past.

We now come, by following in the same direction, to Okaro Lake, situated on the northern base of Kakaramea, and approach the country which is the scene of the late eruption. Passing this over for the moment, merely noting that Rotomahana is directly in the same line of country, we find the Tarawera, Ruawahia, and Wahanga Mountains, all formed of solid trachytic and rhyolitic rocks, and at their northern base come to the hot springs of the Tarawera River, which are continued down its course at intervals for several miles. This part of the volcanic belt is also marked by the old extinct volcano of Mount Edgcumbe, with its double crater and the hot springs. Near Te Teko we find, in Whale Island, situated 6 or 7 miles off Whakatane, another group of hot springs, and close to them the signs of former thermal action on Rurima Rocks, which have been described by Major Mair in vol. v., page 151, of the "Trans. N.Z. Inst."; and, lastly, marking the most northerly point of activity, White Island, an active volcano, but now in the solfatara stage.

A glance at the map will show that the points of activity just described follow a fairly straight direction—north-east and south-west—and evidently mark a line of weakness in the Earth's crust, where the heated interior most readily finds a communication with the surface. But, in addition to this line, there are numerous other places on its flanks where hot springs and other indications of activity are found, as at Te Niho-o-te-Kiore on the Waikato, Rotorua, Rotoiti, Rotoma, Rotoehu, Maketu, and Mayor Island, all within a few miles of this central line.

Besides the places where these indications of volcanic action are present in a state of activity, we find that the whole country, for many miles on both sides, is composed of materials which owe their origin to volcanic action. Vast lava streams and sheets are visible, either as forming the hills or lying hidden under immense deposits of pumice, as on the Kaingaroa Plains, which are nearly everywhere underlain by a sheet of lava, or its accompanying mass of tufaceous rock derived from the same source. Isolated hills, built up of trachytic and rhyolitic rocks, denoting old volcanic necks, are common everywhere. The pumice which has been ejected by the ancient volcanoes covers an enormous extent of country, stretching north-easterly from Ruapehu to near Gisborne, where it is found as a thick layer on tops of the highest hills; and to the westwards, following the river valleys for many miles. We know that the plains of the Waikato are formed almost entirely of fine pumice-sand brought down from the central area, either by rivers or by the wind, or both, and that it has even been carried to within a few miles of New Plymouth. Volcanic mud is of common occurrence all over this country, but now so altered in appearance by decomposition as to be difficult of recognition, were it not for the underlying strata of pumice. It will be seen later on that the recent deposit of mud in the neighbourhood of Wairoa throws a good deal of light on the method of deposition of these beds of mud.

The changes in the central zone of volcanic action since this vast mass of ejecta was scattered all over the country have been, doubtless, very great. It is difficult to believe that all this material has issued from the extinct volcanoes, the remains of which we now see. It is far more reasonable to suppose that, during the ages which have passed since the later Eocene period, other volcanic vents have existed, and added to the immense mass of remains now visible, and that they themselves have disappeared, or been covered up by subsequent outbursts of the present volcanoes. We cannot assign, for instance, to the action of Ruapehu and Tongariro the cliffs of pure pumice on the east of Taupo, which are 400 feet high, nor have the vast lava flöes of the west side of the lake come from those same sources. Is it not far more reasonable to suppose that we now see in this long belt of country a great depression, due to the sinking of the whole surface, which carried with it the numbers of points of eruptions whose remains are now all that is left to denote their whereabouts? But to follow out this line of reasoning, and show from the evidence obtainable that this is probable, would occupy more time than is allowable. If this slight notice of some of the principal features of this great volcanic area has shown that changes have occurred in the past on a stupendous scale, it will prepare us for the acceptance of the idea that similar changes may always occur in that locality, and of this we have had recent evidence in the outburst at Tarawera.

Premonitory Signs.

New Zealand has been colonized so short a time, compared with the geologic ages of the past, that observation has not yet been continued sufficiently long to record any great changes in the volcanic region alluded to.

It is true that, from time to time, slight eruptions of Tongariro, (or rather Ngauruhoe,) have been noted; earthquakes have occurred on a larger or smaller scale; the hot springs have been occasionally more or less active; floods and landslips, involving loss of life, and due more or less directly to volcanic agency, have occurred; but no great catastrophe has been recorded, to bring home to us the fact that any great changes are going on. But, nevertheless, a general opinion has been current to the effect that the forces have been decreasing in activity, rather than the contrary, and Maori tradition lends weight to this impression. They have many stories of the greater activity of the hot springs; indeed, Europeans have seen many fine geysers in play which are now quiet or extinct: but none of their legends speak of any great calamity having befallen their ancestors through volcanic agency, and we may be sure that amongst a people who are so scrupulously careful in handing down their history, any great catastrophe would have certainly been noted. A consideration of some few occurrences in that district during the twelve months, and immediately preceding the eruption, ought at least to have warned us that some changes were impending, a few of which will be noted.

On the 22nd November, 1885, Mr. Josiah Martin, F.G.S., who was then staying at Rotomahana, was lucky enough to witness what may be called an eruption of the basin on top of the White Terraces, a brief description of which he has been good enough to supply us with:—

"Nov. 19 to 21, 1885.—Wind, W., W.S.W. Rain and squalls. Bar. falling.

"Activity of geyser, normal; overflowing and covering the whole of the Terrace.

"Nov. 22.—Wind, S. Clear sky. Bar. rising.

"Visiting the Terrace at daybreak, I found that overflow had ceased, and water was rapidly retiring. At 6 a.m. the great cauldron was empty, and until noon it remained quiet, when activity was resumed by water rising slowly and filling the geyser tube. Very little increase in activity was noticed until 4 o'clock, when furious ebullition commenced, the water rising in wave-like upheavals, with occasional geyser fountains reaching a height of from 50 to 60 feet. By 5 o'clock the basin was half full, and violently agitated. Watching the activity from the upper platform of the Terrace, I was startled by a severe shock, with a deep boom like an underground explosion, when the water in the basin was instantly uplifted into an enormous dome, from the top of which an enormous column of water was projected vertically, with incredible velocity, falling again over the upper Terrace in a heavy shower.

"(The Natives encamped at the foot of Terrace were alarmed at this sudden eruption, which they said was the most violent they had ever seen.)

"By 6 o'clock the crater was full, and no further change was noticed until 8 o'clock, when the water began slowly to retire. On the following morning (23rd) the water was retiring, and by 9 a.m. the basin was left quite empty and dry. No action was noticed until evening, when the water rose a few feet within the basin.

"On the morning of the 24th, the geyser very suddenly resumed its activity, several eruptive explosions following in rapid succession. On two occasions the column of water ejected must have reached a greater altitude than 150 feet, dense ascending clouds of steam accompanying every discharge, and rising to a height of 800 to 1,000 feet before being broken by the wind.

"On Nov. 22nd the movement of the aneroid exhibited a downward tendency, which commenced with the return of activity in the geyser, and continued during its excessive action. During the evening, as the geyser activity ceased, the opposite movement of the barometer was observed. But on three following days a recurrence of similar periods of activity in the geyser was accompanied by reversed conditions of barometric pressure."

A paper which will be read before this Institute by Mr. Laurence Cussen at its next meeting will describe in some detail the crater on top of Ruapehu, which until quite recently was supposed to be extinct. We learn, however, from that gentleman that the crateral lake is filled with hot water, and that on the 16th April and 23rd May last he observed columns of steam rising as much as 300 feet above the mountain; and as nothing of the kind has ever been noticed before, it is a fair inference that the volcanic forces were in a state of greater activity than usual.

Mr. Dunnage, a young officer of the Survey Department, who performed the difficult feat of ascending Ruapehu so lately as the 8th of June last—almost mid-winter, in fact—reports: "The snow was in a favourable condition for climbing, but it was necessary to cut each footstep for the last thousand feet. Large quantities of steam were issuing from the little lake in the centre of the crater, nearly 1,000 feet below us, but was all condensed before reaching the top of the crater. The cold was very severe."

About a fortnight previous to the eruption, one of the fumaroles at Tokaanu, at the south end of Lake Taupo, suddenly burst forth, throwing up showers of mud for several yards round; but it had returned to its usual state on or about the 10th June.

Major Scannell is good enough to inform us that some little time previously to the eruption, a new hot spring broke out at Wairakei, near the north end of Taupo.

About a week prior to the eruption, a wave was noted on Lake Tarawera, causing the waters to rise about 2 feet above the ordinary level, which broke on the shores, washing the boats out of the sheds, and causing some alarm to the Maoris, who, apparently, had never witnessed anything of the kind before. At the same date, some visitors to Rotomahana found that the Pink Terrace had been in eruption, throwing out mud for several yards round, an occurrence which has never been noted before.

It will be remembered that on the evening previous to the eruption an occultation of Mars by the Moon occurred, at 10.20 p.m., the moon being just then entering her second quarter. It would be high water on the coast near Maketu that evening at about 10 p.m. We do not give much importance to these facts, but it is worthy of note that the well-known theory of the tides assumes that the waters of the ocean are at high water piled up, as it were, on that particular portion of the earth's surface which is just under the moon; but through friction, and the counter attraction of the sun, that the tidal-wave lags after the time of passing of the moon over any particular meridian. It is equally a part of this theory that the solid materials of the earth are at the same moment subject to a wave—much more limited in extent, but still appreciable; and it is well known that an atmospheric wave passes round the earth at 2 o'clock each day. Hence, the crust of the earth being in a state of tension, if there is any predisposing cause tending to a fracture about the period of this earth-wave, it is a natural inference that the conditions are then most favourable for the production of such fractures. The attraction of the planet Mars, added to that of the Moon, may be, and doubtless is, very slight; but the fact remains that, whatever influence the moon may exert at any particular moment, it happened to be greater, by the sum of her own and that of the planet, very shortly before the eruption.

The state of the barometer, as recorded by the self-registering instrument at Rotorua, does not indicate any abnormal depression, either shortly before or during the catastrophe. It is found that on Tuesday, the

8th,	at noon,	the reading	was	29·40,	reduced to sea-line,		30·20
8th	,, midnight	,,	,,	29·28	,,	,,	30·08
9th	,, 6 a.m.	,,	,,	29·23	,,	,,	30·03
9th	,, 10 ,,	,,	,,	29·17	,,	,,	29·97
9th	,, noon	,,	,,	29·12	,,	,,	29·90
9th	,, 6 p.m.	,,	,,	29·00	,,	,,	29·80
9th	,, midnight	,,	,,	29·30	,,	,,	30·01
10th	,, 2 a.m.	,,	,,	29·30	,,	,,	30·01
							Eruption.
10th	,, 4 a.m.	,,	,,	29·40	,,	,,	30·20
10th	,, 6 a.m.	,,	,,	29.50	,,	,,	30·30
10th	,, noon	,,	,,	29·50	,,	,,	30·30

from which time it altered little for the next two days. It will be seen that there was a somewhat sudden fall a little before noon on the Tuesday, but still nothing extraordinary, or such as we learn has occurred at other great outbursts in other parts of the world.

Approaching, now, to the date of the eruption, we find that there was a heavy rain for the great part of the 9th June, which cleared up towards evening. The wind on the night of the 9th was southerly, changing during the eruption to the south-west, from which direction it blew hard until 4 a.m., when it dropped. At Auckland, Gisborne, Waikato, and Lichfield the wind was south-west. Major Scannell, who saw the outburst from Taupo, says that when he first beheld the cloud of ashes, it was moving south and east, but a sharp south wind sprang up about 3 o'clock and carried the cloud westward and northward.

Phenomena observed at the Outburst.

The amount of information which has been recorded as to the actual outburst is very considerable, but all through there appears to be a want of exactness as to the times and order of occurrence of the phenomena observed, a very natural result of the excitement and confusion into which people would be thrown by occurrences which threatened their very existence. But the best accounts obtainable seem to place the first signs of anything extraordinary happening, at about 1 a.m. on the 10th June, 1886, when slight earthquake shocks were felt by the people at Wairoa, and at Rotorua, (accompanied at the latter place by rumbling noises,) which appear to have been continued as earth-tremors till 2 a.m., or past. At 2.10 or 2.20 the rumbling noise had become a continuous and fearful roar, accompanied by a heavy shock of earthquake; and at this same time, or immediately afterwards, an enormous cloud of smoke and vapour was observed from Wairoa, rising over the hills which shut in that village from a clear view towards Tarawera Mountain, the outside edges and fringes of the different masses of which were outlined by vivid flashes of electricity, darting through the cloud and colouring it most brilliantly and beautifully. This electric display was accompanied by a rustling or crackling noise, which appears to have been heard above the deafening roar, and which is probably the same noise as is heard in electric discharges of an artificial kind, and also probably the same as is heard sometimes at great auroral displays. This heavy shock of earthquake is doubtless the same as that reported at Maketu at 2.30, Tauranga 2 a.m., and Makarewarewa at 2.30. It was noted by two observers, (Messrs. Blythe and Greenlees,) that from 2.30 onwards severe shocks occurred at regular ten-minutes' intervals up to 3.30. The latter gentleman had the presence of mind to observe, from the swinging of a ham, that the shocks came from the direction of Tarawera. It is probable that the eruption of Tarawera first took place in any strength at about 1.45 a.m. As described by Mr. McRae, who saw it from the old Mission Station, soon after the outburst, three columns of fire and flame (or probably the glare reflected on the vapour from lava below) were shooting upward from the flat plateau-like summit of the mountain to an immense height, with flashes of electricity darting forth in all directions, accompanied by balls of fire, some of which fell at great distances, indeed as far off as the Wairoa village, some 8 miles from the seat of eruption. Small stones now began to fall, as the great black cloud which had formed over the mountain worked towards the west, to be quickly followed by a downpour of mud and water and heavy stones, which battered down many of the houses in the village. The mud appears to have fallen in the form of an exceedingly heavy rain, with sometimes large lumps of mud, and this continued up till 6 a.m. All this time, there appears to have been a more or less strong odour of sulphur experienced by the people at Wairoa; and Mr. Blythe describes a hot suffocating blast, which nearly choked himself and Miss Hasard, after their escape from the burning house, and which warmed them through.

Soon after the first outburst, and before the fall of the first stones, a great wind arose, which rushed in the direction of the point of eruption with great force, and was most bitterly cold. It is noticeable that the people who survived, and were nearest to the seat of the eruption, viz., those at the Wairoa, failed to hear the loud detonations which reached Auckland and other places. Probably the loud and continuous roar drowned the louder reports.

These explosions were heard at Hamilton, Cambridge, Lichfield, Coromandel, Te Aroha, Wanganui, Tauranga, Maketu, Taupo, Christchurch, Wellington, Nelson, Blenheim, Whakatane, Opotiki, Auckland, New Plymouth, Whangarei, and Helensville, and sounded like the reports of distant cannon, or—as has been described by a large number of people from different places—like some one banging an iron tank. The flashes of the electric display were distinctly seen here in Auckland, a distance of 120 miles in a straight line from Tarawera. The immense cloud of ashes, mud, and sand which was shot high up into the air darkened the sky till long after daylight should have appeared. It is stated that it was quite dark at Rotorua till 7.30, (the ashes commenced falling there at 4 a.m.,) and again at 9 a.m.; at Opotiki till 10 a.m., at Tauranga till 9 a.m.; at Te Puke it is said to have been dark as late as 2 p.m. on the 10th; at Maketu till 10 a.m.; the ashes beginning to fall there at 5.30 a.m. The height to which the mass of light ashes was ejected must have been enormous. Professor Verbeek, who was appointed by the Dutch Government to report on and describe the eruption of Krakatoa in May and August, 1883, states that the column of steam arose from that eruption to a height of 50,000 feet, or over 9 miles. The dark cloud of dust and ashes from Tarawera must have been nearly as high as this column of steam. Mr. R. Arthur, of Mount Eden, who had a distinct view of the cloud illumined by electric flashes on the morning of the 10th, took notice of the height which it appeared as seen behind One Tree Hill; and the angle of elevation, as afterwards measured by Mr. Vickerman, of the Survey Department, gives a height, as computed by him, of 44,700 feet above Ruawahia, or a little over 8 miles. Although this method of observation is not a very accurate one, and may not be quite correct, it gives some approximation to the height.* We know from actual measurement that the column of steam arising from Rotomahana several days after the eruption was 15,400 feet, and even then the top of the column could not be seen, from its proximity to the observer. The ashes and dust ejected fell on the coast line at points 160 miles apart in a straight line—viz., at Tairua and at Anaura, a few miles north of Gisborne, and some of it fell on the s.s. "Southern Cross" off the East Cape, and on the s.s. "Wellington" near Mayor Island. It thus covered an area of land equal to 5,700 square miles with more or less of the deposit; on the edges of which, of course, it is barely visible.

In thus calling attention to the great height to which the dust and ashes were projected by the explosive force of the steam, a distinction must be drawn between this height and that mentioned by Professor Verbeek. In the Tarawera case this refers to the top of the cloud of ashes; in that of Krakatoa to the column of steam seen long after the eruption. Nor must it be inferred that in the New Zealand eruption we shall necessarily see the same extraordinary and beautiful atmospheric effects which followed the Sunda eruption.

The electric phenomena accompanying the outburst must have been on the grandest scale. The vast cloud appears to have been highly charged with lightning, which was flashing and darting across and through it: sometimes shooting upwards in long curved streamers, at others following horizontal or downward directions, the flashes frequently ending in balls of fire, which as often burst into thousands of rocket-like stars. Fire-balls fell at the Wairoa and other places, and doubtless the fires which occurred at Mr. Hazard's house and in the forest near Lake Tarawera were due to these.

Earthquakes.

The earthquakes appear to have been almost continuous from 1 a.m. to 3.30 a.m., with heavier shocks at about 4.30 and about 5.30, which were felt over a large district, extending in an east and west direction from Te Aroha, where they were slight, to Opotiki, where 71 separate shocks were felt; and in a north and south direction from the coast to Taupo. Although

* Archdeacon Williams, of Gisborne, who saw the flashes of lightning on the 10th, calculates that they were seen at an elevation of 6 miles.

described as severe, (as they no doubt appeared to those who experienced them,) they cannot really be so classed when it is taken into consideration that no chimneys fell, nor were light articles, such as bottles, vases, etc., cast down from shelves, except in one or two instances. No one who experienced the heavy earthquakes of 1848 or 1855, which caused such dismay in the vicinity of Cook Strait, could call those recently occurring severe ones.

It is true, in some places the earth has cracked and opened, but nowhere to any great extent. Nothing occurred like the great cracks at Wanganui and Wairau, in Cook Strait.

It is a very noticeable fact that all of the cracks we saw took the general north-easterly direction of the line of volcanic action, and all of them followed closely along depressions in the surface, which are undoubtedly old cracks, due to much heavier earthquakes in the past.

Sympathetic Action of other points.

It has been stated that the eruption is quite local in its action, and goes to prove that the series of hot springs in different places, and other signs of volcanic action in the central zone, are separated, and have no connection or sympathy with one or another. A consideration of the following facts relating to events which occurred at the time of eruption, or soon after, go to prove that such a conclusion has been drawn from insufficient data.

The hot springs in the neighbourhood of Rotorua were greatly affected. A small steam fumarole, (which in its ordinary state was only occasionally visible,) near the Government Agent's house, became a large boiling spring about 10 feet in diameter, from which a good-sized stream of hot water ran away towards the lake. Further north—at the base of the Pukeroa hill, and in the direction of the Maori village of Ohinemutu—steam came forth from innumerable cracks in the earth, sometimes accompanied by hot water, which formed streams running alongside the road from the old to the new township; and in the pah itself a spring burst out in the great meeting-house of Tamate Kapua; another in the path leading down to it; and yet another just behind the building. All of these outbursts occurred on the night of the eruption; they all follow, however, the old deposits of sinter at the base of the Pukeroa hill—the last remaining signs of former great activity in that locality. The activity of the vast number of fumaroles and springs in and around Ohinemutu was certainly greater than usual a few days after the 10th. The level of Lake Rotorua oscillated somewhat on the 10th June, but to no great extent. At 7 a.m. it fell 1 inch, at 9 a.m. it rose 6 inches, and fell again at noon 3 inches, and remained so all day, falling on the night of the 10th 5 inches; since when the oscillation has been continuous, but to no very great extent. The temperature of Rachel's Spring at the Sanatorium on the 11th June was 170°, and from that date to 1st July it gradually rose to 196°, with a greater flow than before. For these exact data we are indebted to Mr. Boscawen, who obtained them from Mr. Hall, the Observer.

In the far north of the central zone, at White Island, it was reported by the s.s. "Jane Douglas" that the crater was showing unusual signs of activity at 9 p.m. on the 13th, whilst the "Hinemoa" reported it to be in its usual state on the 14th. Te Puke settlers saw a "violent eruption of steam on the morning of the 10th." The "Te Anau" reported that nothing but an unusual amount of steam was rising on the 13th. On the 14th, vast columns of steam were reported as being seen all day from Tauranga, and the same on the 15th. At Wairakei, near Taupo, the springs and geysers are reported to be "in an extraordinary state of activity" on the 10th. We may add that we saw much more steam than usual arising from the large group of springs south of Maungakakaramea on the 14th; but these being in the direct line of the great fissure, it is only natural to expect this.

Taken altogether, then, this group of authenticated facts goes to prove that the disturbance was felt all along the central line of activity of the central zone, from extreme north to south, as well as on its flanks.

Description of the Points of Eruption.

We will commence our description of the effects of the eruption, as seen by ourselves on the 13th, 14th, 15th, 16th of June, by commencing at the southern end, near Lake Okaro, and tracing it thence northwards to the Wahanga Mountain, the most northerly point of eruption. This line, or irregular (and sometimes hidden) fissure, is about 8½ miles long, running in a general north-easterly direction, and along it can be traced a series of craters and points of eruption almost, though not quite, continuous.

Appearance of the District, approaching from the South.

Emerging from the bush called Pareheru, which the track approaching Rotomahana traverses, the scene is wonderfully striking. The whole country is clothed in a pale grey mantle. Hill and dale, level and steep, all is of the same hue. In the far distance, as in the near foreground, nothing has escaped this ashen covering save the Okaro Lake, which lies before us sombre, silent, and unruffled. Away in the front rises an ever rolling, slow-changing, towering mass of steam, interspersed in the lower portions with sudden bursts of darker material, which prove to be stones, sand, mud, and water, flung up to the height of 400 or 500 feet above the lip of the crater. At times, the bright sun glancing over this wondrous column gives a vivid brightness to it; and again, so brilliantly reflected is the sunlight from the more distant portions of the mantled earth, as to bring vividly to the mind of the onlooker the semblance of a vast field of snow.

On entering this sombre plain, the ashen covering proves to be a fine, dry, powdered material, having throughout small fragments of scoria. Occasionally spherical or ovoid nodules are found, which easily crush between the fingers, and sometimes contain a nucleus in the shape of a rounded fragment of scoria.

Advancing through this material—which closely resembles in colour and appearance Portland cement—the deposit becomes deeper, so that walking was very fatiguing. In many parts each step was knee-deep, while, by leaving the ridges, the soft ash was found to be so deep as to be dangerous, and the effects of the wind stirring the surface made breathing laboured.

Travelling somewhat to the north of Okaro Lake for the distance of about a mile and a half, brought us to the most southern part of the fissure, which has extended from the Rotomakariri Lake in the direction of the Okaro Lake, partly through the Haumi Stream. On the line of the fissure in this direction are five distinct craters, the most northerly of which was decidedly the most active, while the southerly one was nearly dormant.

On reaching the edge of this one, which was ovoid in shape, the bottom was found to be covered with muddy water, evidently hot and probably deep. In the northern part of the crater an occasional uprush of water would take place, rising about 20 feet in height, and slowly falling back into the pool. This would cause a wave to gradually extend, which, reaching the sides, would wash in some of the steep sloping earth, followed occasionally by heavy slips extending to the surface. (Since our visit, Mr. Boscawen and Mr. Main have seen these craters, and have each witnessed the most southern crater, which we have stated as dormant, suddenly, and without warning, send masses of water, mud, and stones high into the air above the edge of the crater, after which, Mr. Main asserts, the activity would be followed by each of the others in succession to the northwards.) At the lip of the crater, and for a considerable distance back from the edge, cracks had formed following the contour of the lip, and from 2 to 6 or 7 feet apart. These cracks made travelling dangerous in the near vicinity of the craters, as the occasional shocks of earthquake were liable to precipitate the overhanging portions to the bottom. The depth from the lip to the water was estimated at about 350 feet, and the length about 200 yards, with a width at the lips of 100 yards.

The second crater to the north was rather more active, sending up columns of steam, through which occasionally an uprush of stones and mud was discernible. Owing to a heavy slip of earth into this crater, a terrace had been formed about 50 feet below the lip, and with a little effort it was possible to obtain an excellent view from this place, not only of the crater in question, but of the steam-jets in the third crater. (The second and third craters here referred to subsequently became joined in one, called "Echo Lake Crater.") These, to the number of five, rose in unbroken columns to the height of about 40 feet, sending up stones in large numbers, some of which reached above the surface. The roar of the escaping steam from this crater was very great. Passing round to the north, it was possible to cross the line by a narrow passage between the third and fourth craters; and from this point an excellent view could be obtained of the energy displayed by the escaping steam, which sent up showers of stones to within a few feet of us.

Looking north from the passage on which we stood, the fourth crater (since called the "Inferno") displayed a very peculiar form. It had the appearance of an immense cutting through a long hill, and this was actually the method of its formation: the disruptive force having been exerted under the centre of a long spur, had removed the centre of the hill throughout its entire length, and deposited portions of the material on its sides. It was noticeable that in each of the craters already described, the forces had been exerted in the same manner, the crater having been formed in a hill, the material of which had been ejected to a considerable distance on each side. In the most southerly crater the formation was most distinctly shown, as the surface soil was marked by a ragged fringe of dead fern and ti-tree, which extended all round the side from about 10 to 25 feet below the lip of the crater, the ejected material taking the usual outward slope characteristic of volcanic cones. The natural contour of all the land covered in this vicinity, notwithstanding the tremendous forces which had been at work, was very little altered, and in one instance, on a steep slope which faced the westward, the fern and ti-tree was still visible. Still proceeding to the north, the fifth or Black Crater was reached, and this was certainly the most active in the line. After a toilsome ascent, a position was obtained from which the activity could be witnessed with comparative safety. This cone was the highest of all, and far above the level of its edges were thrown immense quantities of stones, mud, and water, the majority of which fell back into the crater, though large masses were flung with a terrible clatter on to the sides, gradually building them to a greater height. Some of the stones launched out fell several hundred yards from the edge, burying themselves in the mud, and sending up volumes of steam. It was now possible to witness the manner in which the stones were buried, both in the mud and in the dry deposit, and to note how greatly reduced was the activity of the geyser action to what its earlier efforts had been.

While traversing the ground between the edge of the deposit and the craters, a large number of circular depressions had been observed, of various sizes, and having the appearance of fumaroles. Some of these were not less than half a mile from the edge of the nearest crater, while as the distance was reduced the number of these holes increased. Finding a place where water and mud had been ejected in sufficient quantity to form a moderate hardness on the surface of the dry deposit, a search was made at the bottom of some of the holes, resulting, after a little excavation, in each case in finding a large stone. Sometimes these had only just penetrated the hard wet crust, and at others had disappeared in the dry deposit which lay below. In one small valley, where an immense deposit of stones had taken place, a rhomboid had been thrown which measured about 4 ft. by 2 ft. 6 in.* This had a raised mass of material round it, showing that it had been thrown, and had not rolled to its situation. During the whole of the time spent on the sides of this crater, a constant tremor of the earth was noticeable, and a heavier discharge than usual of mud and stones was invariably accompanied by a shock, which gave timely warning before the effects were seen above the edge of the crater.

Skirting this active geyser, and ascending the hill called Hape-o-toroa, the former Rotomahana Lake lies before us, sending up a great volume of steam.

This hill, Te Hape-o-toroa, is situated immediately to the south of the Rotomahana crater, and, being the highest land anywhere in the neighbourhood, commands a fine view of all the points of eruption excepting Tarawera and Ruawahia, the flanks of which are occasionally visible through the vast mass of vapour ascending into the upper regions of the air. Its close proximity to the southern edge of the crater—being distant from it only 250 yards—enables the beholder to look down on to the various points of eruption with great advantage, though it must be acknowledged that the constant shocks of earthquake induce a wondering expectation as to whether the steep hillside will not be precipitated into the depths below. Immediately to the

* Subsequent explorations show that several rocks, measuring over 1,000 cubic feet in solid contents, have been ejected in this neighbourhood.

right hand, and at the eastern base of the hill, is the course o the Haumi Stream, which formerly wound its way from Okaro Lake to Rotomahana, joining that lake a little to the south-east of the Pink Terraces. But what a change has occurred here! Directly at the base of the hill is a great fissure, from which issues an enormous mass of steam, whilst every now and then, after a loud report like a cannon shot, it is accompanied by large quantities of stones and sand, shooting up into the air and falling generally back again from whence they came. Immediately in front, between us and the crater lip, is a deep dark hole, sending forth a high column of steam. The edges of the crater are covered with fragments of stone ejected from it.

One looks in vain for any sign of the Pink Terrace: all view in that direction is cut off by the column of steam. The edge of Rotomahana Lake is now far within the crater wall, which follows round from our immediate front in a westerly, then north-westerly, northerly, and north-easterly direction to the site of the White Terrace. The crater has clearly eaten its way back from the edge of the lake, a distance of at least a quarter of a mile from the site of the Pink Terrace; and all along the foot of the wall the steam rises from so many points, that it is impossible for the eye to penetrate within its precincts, except on rare occasions when the wind causes a separation of the masses of vapour; and then is disclosed to view for a short time a cavernous-looking aperture, in which can be discerned a picture once seen never to be forgotten. A dismal coffee-coloured light, penetrating the vast mass of vapour from above, enables us indistinctly to see a horrible mass of seething, boiling waters, stained of a black or dirty brown colour, encircled by walls and hillocks of dreadful-looking hot mud, from which the steam curls up in innumerable places. Mud volcanoes scatter their contents around on all sides, whilst every now and then a loud detonation precedes the discharge of a column of water, mud, and stones high into the air, and as they fall splash the black mud right and left. The whole interior surface of the crater, as far as the eye can penetrate, seems to have been boiled and steamed and hurled about to such an extent that the old landmarks are no longer recognizable. Whilst the greatest activity seems to follow the foot of the crater-wall round by the western side, the eastern has also its points of eruption, from which vast columns of steam arise to join the general mass above; but, as yet, no one has been able to obtain a clear view of this eastern side. The size of this crateral hollow is about $1\frac{1}{2}$ miles in a North and South direction, with a width of about $1\frac{1}{4}$ miles.

From a point which was reached with great difficulty on the west side of the crater, a view is obtained looking north-east, past the site of the White Terraces, and embracing the whole of

Tarawera Mountain. The deep sand in this direction makes progression most slow and fatiguing, and not without danger from the slips of sand on the steep hill sides. We looked in vain for any sign of the White Terraces; and as the eye gradually got to recognize some of the more prominent features of the country near there, under their altered shapes and appearance, the conclusion was forced on us that these beautiful terraces—the most lovely and wonderful of their kind on the whole earth—had disappeared for ever from mortal view. The changes in the general appearance of the country near there are so great, that, even with a familiar knowledge of the locality, which had been impressed on the mind in a visit to the same spot on which we now stood only three short months before, we recognized with great difficulty and uncertainty the main features of the land. But, still, the evidence of the whole contour of the country goes to show that the site of the terraces is now occupied by a horseshoe-shaped recess or bay in the general line of the main crater, from which an enormous column of steam arises high into the air. Nearer to us than this recess could be seen a gentle declivity, forming a very shallow valley, in which once ran the Kaiwaka Stream, the former outlet to Lake Rotomahana. This once deep gully is now nearly filled to its top with ejected matter, to a depth of 80 feet, of stone, sand, and mud. All around this part of the crater edge the ground was cracked and fissured by earthquakes, and by the torrents of water ejected from the crater. Lying immediately to the west of it was a large deposit of mud, which extended some way up the range that divides Rotomahana from the Wairoa Stream, and on its surface were occasional pools of water, the remains of deluges cast out from the crater.

From this same spot a good view of the whole of the south end and top of Tarawera is obtained. The eye is immediately attracted by the altered appearance of the south-west end of the mountain. Here a great rift—an enormous chasm—extends from the plateau-like top to the base of the mountain, ending (apparently) quite close to the site of the former Rotomakariri Lake. Various estimates have been formed of the dimensions of this great rift, and we believe that we are quite within the mark in stating it to be over a mile long, 500 feet wide, and 500 feet deep. No one, up to the present time, has been able to see the actual bottom of it.* Out of this chasm rise, at several points, columns of dense black or brown smoke, not continuously, but intermittently; but no sign of any ejection of solid material was visible at the time. The edges were quite sharp and ragged,

* Subsequent exploration proves that this fissure extends right down to Rotomahana, a distance of over two miles; and within it, just at the foot of Tarawera, the new Lake Rotomakariri has been formed.

as if the solid rock had been ripped open by the enormous force of imprisoned steam; and in its upper part the ashes, rocks, and the ground generally for a long distance on either side, were coloured a yellowish-green, due no doubt to some of the products of volcanic action—such as ferric chloride. The slopes of the mountain around were covered deeply by ashes and stones, and near the base of it steam escaped from several cracks. As we sat on the surface of the sand observing the chasm through the glass, frequent shocks of earthquake caused cracks to open near the rift, and steam was seen to escape in little jets, ceasing, however, soon afterwards, as the cracks closed in or the loose materials fell into and stopped the vents. The southern end of the rift seems to be continued as a hollow right into the site of Rotomakariri, which is now occupied by a crater, from which rises a vast column of steam and occasionally smoke; indeed, this part seems to be one of the most active craters of the whole series. Mr. Morgan, who approached this side of the crater from Galatea on the night of the 14th, states that he saw a great glare as of fire, and a large mass of smoke issuing therefrom.

During the time we were in the district the weather was most beautifully clear, with a light south-west wind; and this allowed of a careful study through the glass of the heights of Wahanga, Ruawahia, and Tarawera, as seen from various points. That great changes have taken place in the two latter is obvious to any one who knew their former shapes and appearance. In 1874 we made the ascent of Ruawahia on three occasions, starting from near the outlet of Lake Tarawera, and are thus able to give some description of the range prior to the eruption. All those who have visited the Lake District are familiar with this range, which rises out of the lake on its eastern shore by gradual easy slopes, until near the summit, where a wall-like mass of trachytic or rhyolitic rocks marks the division between its plateau-like top and the gentler slopes below. From the northern end of Wahanga to the southern end of Tarawera is a distance of about three miles, whilst the plateau has a width of perhaps a mile, broken at one mile from the north end by a deep saddle, dividing Wahanga from Ruawahia. The surface of the plateau was covered by immense masses of broken trachytic rocks, which looked as if they had been shivered and fractured by the action of the frost into long angular blocks of various sizes. Running in all directions were depressions or crevices dividing the surface into hummocks, and making travelling very difficult; whilst occasionally a hillock formed of the piled up masses of loose rock rose above the general surface. No sign of any crater was seen, though the rocks are all undoubtedly due to volcanic action. Possibly in this range we see an illustration of one of those great masses of ejected lava described by

Judd, which, issuing from a vent or vents below in a viscid state, swell up in a somewhat rounded mass without forming a crater. Of this description is the well-known Grand Puy of Sarcouci, in France, and numbers of others in various parts of the world. The cracked and fissured surface of these mountains would then be accounted for by cooling from a state of considerable tension.

That a great change has taken place in the mountain top is obvious. The glass shows clearly that Ruawahia and Tarawera (both of these names being on the same plateau—the latter being the name of the southern end,) have been apparently rent along their whole length, and some of the little peaks along this rent appear to be the result of solid materials ejected from below, and built up by stratified layers of scoria or stone having the outward dip common to volcanoes. Smoke was rising from several points for a distance of a mile and a half, but not in any great quantity, though occasionally it increased in volume, sending a dark black cloud high into the air. The surface of the ground on top was coloured a yellowish-green for many acres, denoting the presence probably of ferric chloride, whilst all the original fissures appeared to have been filled up to one general slope by the materials ejected. It is as yet premature to make any definite statement as to whether the mountain is higher than it formerly was—namely, 3,606 feet; but it certainly has that appearance, and the evidence of sketches and photographs tends in the same direction. We believe that when the mountain can be approached sufficiently near it will be found that a true crater has been formed on the north-east side of it.*

In general appearance Wahanga seems to have altered, but not to so great a degree as Ruawahia. Smoke issues in smaller quantities from several places on its summit, but principally from the highest point. It also is covered with a mantle of ashes and stone ejected from one of the vents.†

Dr. Hector, in his report‡ on the eruption, has given some slight weight to the significance of these three names as bearing on the question of former activity, of which, however, no tradition exists among the Maoris; but we think no value can be attached to this argument when it is known that each name has another interpretation; and we cannot think that the obvious

* The height of Ruawabia since obtained is 3,770 feet, showing an increase in height of about 170 feet. This is caused by the black and red vesicular scoria piled along the edges of the great fissure.

† The great fissure is found to extend along the eastern face of Wahanga nearly to its northern end, and in it are two deep craters, one of them being the deepest of any along the whole line.

‡ "Preliminary Report on the Volcanic Eruptions at Tarawera on 10th June," dated 23rd June. Appendix, Jour. H. of R., 1886.

signs of great age in the trachytic lavas of which the mountains are formed will allow of our placing the time of its former (latest) activity within the historical or traditional period, a time extending back for not more than five hundred years.

Many will remember the fine forest that occupied the western slopes of Ruawahia, reaching down nearly to the lake margin. Nothing is left but a number of stumps and branchless trees, many of them burning, and adding by their weird appearance to the general desolate look of the country. The clumps of trees which adorned the south-eastern slope of Tarawera have almost wholly disappeared, being covered up by the deposits which buried the little Maori village in which poor Brown and his Maori friends lie buried. A few charred and blackened stumps are alone left to denote the spot.

The changes in the contour of the country around the base of Tarawera and Rotomahana are most remarkable, and bear witness to the vast amount of matter which has been ejected. Messrs. Harrow and Edwards, who formed part of the boating party which crossed Lake Tarawera to search for Te Ariki village, where it was known a large number of Maoris lay buried, tell us that in many places the shore of the lake near the old landing-place on the route to Rotomahana is so altered by the conversion of part of the lake into dry land that localities cannot be recognized. They furnish an instructive section of the ejecta, as seen in the bed of a torrent cut through it since the 10th June:—

	Ft.	in.
On the bottom were large stones... ...	0	0
Ashes and mud	3	0
Scoriæ (still hot on the 15th)	1	0
Ashes and sand	15	0
Mud, forming the surface	4	0

This gives a depth of 23 feet in that particular locality, but it is evidently much deeper in others. On the slopes of Te Hape-o-toroa, we can state positively that in one place 25 feet of matter has been deposited, the topmost layers being fine and coarse sand mixed with small fragments of stone and sinter; and this deposit was quite hot on the sixth day after the eruption at a depth of 4 or 5 feet. The vast number of small fragments of siliceous sinter scattered over the country west and south-west of Rotomahana, points to the destruction of the terraces, of which materials they were mainly formed.

The Steam Cloud.

Riding home, weary and covered with mud, we halted to gaze upon one of the most glorious sights man could view. We stood in a light-timbered grove just outside the belt of the ash-covered plain, the setting sun at our back. Away and away in our front for miles lay the scene that not long since looked like snow, but now, reflected on it, the rays of the setting sun gave it the aspect of red coral. But, above all, there rose in solemn grandeur the towering mass of steam—thousands upon thousands of feet it ascended, until its crown was lost in the bright, fleecy clouds that came rolling up from the south. Bright, aye bright with the full effulgence of the orb which was still high above the horizon there; but lower, the dazzling brightness waned, and a faint glint of a golden hue was seen, to be rivalled by the richer colours and deeper gold of the nether parts until they deepened and sank through rose to carmine, and deeper hues suffused the base and the far-reaching crimson plain, while the deep greens of the bush in which we stood made up a picture difficult to equal, impossible to excel. And thus from earth to sky rolled the ever-changing mass of steam, rent at the base with the uprush of countless geysers, imparting to it changing and varying tints, beautiful and transient; but above, calm, solemn, and gorgeous, and apparently immovable. Slowly the deeper tints crept up, and left the base white and beautiful in the light of the bright full moon, while the crown still reflected the deep soft tints of a sun which had long since set with us.

Appearance of the Road to the Wairoa.

The appearance of the district, after having entered upon that portion upon which the deposit of mud has fallen, is sombre in the extreme. The view all round is the same: the neutral grey of the wet mud is spread as a pall over the earth. The contour of the ground is not altered, only the steeper angles are rounded off, the smaller gullies and hollows filled up by the all-pervading mud. Locomotion is naturally retarded, the track having from 4 to 6 inches deep of the plastic mass. Proceeding in the direction of the Wairoa, we reach the Tikitapu Bush, so famed for its beauty of tree and fern. Now, all verdure is gone, trees and shrubs are alike stripped of their leaves, and the bark no longer shows its natural and varied hues, but is encased with the all-pervading grey. Only in some hollow of a larger tree on the sheltered side may be seen a few scattered leaves of some close-clinging creeper, or the hardy leaves of the *tataramoa*, bespattered with mud. Advancing into the bush, we soon came upon more striking effects than that wrought by the fall of the deposit. Trees are lying uprooted, increasing in number as we reach the Tikitapu Lake. Advancing along the road, we find them lying parallel with it in nearly every instance. It runs in a nearly straight line in a S.E. direction, bearing directly to Rotomahana. In one short stretch, near the lake, twenty trees were counted lying near to and on either side of the road, and in only one instance was it necessary to make a detour, on account of a tree which had fallen *across* the road. This remarkable effect of the storm was only noticeable in the bottom of the valley through which the road ran, as on either side on the hills the trees seemed to have been blown irregularly, and in different directions.

To account for the regular disposition of the trees is not difficult, when we remember that the evidence of the survivors at the Wairoa shows that during the precipitation of the mud a terrible storm was blowing in their direction, from the direction of the valleys which lead down to the village from S.E. of W. This wind would find its easiest passage through the bush up the road which ran in the same direction in which it was travelling, until the pressure became so great that the tall trees abutting on the road, being unable to bear it, were precipitated in the same plane. Further evidence as to this as a cause is the precipitation of the mud on the trunks of the trees still left standing, but only on the S.E. side; while what few leaves of creepers are still left clinging to the trees are only noticeable on the N.W.

Advancing towards the Rotokakahi Lake, the mud deposits on the hill sides appear to be more liquid, and have run together, giving the hills a striped appearance. The steeper angle, and rocky nature of the ground admitting less absorption of the watery matter, is no doubt the cause of this, and will have a serious effect in regard to the future stability of the deposit. In the valley of the Wairoa the deposit is much deeper, and where it has drifted up against fences or trees must be from 5 to 7 feet in depth. At the time of our visit, however, Mr. Macrae's waggon was being dug out from where it had been buried while standing on the road, and there the depth from the surface of the deposit to the top of the old road was 2ft. 8in. Through this deposit were mixed fragments and masses of rock, much of it being scoria; while in some of the roofs of the houses were clearly discernible the holes which had been caused by the force with which these stones had descended. In one instance, we removed a stone which was still imbedded in the hole it had produced. Here, again, the deposit piled on the sides of houses, fences, and trees showed that the material must have been carried with great force in a northerly direction. (On the edge of the deposit in the direction of Ohinemutu it was interesting to note the effect of the mud and stones which had been precipitated on the vegetation, notably on the strong leaves of the *tupaki*, growing abundantly on the sides of the road. At first the leaves were only bespattered with mud, further on they were perforated by the small stones, still further on the fleshy portion had been beaten out, leaving only the midrib, while beyond this not a vestige of a leaf had been left on any of the bushes.) The bed of the Wairoa Stream was filled with mud, and its exit from Rotokakahi so raised as to prevent the outflow of water. The water of all the lakes was grey and turbid, from the semi-liquid mud which had been precipitated into them. On the shore of the Tikitapu Lake was a thin liquid rim of what appeared to be gravel, but which on closer inspection proved to be small fragments of scoria and a few quartz crystals, washed from the mud deposit by the waves caused by the storm. Already the mud had begun to descend the steeper mountain sides in avalanches, with loud rattling noises.

The Material composing the Ejected Matter.

Having viewed the deposition of the material, we will now consider its structure and composition.

We have, first, the dry ash laid in the vicinity of Rotomahana (south side), and extending in a gradually reducing thickness to Galatea. Then the mud precipitated over the Wairoa, Rotoiti, Okareka, and Okataina. The dry ash carried in the shape of fine powder over Tauranga, and as coarse sand at Whakatane and Opotiki. Then we have a secondary coating of mud overlying the dry ash in the immediate vicinity of the geysers at Rotomahana, and the varying degrees of fineness of the ash deposited at long distances—notably at Whakatane, where a coarse sand fell for the first few hours, followed by a very fine dust for some hours afterwards. The same circumstance, but in a less conspicuous degree, was noted at Tauranga. In the order as arranged, we find the mud to be chiefly composed of quartz, in the form of fragmentary rock crystal; and as sinter, both white and coloured pink by peroxide of iron; together with a large amount of volcanic scoria in fine fragments, and exceedingly vesicular. This fragmentary scoria we shall find to be in very different proportion as we proceed, and the greatest interest will be felt in this fact, together with its bearing on the future fertility of the soil on which it has fallen, or will itself have replaced. We have not, however, found pumice to any large extent. In some of the older fragmentary rocks isolated patches were attached, but the fine deposits are singularly free from it.*

In addition to these varieties of ash, we have also the solid portions of stone which have fallen, not merely in the vicinity, but also at long distances from the scenes of eruption. The materials thrown out vary considerably. In the immediate neighbourhood of the craters are to be found stones from a few ounces to over a ton in weight.† These vary considerably in

* Some few specimens of newly-formed pumice were afterwards found scattered over the ash-fields, but the quantity is so small as to escape any but the most careful search.

† Some have since been found which would weigh nearly 10 tons.

formation, but are all portions of the rhyolitic rocks adjacent—a fine-grained tuff and coarse-grained brecciated trachytic rocks being plentiful. In the Wairoa, however, we find both scoria and the cross-grained trachyte just alluded to; while on the eastern end the principal solid material is composed of a basic scoria, in the form of lapilli. Returning now to the examination of the mud and ash, we find that the deposits at Okaro, Wairoa, Tikitapu, and Tauranga are very similar in appearance, being composed very largely of silica, both in the glassy solid crystalline form and as sinter; together with a small but varying proportion of scoria. Coming next to the deposit at Matata and Whakatane, we find the silica in the same forms, but the scoria has increased considerably in proportion. Advancing still further eastward to Opotiki, we find the same characteristics, but the scoria has still further increased in its proportion to the uncombined silica.* Now, if we turn to the analysis we have made of the materials obtained from the places mentioned, we find that they bear out the results of our optical examination. Clearly the ash from Okaro, Wairoa, and Tauranga are of the acidic group, while those from Whakatane and Opotiki are more nearly approaching the basic form. Again, the scoria obtained from Wairoa, and also from the southern end of the eruption, are undoubtedly basic, and have been thrown out in exceedingly large quantities, viewed from the amount and composition of the eastern deposits. Now, hitherto we have had the whole of the rocks of this region placed in the acidic group, and certainly no large mountain masses of a basaltic character could well escape the practised eyes of Von Hochstetter, or the members of the Geological Staff of our Colony. We are therefore forced to the conclusion that large quantities of basaltic scoria were ejected from the Tarawera volcano, or mountain, at the earlier stages of the eruption on the morning of the 10th of June. This is fully borne out by the numerous eye-witnesses, who unanimously speak of columns of fire rushing up from the newly-formed craters, and masses of fire bursting and falling back and around the sides of the mountain. That there was no outflow of molten lava actually discernible after the night in question is accountable by the enormous rush of high-pressure steam carrying off the molten mass in a fine state into the air, where it was carried away by the strong south-west wind which had now commenced to blow, or by being covered up by subsequent deposit of ashes.

We see from the foregoing that we have had two distinct eruptions, the one hydrothermal, the other volcanic, throwing

* The deposit found on the shores of Rotoiti contains large quantities of fine scoria, and as the mountains are approached this increases in quantity and the size of particles, until, on the top of Ruawahia, scarcely anything else is found.

out differently rocks, acidic and basic, the physical characters of these rocks being as different as their chemical composition. Thrown to a great height, they were caught by the wind-storm and borne along by it in parallel lines from whence they emanated, the acidic to the westward and the basic to the eastward, more or less admixed in the centre, but slightly commingled on the extreme outer edge of the line. In this order they advanced, and in this order were precipitated on the lands over which they passed. Coarse sand, finer particles, dust: thus it was laid, in the order most to be desired by the agriculturist. So fine, indeed, is a large portion of the deposit, that the elements of nutrition in it are available for vegetation almost as soon as the first rains have carried it into the soil; while the particles not so exceedingly fine are already being attacked by that wonderful disintegrator, carbonic acid. For a moment let us glance at the basaltic lava cones in the vicinity of Auckland; and here we find the richest land, capable of growing extensive crops. The more decomposed, the finer the particles, the greater the amount of disintegration: the richer the ground, the greater the profusion of the elements of fertility. And this is the material which has been so lavishly spread over the land on the eastern portion of the district, and which is so largely intermixed with the acidic matter which has fallen over the western. That this rock in its unbroken, undecomposed form, is nearly valueless for plant life we can learn, by turning to the basaltic floes and cinder deposits of Rangitoto; but even there, in the few gullies where rain has washed the dust, and given depth of friable soil for plants to live in, where will we see a richer profusion of vegetation? The result of this downpour over so large an area need not dismay us, but rather give cause for rejoicing that, in the majority of instances, a richer soil has been added than formerly existed; and so lightly and finely has it fallen, that the winter rains will not have passed before it will have been washed into the soil to invigorate the new vegetation and improve the pastures, except in close proximity to the scene of the eruption. Even here we have shown that these deposits are capable of supporting vegetation.

Probable Cause of the Eruption.

To hazard a theory for so stupendous a cataclysm without first obtaining the most complete data on which to build, would appear reckless and unscientific; but the amount of data already accumulated, and the certainty that many months must elapse before a complete investigation of Tarawera and Rotomahana can be made, prompts us to advance a theory based on known laws, the working of which has been a source of wonder and attraction, and of world-wide interest, centring in Rotomahana. Here, as we are well aware, rose the beautiful terraces of Te

Tarata and Otukapuarangi; here also were geysers, ngawhas, mud-springs, steam-holes, solfataras and fumaroles, each and all pouring out in larger or smaller quantities its volume of heated water until the lake itself was fully deserving of its name, "Rotomahana," (warm lake,) and its effluent Kaiwaka was worthy of a similar distinction. Now, the body of water debouching from this lake was large and continuous, and many millions of gallons were daily discharged into the Tarawera Lake. If now we turn to Rotomahana, and witness the effects of these hot springs and geysers, we find an amount of sinter deposited which is surprising, for though we have been used to speak of the two terraces, there were several others in a state of decadence or fragmentary condition, while lavishly around us were the evidences of sinter deposit. Year after year, probably for centuries, had this deposition gone on, though only a tithe of the silica which rose in solution had been arrested. Fortunately these waters have been analysed, the results of Mr. Skey's examination showing the water from the White Terrace to be charged with mineral matter to the extent of 144 grains to the gallon, and from the Pink Terrace 154 grains. Accepting this as equal for all the springs so constantly at work, we shall have in the course of years a very large amount of rock material withdrawn from the earth, most probably leaving cavernous spaces, and a weakening of the earth's crust locally. It required then only some local disturbance of the earth's crust to precipitate the falling-in of these spaces, which would have occurred sooner or later without such disturbance.

There can be no question that the first outbreak came from the Tarawera Mountain, caused probably by some slow-moving earth-wave, evidences of which we have already adduced. This in itself was sufficient to cause a precipitation of the weakened honeycombed rocks through which the waters of the Rotomakariri Lake would make their way into the chasm, and, coming into contact with a large surface of the molten rock, would be followed by a terrible convulsion, the escaping steam ripping up the side of the mountain in the manner already described. Water rushed down on the heated rocks only to be driven back and dissipated into the surrounding space, together with the fragmentary matter and dust resulting from the shock. The water from the Rotomahana Lake would then be driven up, together with the steam and debritic mass, to fall over long distances in the form of mud, as we now see it, until the water had been repelled from the lake, and with it the solid material of its bed. By this action the bed of the lake has been lowered, and its sides greatly extended, while there can be but little doubt that the whole of the terrace formation has been swept away.

That the long dormant mass of molten lava underlying it extended no further, is very questionable, and the evidences of the further extension in a S.W. direction are shown by the length of the rift extending to Rotomahana, thence by its entire length, and finally proceeding in the direction of Okaro Lake for a mile and a half. Here we find its effects very violent, the active craters already described not being built up, but blown directly out of the rhyolitic rock.

But all speculations of this kind are premature, in view of the paucity of information with regard to the present state of the interior of the lake crater. We merely bring them forward to incite inquiry, and thereby arrive at the whole truth of the questions involved.

We cannot close without a tribute to the memory of the dead. That this disaster should have had so fatal a result is a matter of great sorrow. Awoke by the roaring of subterranean thunder, by repeated shocks of the moving earth, awed by the fearful scenes of fire and lightning, apparently emitted by a mountain close in their vicinity, with hope of escape cut off, and the despair and uncertainty of unknown and unexperienced terrors, not less than 102 of the poor Natives must have gazed in fear; until with a terrible roar the lake beside them was belched out to cover and obliterate them, their villages and lands, and leave no trace of what had been their homes and cultivations for many years.

Nor can we think without deep regret that some of those Europeans at Wairoa who had viewed the grandeur of this wonderful outburst for hours, from apparently so safe a position, should have succumbed to the storm which raged so soon afterwards. Long, indeed, will it be before the name of Wairoa will be forgotten, or the memory of this beautiful valley, which was transformed into a mournful desert in a few hours.

Analyses of Volcanic Ash and Lapilli from the Tarawera Eruption.

By J. A. Pond, Colonial Analyst, Auckland District.

	Dust Ash or Mud.					Lapilli.		
	1. Okaro.	2. Wairoa.	3. Tauranga.	4. Whakatane.	5. Opotiki.	6. Wairoa.	7. Pareheru.	8. Rotoehu.
Soluble on heating in hydrochloric acid and water, equal quantities—								
Silica	·35	·20	·35	·65	·60	·50	·70	·50
Iron Oxides	2·05	2·50	3·00	2·90	3·20	3·90	3·85	3·50
Alumina	3·45	2·80	5·01	4·45	3·90	3·70	4·95	6·60
Lime	·95	·67	2·01	1·92	2·10	1·79	2·14	2·65
Magnesia	·20	·30	·30	·47	·80	·67	·45	·70
Soda	·33	·37	·58	·64	·59	·70	·84	·67
Potash	·16	·19	·18	·17	·17	·14	·16	·09
Chlorine	·05	·07	·03	·04	·06	·04	·05	—
Phosphoric Acid ..	·09	·09	·14	·095	·125	·16	·125	·06
Sulphuric Acid ..	·39	·32	·48	·35	·30	·22	·41	—
Carbonic Oxide ..	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.	Tr.
Organic Matter ..	1·30	1·30	·90	·20	·25	—	—	—
Water	·85	·90	·75	30	·15	—	·25	—
Insoluble in acid—								
Silica	66·50	69·90	63·65	56·50	55·70	50·4	50·65	52·10
Iron Oxides	4·60	2·65	4·20	8·65	8·30	10·20	10·65	9·20
Alumina	14·50	13·15	13·15	13·90	13·80	16·30	13·25	11·70
Lime	2·90	1·93	3·41	6·44	6·35	8·59	8·12	8·40
Magnesia	Tr.	Tr.	1·60	·90	1·40	2·10	2·65	3·95
	97·07	97·34	99·74	98·57	97·795	99·415	99·245	100·12

ANALYSES OF VOLCANIC ASH AND LAPILLI FROM THE TARAWERA ERUPTION.

Analysis made by J. A. POND, Colonial Analyst, Auckland District.

Form.	Locality.	Silica.	Iron Oxide.	Alumina.	Lime.	Magnesia.	Soda.	Potash.	Chlorine.	Phosphoric Acid.	Sulphuric Acid.	Organic Matter.	Water.	Total.
Ash	1. Okaro	66·85	6·05	17·95	3·85	·20	·33	·16	·05	·09	·39	1·30	·85	97·07
Mud	2. Wairoa.. ..	70·10	5·15	15·95	2·60	·30	·37	·19	·07	·09	·32	1·30	·90	97·34
Dust	3. Tauranga ..	64·00	7·20	18·16	5·42	1·90	·58	·18	·03	·14	·48	·90	·75	99·74
Ash	4. Whakatane ..	57·15	11·55	18·35	8·36	1·37	·64	·17	·04	·095	·35	·20	·30	98·57
,, ...	5. Opotiki ..	56·30	11·50	17·70	8·45	2·20	·59	·17	·06	·125	·30	·25	·15	97·795
Lapilli	6. Wairoa ..	50·90	14·10	20·00	10·38	2·77	·70	·14	·04	·16	·22	—	—	99·415
,, ...	7. Pareheru ..	51·35	14·50	18·20	10·26	3·10	·84	·16	·05	·125	·41	—	·25	99·245
,, ...	8. Rotoehu ..	52·60	12·70	18·30	11·05	4·65	·67	·09	—	·06	—	—	—	100·12

Art. XLV.—*Notes on the Eruption of Tarawera Mountain and Rotomahana, 10th June, 1886, as seen from Taheke, Lake Rotoiti.*

By Major W. G. Mair.

[*Read before the Auckland Institute, 26th July, 1886.*]

During the first week in June the weather was stormy, the wind being N.E. to N.W. and W., with a moderate rainfall. On the 6th of the month the wind changed to South, and clear cold weather set in. This continued to the morning of the 9th, when the wind hauled back to West, blowing a stiff breeze, with a cloudy sky. In the afternoon there were several sharp rain-squalls, but the night set in fine, the moon being just in her first quarter; and an occultation of Mars, which occurred about 9 o'clock, was clearly seen. The wind at this time was light. At about a quarter past 1 o'clock on the morning of the 10th I was awakened by an earthquake. This was followed in a minute or so by a much heavier shock, which aroused everyone in the place; and then there succeeded, at intervals of about 50 secs., a succession of vibrations, varying in character, some being uniform undulatory movements, others sharp and irregular; while some resembled the striking of heavy blows upwards. This state of things continued for half-an-hour. About 1.45 I was startled by a steady roar, like that produced by a blast-furnace, or a great waterfall. A friend in an adjoining room called to me to look out of my window. My room was on the east side of the house; and upon looking out I saw that all that side of the heavens was aglow, and there seemed to be a great column of fire rising to a height of about 15 to 20 degrees, while above it was a dense column of black smoke. Masses of solid matter appeared to be hurled up, amid showers of both ascending and descending sparks. At the same time there was a marvellous electrical display, all the ordinary forms of lightning were there playing, as it were, through the flame, the white light showing conspicuously against the red. Over and on either side of this there constantly flashed rounded masses of dazzling white light, as if caused by the explosion of bombs, and bayonets of sparks, which crackled like fireworks. My first impression was that there was an eruption of the Tikitiri Springs, 2½ miles distant; but upon ascending a hill I made out the Whakapoungakau Range in the foreground, the trees on its summit being distinctly visible; and then I made out that the seat of action was Wahanga, the northernmost peak of Tarawera Mountain, some 13 or 14 miles distant. There was very little tremor of the earth at this stage. I went down to the lake shore, but could not detect any disturbance there. A gentle breeze was blowing from S.W., and in that direction the sky was perfectly clear. Later on the roar became louder, with crashing reports, as of heavy bodies falling; the thunder, too, increased, and the lightning was, if possible, more active. The shocks, too, were renewed with great vigour. At this time a dense black column rose on the right of the blaze — that is, more to the South, and in the direction of Rotomahana, and spread out in the sky. Soon after 3 o'clock the wind shifted to the South-east, and the black cloud was driven slowly in on the light, dropping over it like a veil, and by degrees blotting it out. For a time the lightning flashed through the murky mass, and then there came on the most utter and appalling darkness. The roar of the volcano could still be heard, and occasional tremendous peals of thunder; but these gradually died away. About 4 o'clock there was a pattering of light cinders on the roof, and a sulphurous smell was apparent. Upon going outside I found the air charged with fine dust, which was painful to the eyes. The night was intensely cold, and I went back to my room and slept for some time. On awaking I opened my window, and found the sill covered with a fine sandy mud. Some Maoris then, by the aid of lanterns, found their way to the house, and reported that their huts were being buried, and they feared that the roofs would fall in. At 8 o'clock there was still the most intense darkness, and no sound could be heard except an occasional rumble like thunder. The soft ooze was falling silently as snow, and covering everything up. At 9.30 there appeared a faint gleam of greenish light, low down in the South, and the wind having veered again to that quarter, the fall of sand gradually became less, and ceased altogether at 11 o'clock. By noon one could read a newspaper in the open air, but the position of the sun could not be made out until 2 o'clock. Throughout the day there were occasional tremors of the earth, and thunder and lightning in the East. All along the ridge of Tarawera immense masses of dark smoke were being belched forth, while to the right a great column of steam arose, and further south a smaller one. All round Rotoiti everything was covered with the grey volcanic deposit. In some places it was in drifts of 18 inches deep, and nowhere was it less than 3 inches. The fern and light shrubs in the open country were levelled with the ground, and in the woods every leaf and spray was covered. The telegraph wires were coated, and looked like ropes an inch thick. Numbers of straight dead tree-trunks were burning like great torches. The lake had become a soapy-white colour, and had risen 3 or 4 inches, the water being unfit for domestic use.

On the 11th and 12th of June there was a hard cutting south wind, bitterly cold. Light shocks were felt. Great numbers of koura, and myriads of the small fish found in these lakes, were washed on shore dead or dying; many of the fish, though not dead, presented a bruised and discoloured appearance. All the small birds had disappeared; pheasants and Australian quail came almost to the doors of the houses seeking food, and numbers of rats were wandering about the hills and valleys.

There is no tradition of any activity in Tarawera Mountain, nor of any alteration in Rotomahana. The mountain was in past ages the chief burial place of the Ngatirangitihi tribe, the section of the Arawa to whom the country about the east end of Tarawera Lake belongs. Apumoana, the eldest son of Rangitihi, the great ancestor of all the Arawa tribes, who lived about fifteen generations ago, was buried in a cave on the rim of a crater there. It has been said, I believe, that the names of the different peaks of the mountain suggested some volcanic activity during the period of Maori history. I cannot see the connection myself; but, in any case, Maori names of places do not necessarily point to the literal meaning of the name. For instance, the name Rangitoto—literally, *sky of blood*—is thought by some people to denote that the Island of that name near Auckland was in a state of volcanic activity when the ancestors of the Maori came from Hawaiiki. But the word "rangitoto" also means "scoria" or "cinder," and there are several places in the North Island so called where there is no scoria or cinders. Where the meaning is not palpable, great caution and research should be exercised in tracing the reasons for the names of places and things, or one may commit a great blunder. For instance, the author of the "Aryan Maori" considers that the moa (*Dinornis*) was so named from moana (the ocean), on account of its vast size; but he would hardly have ventured that opinion if he had known that in the Samoan Group "moa" is the name of the domestic hen.

Art. XLVI.—*Thermal Activity in the Ruapehu Crater.*

By L. Cussen.

[*Read before the Auckland Institute, 26th July, 1886.*]

During my last season's work in the triangulation of the King Country I had occasion to ascend Ruapehu, to include a trig.-station on Paretetaitonga, one of its southern peaks, with our system of triangles. It was not my intention to attempt a geological examination of the mountain; but the few notes which I was able to make in the short time I could devote to the subject will be of interest, chiefly as disclosing the fact that the volcanic forces considered to be long since spent on Ruapehu are still active, in at least so far as the solfatara stage is concerned.

It was not until the 9th April that the snow on the lower slopes of the mountain, where it is usually too soft to walk over, had sufficiently melted off to allow of an ascent. We made a start on the 9th, following up the valley of the Whakapapa River for some three miles to an open plain at the foot of the mountain, covered with native blue-grass (*Patiti*) and tussock; here we left our horses, and travelled on on foot for about four and a-half hours, crossing over lava ridges and deep ravines in a southerly direction, to reach a long prominent ridge which ran down in a tolerably regular line from the top of the cone to its base. Finding a convenient camping-ground in a deep ravine, where a small tongue of the stunted bush which covers the lower western slopes of the mountain runs up into the gorge, we camped for the night to await the first opportunity of clear weather for our ascent. The next morning a thick heavy fog hung over the mountain, and came down throughout the day in a drizzling rain, which, however, cleared up towards evening, and there was a hard frost during the night. The morning was beautifully clear, with a cloudless sky. We left our camp while the stars were yet bright, as we had 4,000 feet to ascend, our camp being about 5,000 feet above the level of the sea, and very nearly at the limits of vegetation. For about an hour and a half we followed up the gorge, shut in on both sides by high precipitous rocks and ridges of lava, over which it was difficult to get a passage. At the head of the gorge, however, we found a practicable passage, and reached the back of the spur we had selected for our ascent just as day was dawning.

The scene was indeed a magnificent one, as the first rays of the sun lit up the snowy peaks towering high above us, and gradually shone over the snow-fields and great dark ridges and gorges of the mountain. All around us were examples, most varied and instructive, of volcanic phenomena, and the forms and shapes assumed by the cooling lava. The ridge on which we stood was probably built up by the most recent eruptions from the mountain, formed of alternate sheets of lava and layers of ashes; at its base were immense masses of jagged scoria rocks, piled up in irregular heaps and presenting most grotesque shapes and forms. To the south of the ridge, and running down from under the snow, was a well-defined stream of lava, embracing in its course large blocks of half-molten rocks, around which the lava stream had cooled, giving them the appearance of stones standing in a river current. At the base of this flow was a most beautiful example of the columnar form assumed by cooling lava. A large mass of the cooling metal would seem to have become detached, and rolled down the mountain side in a separate mass, or boulder, from 70 to 100 feet in height; the outside of it presents a slaggy scoria-like appearance, becoming gradually closer and more compressed towards the centre. One side of this boulder has been broken away, probably from the masses of rock moving down the mountain side coming in contact with it, and thus the construction of the interior is exposed. It presents a most remarkable appearance, a number of long prismatic columns, about 9 inches in diameter, extend outward, radiating from a central point at the bottom to the top and sides in a fan-like fashion, somewhat in the form of a peacock's tail, fitting closely together at the centre, the space between them widening towards the outside; they are intersected by transverse cracks, which divide them into various lengths; some of them can be moved and replaced; though being of various lengths the regularity and symmetry of the portion exposed is very striking and wonderful. About half a mile to the northward of the ridge we were ascending, another lava stream appeared to have cooled running down over the ridge, and to dip down on the lower side of it in the same direction as the slope of the underlying rock, giving to the lava-flow the appearance of a waterfall in the distance, at the foot of which great masses of scoria were piled on top of one another in a confused irregular fashion. The effect of frost upon the rocks became more apparent as we went higher up the mountain; masses of trachytic lava lay in heaps and ridges, broken up into fragments as if struck by sledge-hammers; the travelling was difficult, and sometimes accompanied by danger, over these masses, which would give way beneath the hands and feet, and roll down in large quantities.

We reached the perpetual snow-line in about three hours from our camping ground. There was yet about 2,500 feet to ascend, but the remainder of the ascent was all over the frozen snow, and not very difficult. The ridge was rather narrow in places, whilst on both sides of it steep snow-fields sloped away many hundreds of feet, terminating over the rocky precipices which girt the base of the mountain. Our party were five in number, and we travelled over the snow in "single file," a long rope fast from one to the other to guard against accident, lest either through a caving-in of the snow or by a false step any of us should slide down over the steep snow-fields. It took five hours from our camping-ground to reach the summit.

The weather was still beautifully clear when we got on top, and the view in all directions around us was truly magnificent. To the westward, the snowy cone of Mount Egmont was very conspicuously prominent, its distance from us being 73 miles. We thought we could distinguish the houses at Waitara with our telescopes; and some of our party suggested that a column of smoke which we saw rising up there came from the chimney of the Auckland Freezing Company's establishment. The sea was visible beyond the east and west coasts, and all the successive mountain ranges and river valleys in both directions could be traced out with our telescopes. The rugged peaks of the Kaimanawa Mountains, extending for many miles away to the eastward, looked rather insignificant beneath us, although their height varies from 4,000 to 6,000 feet above the sea. The crater of Ngauruhoe, nine miles to the north of us, looked like the dilapidated chimney of some vast furnace down into which we were looking. Taupo Lake, which I have seen described as "a vast inland sea," as seen from some of these mountains, looked quite small from our great height. The distant peaks of Pirongia, Te Aroha, and other prominent features of the Lower Waikato District looked but a short distance away from us, considering they were over 120 miles off; and as all our party hailed from that direction, each took pleasure in recognizing the familiar landmarks which surrounded his own home, and which he had not seen for many months past. The comparatively low country lying between us and the west coast, though intersected by deep valleys and mountain ridges, seemed rather like a level plain, and, as one of our party remarked, "the mountains only looked like potato ridges."

The exact form and construction of the top of Ruapehu it would be impossible to describe, the whole mountain-top being covered in a deep mantle of snow. The view presented to the eye is as follows: three prominent peaks, one to the extreme north being exactly a mile distant from where we stood, and not quite so high as the peak we were on; another half a mile to the eastward of us, somewhat higher than ours. Paretetaitonga itself, on which our station is, is a very sharp pointed peak, formed of loose masses of probably trachytic lava, broken into all shapes and sizes by the action of the frost. It has an almost perpendicular inner face, so much so that the snow seldom rests against it, and is soon thawed by the heat of the sun on the rocks during the daytime. Between these three principal peaks lies a snow-field of unknown depth. This snow field is intersected by long crevasses running in all directions through it; they are from 10 to 30 feet in width, and run to great depths; some that we saw, I should think, were several hundred feet deep.

Deep down in a crateral hollow of basin-like shape, its steep sides covered with perpetual snow and ice, is a pool of water of a greyish-cream or drab colour. From the trig-station we overlooked this lake, the peak on which we stood being the south-west portion of the old crater-lips which surround the lake. From its peculiar surroundings of snow and ice, it was difficult to estimate with any degree of accuracy the diameter of the lake, and time would not allow of a proper measurement. It appeared to me to be nearly of a circular form, and 500 feet or more in diameter. It was quite impossible to descend to the lake, except by the aid of a long rope, and even then the descent would be attended with danger and difficulty. When I got on the top of the peak I noticed little clouds of steam rising from the surface of the water. On watching more closely, the water appeared now and again to assume a rotatory movement, eddies and whirlpools passing through it from the centre to the sides, and steam flashing up from those eddies, leaving little doubt in my mind that the water was in a boiling state. Close to the water the sides of the crater are bare of snow, and appear to be formed of loose particles of rock and volcanic ash; above are steep inclines of snow, sloping in all directions towards the water and terminating in icy masses overhanging the lake. The masses of ice show, in the cracks and crevasses which intersect them, and in their fringes of icicles, the effect which the heat from the lake has on them.

We had not very long been engaged in trigonometrical observations at the trig-station before a heavy cloud rolling up the mountain side enveloped the peak and covered us almost in darkness, so that we could not see one another ten yards distant. Whilst we sat on the mountain top waiting for this to clear away and allow us to complete our observations, a portion of the icy mass surrounding the lake, breaking away from its position, crashed down over the precipice into the lake below, sounding with an awful and solemn effect amongst the stillness of all around. As the dense cloud continued to hang on the peak, and the time had arrived for us to start back for camp, we were obliged to leave our work for another day and commence our descent. I may mention as a curious fact that on top of one of the highest peaks of Ruapehu we found, on a ledge of ice, the remains of a rat in a good state of preservation, the skin only being devoid of the fur, and a portion of it still remaining on the chest, across which the fore-legs were folded.

As I mentioned before, the snow-fields which fill up the crateral hollows of the mountain prevent the possibility of judging what the shape of the top is; but from the vertical inward faces of the peaks which can be seen, and the outward appearances lower down the mountain on the western side, it would seem reasonable to infer that they surrounded a great central hollow, and that the mountain had been a truncated cone, large portions of the sides of which were blown away by eruptions; and that subsequently, inside the remains of the old cone, two or more craters had broken out and built up new cones. The vent in which the thermal action still continues seems to be the last crater which was active, judging from the appearance of the lava streams down the mountain side. Around the lower slopes of the mountain, and underneath some of the lava flows, are immense beds of consolidated tuff; on the lower slopes the soil of volcanic loam is forming.

The waters of Wangaehu have a sulphurous taste and smell. Its course can be traced down the eastern side of the mountain from nearly the top of the cone in which is the hot lake; it may therefore be inferred that the water receives its character from this lake, through a subterranean passage in the mountain. Since discovering that the crater contained hot water, I have mentioned the fact to the oldest Natives in the district, and they all concur in the belief that it is something new. I am, however, inclined to doubt this, and to believe that a low volcanic heat must have prevailed there throughout. Five years ago, when engaged in triangulation on the Kaimanawa Ranges, I noticed hanging over Ruapehu, in the position of the crater, what seemed to be a cloud mass. This I remarked more than once, but I did not know of the existence of the lake at that time, and I considered that it must be a cloud or fog rising through some of the gorges of the mountain, although it closely resembled a column of steam. I may also mention that some eighteen years ago, (I am informed,) an abnormal flood occurred in the Wangaehu River, carrying down with it large blocks of snow and ice. There had been no heavy rains at the time to account for this flood: it is therefore reasonable to infer that it was caused by an escape of the warm water from the lake, passing down through some underground passage below the edge of the water, and thawing the snow and ice on the mountain side. This, however, appears certain, that before or about the beginning of April, a considerable increase of volcanic heat in the Ruapehu crater took place, which continued to increase until towards the end of May, after which time I had no opportunity to observe it.

On the 16th of April I noticed a well-defined column of steam rising from the crater, several hundred feet above the mountain top; it was also visible several days subsequently. I showed it to several of the Natives, who said they never had known of such a thing before. If it were of common recurrence, and in such volume, I think it impossible that it could have escaped the notice of the Natives.

On the 23rd May, the weather being very clear and bright, a larger column than usual ascended from the crater, about 300 feet above the mountain, spreading out horizontally into a cloud-like mass, the outside portions of which descended again and rolled down the mountain side. Towards noon this column began gradually to decrease, until it disappeared altogether by sunset. Since the end of May the dull weather prevented any further observations of the mountain. Should the volcanic heat so increase as to cause a sudden thaw of the ice and snow which fill up the crateral hollows of the mountain and mantle its sides for several thousand feet, the result must be heavy floods in the Wangaehu, Waikato, and Wanganui Rivers, probably attended with serious consequences to the town of Wanganui. The great boulders in the Whakapa and Wanganui Rivers, some of them weighing over 50 tons, would seem to have been carried down by such floods in the past. That the atmospheric conditions affect the state of the thermal springs and fumaroles in the Tongariro group appears very evident. I had not sufficient opportunity of noting the state and conditions of the steam-vents, under various atmospheric conditions, to make any definite statement on the subject, but I noticed that the discharge of steam was greater in the early morning with southerly winds and frosts; and the Natives always look for bad weather when the steam hangs low on Ngauruhoe in the morning.

Art. XLVII.—*Phenomena connected with the Tarawera Eruption of* 10*th June*, 1886, *as observed at Gisborne.*

By Archdeacon W. L. Williams.

[*Read before the Auckland Institute*, 26*th July*, 1886.]

About 2h. 30m. a.m. on the morning of the 10th June, 1886, most of the inhabitants of Gisborne were roused from their slumbers by the rumble of distant explosions, following one another in quick succession, accompanied by an extraordinary agitation in the atmosphere, (there being no wind to speak of,) which kept the doors and windows rattling in their frames, as though from the effect of a discharge of heavy artillery in the neighbourhood. The first probable cause that suggested itself was thunder; but, on looking out, it was seen that the sky was perfectly clear and the stars shining most brilliantly. Then, if it was not thunder, might it be the forewarning of a violent earthquake? But the atmospheric disturbance showed that it could not be a mere earth-rumble; and so the conclusion was forced upon one that it must be a distant volcanic eruption, probably from Tongariro.

A further survey of the horizon, however, showed a cloud low down in a W.N.W. direction, in or near which there was something unusual going on; flashes of light illuminating the whole cloud; then linear flashes darting in various directions, or round balls of light. As the view of the cloud was somewhat obstructed by trees, we could only see the upper part; and concluded that, wherever the eruption might be, there was a thunderstorm of an unusual character raging in that direction in the far distance. Other people, who had an unobstructed view of the W.N.W. horizon, saw much more of the fiery display than I did. Accounts given by different people vary somewhat; but this is probably owing to the difference of time at which the observations were made. Those who had an early view, about 2h. 30m. a.m., describe the cloud as shaped somewhat like a mushroom, the lower portion forming a distinct column, while the upper part spread itself out on all sides. The flashes, or incandescent objects, also were seen to be projected from below into the upper part of the cloud, and some of them to fall again, and others apparently to explode, many of them presenting decidedly the appearance of balls. After a time the cloud became more diffused, and no longer maintained the mushroom shape. Between 3 and 4 a.m., a south-west squall came up, with heavy rain, which effectually put a stop for some time to further observations. A number of slight shocks of earthquake were experienced at intervals, some persons having counted as many as twelve between 3 o'clock and noon.

Towards morning it was observed that there was an unusual darkness, though there was a low comparatively bright arch in the south-west horizon. At 7 a.m., when it should have been broad daylight, it was still exceedingly dark, but near objects on the north-east side were dimly lighted up by a weird reflection from the south-west horizon, the light taking a very peculiar colour from the cloud overhead. It was evident now that we were under the edge of a dense cloud of volcanic dust, which shut off the sunlight very effectually, with the exception of what came to us in a roundabout way by the south-west. Under the influence of the south-west gale, which had now set in decidedly, the dense dust-cloud gradually moved off to the north-east, and by 10 a.m. we were able to dispense with artificial light.

There were frequent squalls and showers from the south-west during the day; but nothing further was seen of the eruption, though the rumble of the explosions continued to be heard from time to time during the day, and for several days afterwards.

On the evening of Sunday, 13th June, the horizon being clear, there was visible a distinct column of vapour or smoke in the W.N.W., which formed a diffused cloud above.

There has been no fall of dust or ashes in Gisborne, though there was a sprinkling at places about fifteen miles off in a north-westerly direction, and, of course, more further on. The southern limit of the deposit on the coast is Anaura. At Waipiro, in Open Bay, dust came down from about 4 a.m. to about 10h. 30m., causing the most intense darkness, until it was gradually driven off by the south-west wind about 11 o'clock. The deposit there is about 1 inch thick on an average.

According to the best available maps, the distance in a direct line from Gisborne to Tarawera is just 90 miles; the height, therefore, of the cloud of vapour and dust which was visible here at the time of the eruption must have been very great. An object at that distance, to be visible at all on the horizon, must be at least one mile in height above the level of the sea. It is not possible to obtain an absolutely correct measurement of the height of the cloud above the horizon, but a close approximation can be arrived at by the aid of other objects with which it could be compared. In this way it appears that the angular measurement of the height of the cloud, as seen from Gisborne, was from 3½ to 4 degrees, corresponding to a height above the plane of the horizon of from 5·5 to 6·3 miles. For the full height, we must add to this the distance between the plane of the horizon and the top of the mountain, which will bring the whole height, at the lowest computation, to a little over 6 miles from the top of the mountain.

Art. XLVIII.—*Notes on the Eruption of Tarawera, as observed at Opotiki.*

By E. P. Dumerque.

[*Read before the Auckland Institute, 21st July, 1886.*]

On 10th June, 1886, at about 2 a.m., people were aroused by violent noises as of peals of thunder, and volcanic rumblings, and towards the south-west the sky was illumined with strong light, from the midst of which at intervals shot forth balls and forks of fire.

From about 2 till 9 a.m. there was a succession of shocks of earthquake of moderate force, accompanied by a peculiar floating or rolling, as it were, of the earth.

At about 3 a.m., the sky at the time being perfectly clear and starlight, an inky-black cloud rose in the south-west and drifted towards the north-east, and gradually quite overspread the heavens; and a rain of fine ash, and subsequently dust, commenced, which lasted till noon, and covered the Opotiki district to a depth of about 1½ inches. The air was unusually cold. It was pitch dark till 10.20 a.m., at which hour the fall became slighter and daylight gradually appeared, and the rest of the day was twilight.

Animals were greatly distressed, and cattle gave vent to constant bellowings. Many small birds died, and insect life suffered severely.

No tidal disturbance was noted.

At Orete Point, 45 miles north-east as the crow flies from Opotiki, Mr. Seccombe describes the morning of the 10th June to have been clear, and at about 8 a.m. the cloud of dust caused darkness, and a layer of ashes and dust was deposited of about the same depth as at Opotiki.

"Opotiki, 22nd June, 1886.

"MY DEAR MR. DUMERQUE,—

"I kept rough notes of what I experienced on the morning of the 10th instant, and give you them with pleasure.

"It was fine bright moonlight up to 10.30 p.m. of the 9th, when I 'turned in.' Between 3 and 4 a.m. of the 10th I was aroused by a noise like distant thunder. I took little notice of it for a time; but as it developed it became occasionally a continuous roll, broken at intervals by explosions resembling heavy artillery fire. Cattle were bellowing and horses neighing, and it became quite evident that a storm of unusual character was brewing. This much could be surmised while lying in bed. What appeared to be gentle rain was heard falling on the trees near the window, but it was never heavy; and the thunder seemed to remain in the same spot. The usual sound of the rain running off through the spouting was conspicuous by its absence, and created surprise in my mind. The lightning was bright and the thunder loud, but between the peals at times the noise as of distant artillery-fire was audible. Mild shocks of earthquake were also noticeable about every half-hour. I rose at 4.30 a.m., and went into a room with windows facing South and West, and a cold, damp, sulphurous smell led me instinctively to open the window facing South an inch or two and feel the sill. There could then be no longer any doubt as to what had occurred, as a thin sprinkling of sand could be felt outside. It was intensely dark. I then procured a lantern and made my way into the street, which I found evenly covered with a thin coating of dark and fine sand, which was falling gently; and, while it thundered, the sand seemed to fall faster or thicker.

"There was a strong sulphurous smell outside, and the wind blew cold and in gusts.

"About due South a dull flare-up could be noticed occasionally through the falling sand and dust. This led me to think I was at the wrong side of the house, and that it was the glare from an eruption on White Island; but I soon discovered that nothing was to be seen towards the North.

"At 6 a.m. my aneroid barometer stood at 30·05°, and the thermometer at 50° in the office.

"Roosters all round were crowing vigorously from 6 a.m. till daylight came.

"Having read in a late paper that Ruapehu had been seen smoking, I concluded that either that mountain or Tongariro was in violent eruption. Moreover, the mild earthquake shakes, and the fineness of the sand and dust, showed that the disturbance must be a long way off. These reflections were sufficient to prevent alarm. A peculiarity about some of the earthquakes was that the house seemed to be afloat. I found that a scissors suspended by a nail in the wall gave frequent notice of shakes that would not otherwise have been apparent.

"Up to 9.30 a.m. it was dark as pitch, but shortly afterwards showed signs of clearing, and by 10.30 a.m. there was twilight, which gradually brightened until the place where the sun was could be distinguished. The sand and dust penetrated the house, and covered everything.

"From 10 a.m. there was a calm until 2 p.m., when the wind blew lightly from the south; and there was not much more than twilight all day.

"At 5 p.m. it cleared to the eastward, but a thick bank of fog was visible in the west. The night was calm, and cool, and fine, and slight earthquakes were felt occasionally.

"The storm had rendered the telegraph wires useless, and we had no communication with the outer world for about 24 hours. Very little alarm was felt generally, and there was no panic.

"Careful measurements of the depth of sand and dust show that about 1½ inches had fallen in town; but it is reported to be deeper on the table land.

"On the morning of the 11th, which was bright and clear, an immense cloud of steam was seen in the west, and it was rightly guessed that Rotomahana was the seat of the volcanic disturbance.

"The sand is nearly black, and lies under the dust, which is of a light mouse colour, and the layer of the former is twice as thick as that of the latter. This sand is precisely the same article that our forefathers, not so many generations back, used for the purpose of drying letters, when blotting paper was not so good or so common as it is now. And some years ago, when I was an office boy in a mercantile house in Old Broad Street, London, engaged in the Russian trade, several of our correspondents in the interior of Russia dried their letters with the same sort of sand.

"Yours faithfully,

"F. W. Henderson.

"E. P. Dumerque, Opotiki."

ART. XLIX.—*Traces of Volcanic Dust-showers at Napier, Petane, and generally throughout the East Coast Districts, North of Cape Kidnappers.*

By H. HILL, B.A.

[*Read before the Hawke's Bay Philosophical Institute, 12th July*, 1886.]

THE results of some recent experiments made by me upon the dark soils covering the Napier and Petane Hills, as also upon a dark sand deposit near Mr. Villers' hotel at Petane, may not prove uninteresting to members of this Society. For some time past I have been collecting data as to the extent and character of the pumice deposits of the East Coast District between Poverty Bay and the Manawatu Gorge, in the Seventy-mile Bush. Within this wide area there is ample evidence of comparatively recent volcanic products; but until examining specimens of the ejectamenta of the recent eruptions at Tarawera, in the Lake District, the thought had not occurred to me that possibly there might be evidence in our Napier hills of dust showers similar to those which have been experienced in the district extending from Tologa Bay to Tauranga, including the whole of the Bay of Plenty.

The Napier hills, or, at least, those portions of them that have not suffered from extreme denudation, are covered with a remarkable cap of what at first inspection seems to be a dark vegetable soil. When first broken up this soil is very productive; but this quality quickly disappears unless manures are plentifully used, there being little or no "body" in the soil. I had often wondered how such a cap of black soil came to be formed upon the hills, for only a small percentage is of vegetable origin; but on seeing several specimens of the volcanic dust and sands which fell upon the deck of the "Southern Cross," on her way down from Auckland at the time of the Tarawera eruption, the thought at once occurred to me that possibly the black soil of Napier and surrounding district might be the result of similar showers of volcanic dust, at a time when the volcanic cones of Ruapehu, Ngauruhoe, Tongariro, Tauhara, and others were in a condition of activity. The results of my tests confirm this opinion; for I find that among the many tests I have made of the soils in and around Napier, a very large percentage, in fact the greater portion, are of volcanic origin.

My experiments were carried out in the following manner: I obtained from the edge of the Napier Bluff, and immediately underlying the turf, a small parcel of black soil, containing altogether about 20 ounces. This I moistened with water, and made up into a kind of paste. I then arranged five different receivers, one inside the other, so that the overflow of water from the smallest vessel might pass into the one next in size, and so on. Water was then allowed to run slowly upon the pasty mixture, which was stirred continuously, so as to drive off the vegetable matter and lighter products. The process was continued until nothing remained of the original soil except the heavier and insoluble sands and grits. After allowing the mud and lighter sands which had overflowed into the different vessels to settle, the water was drawn off, and the sediment or deposit contained in each was carefully collected and placed in an oven to dry. The same plan was followed with a number of other specimens from the hills where the lands had not been broken up, as also from other places outside Napier, and in each instance the results were very similar. The products, as far as I have been able to make out with any degree of certainty, are: pumice sands, magnetic iron sands (magnetite), lava, ashes, felspar, nepheline, leucite, and olivine. Under the microscope beautiful specimens of minute glass-like rod crystals of leucite were common, having a faint black or dotted line running through them similar to those described by Rutley.

It is a curious fact that the whole of the East Coast between Poverty Bay and Cape Kidnappers has a black soil similar to that covering the Napier hills, the only difference being in the thickness of the deposit, which varies from 4 inches to about 16 inches.

Since writing the foregoing, I have found at Petane a peculiar black sand or soil deposit, about 8 inches in thickness, inter-bedded with fine sands like those which form the highest beds at Battery Point, Napier. This black sand has a close resemblance to the black soil covering the surrounding hills, and but for the somewhat greater compactness of the former, due, no doubt, to pressure, it would be difficult to distinguish it from the present surface soils. I have washed specimens of this black sand, and I find that it also is of volcanic origin. Scoria, lava, obsidian, olivine, perlite, felspar, mica, and a trace of magnetite are distinguishable; but some of the sands I am still unable to identify. After washing, the sand is not unlike emery powder in appearance.

From the results of my experiments I feel convinced that the East Coast District of this island has been subject, at a not very remote date, to dust showers of volcanic ejectamenta. Had the wind been blowing from the north-west at the time of the recent eruptions, it is a matter of certainty that the dust showers which fell in the district extending in a north-easterly direction for about 120 miles from the seat of the volcanic outburst, would have fallen throughout the East Coast District as far as Napier and the Hawke's Bay river system. Within 75 miles of Napier there are many volcanic cones, including the semi-dormant Tongariro and the not-altogether-extinct cone of

Ruapehu—the highest point of elevation in the North Island; and although this district is separated by the Ruahine chain of mountains, and other minor ranges, from what may be termed the zone of active volcanic phenomena, as represented by hot springs, solfataras, geysers, and burning mountains, it is certainly not outside the zone of volcanic influences, the effects of which may be seen at any time along the East Coast. A recurrence of activity in and about the district of which Lake Taupo is the natural centre, would undoubtedly bring showers of volcanic dust and débris as far as Napier, should the wind be blowing in this direction at the time; but I cannot agree with those who say that such showers would be detrimental to vegetation. They may cause temporary inconvenience, but of their beneficial effects in the production and formation of soils I think there can be no question for a doubt. To me, volcanic dust showers are blessings in disguise. They may cause loss and inconvenience at the time of their deposition; but they contain within their particles the elements of fertility, and only need, like wine, age to make them valuable adjuncts in the formation of rich soils.

Art. L.—*A Description of a* Scaphites, *found near Cape Turnagain.*

By H. Hill, B.A.

[*Read before the Hawke's Bay Philosophical Institute, 11th October,* 1886.]

On paying a visit to Wainui, a small township near Cape Turnagain, a short time ago, I found awaiting me at the schoolhouse a fossil, which had been sent there by Mr. John Fallahe, a settler residing in that district. He stated that the fossil had been found by a person named James Busby, in the bed of the Wainui Stream, about 10 or 11 miles from its mouth, and that it was thought to be, by those who had seen it, a fossil lizard. Indeed, it was so described to me by a gentleman in Porongahau several days before I had the opportunity of seeing the specimen. The end of the outer whorl of the fossil has the appearance of a lizard's head, and the inner whorls resemble somewhat the body and tail of the *Hippocampus brevirostris*, or Sea-horse, which is to be found in most places along the New Zealand coasts after heavy storms. The specimen, however, though having a great likeness to a vertebrated animal, is merely the cast of a shell belonging to the genus *Scaphites*, a genus closely allied to the fossil *Ammonites*, which had their chief development towards the close of the mesozoic period.

The fossil is interesting, as being the first of the genus *Scaphites* found in New Zealand, and Professor Hutton thinks it is the first that has been found in the Southern Hemisphere. Further, it is interesting as settling the question of the identity of the rocks about Cape Turnagain and the valley of the Wainui Stream.

From a recent inspection of the rocks in the district between Kaikora, near Waipawa, and Pourere on the north, and the Wainui Stream on the south, I conclude that the rocks through which the latter stream flows mostly belong to the middle and lower cretaceous, and that the fossil *Scaphites* comes from the pale-blue and grey chalk which underlies the greensand.

I propose naming the fossil *Scaphites hectori*, in honour of Dr. Hector, the head of tke Geological Survey of New Zealand.

Key to the description of the fossil after Nicholson:—

1. Class—*Cephalopoda.*
2. Order—*Tetrabranchiata.*
3. Family—*Ammonitidæ.*
4. Genus—*Scaphites.*
5. Species—*Scaphites hectori.*

Where found: Patangata County, North Island, N.Z.
Locality: Wainui Stream, south of Cape Turnagain.
Date: September, 1886.
Formation: Cretaceous.

Art. LI.—*Notes on the Hot Springs Nos. 1 and 2, Great Barrier Island, with Sketches showing the Temperature of the Waters.*

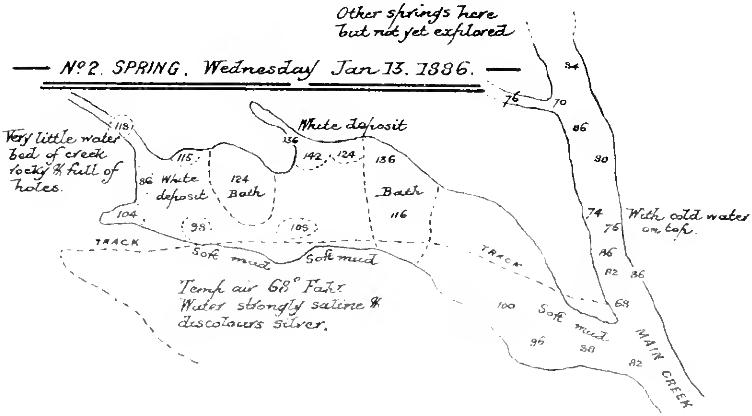
By C. P. Winkelmann.

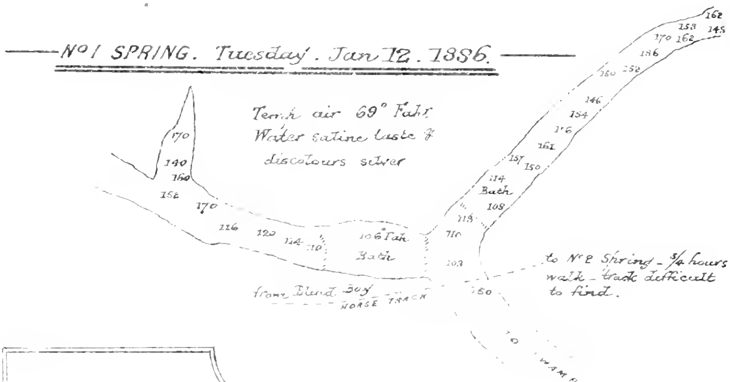
[*Read before the Auckland Institute, 14th June, 1886.*]

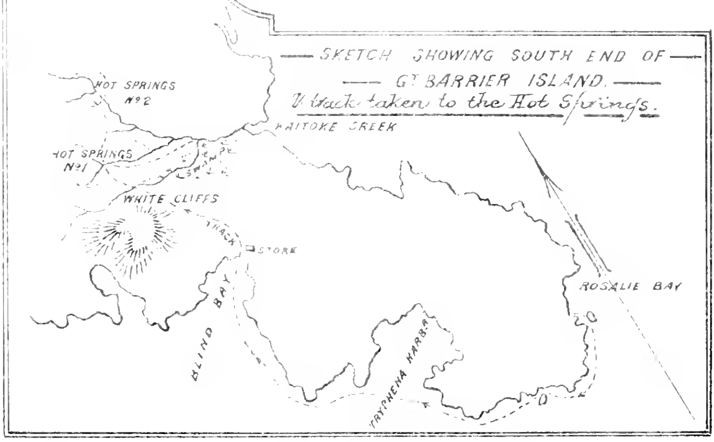
Plate XXIII.

I.—On Monday, the 11th January, during the morning, I left Rosalie Bay, situated on the east of the south end of the Great Barrier, in a boat, rounded Cape Barrier, crossed Tryphena Harbour, arriving at Blind Bay in the afternoon.

From Blind Bay to the Hot Springs No. 1 there is a fairly good track, the walking being quite easy, and the surrounding country not being devoid of interest to both the botanist and geologist; but as my time was limited, and my special object was to examine the springs, I could not, though I much wished, search amongst the vast masses of volcanic rock and abundant growth of plants found skirting the heights of the White Cliffs.







C.W. delt. To illustrate Paper by C. Winklemann

When once the cliffs are mounted the track is a comparatively easy one, for the most part consisting of a gradual descent, and any hardship experienced during the first part of the journey quickly vanishes as portions of the forest are entered. Groups of fine *Cyathea*, *Lomaria*, and *Pteris* at once attract attention; and under the spreading leaves of the beautiful nikau (*Areca sapida*) the weary traveller, if he may be so termed, may rest and refresh himself, the solemn silence of the forest being alone disturbed by the melodious song of the tui (*Prosthemadera novæ-zealandiæ*) and the lively twitter of the little fantail (*Rhipidura flabellifera*), ever flitting about.

After about two hours' walk the first lot of hot springs are reached, their nearness being announced by a strong sulphurous smell, and, on reaching the place where the track cuts across the creek flowing into the Kaitoki Swamp, a sensation of warmth, and at times of oppression at the chest, is felt. This is, no doubt, caused by the accumulation of the sulphurous fumes in the valley-like locality in which the creeks and hot springs are, and is noticeable chiefly on calm days. In the early morning, and also in the evening, clouds of steam may be observed rising from the creeks, giving a very weirdlike appearance to the place.

There are two creeks, which run from two opposite directions and join at a point just below where two baths are now constructed; the water, after passing through the baths, flowing into the creek running to the Kaitoki Swamp.

The temperatures of the baths are 106° Fah. and 108° Fah., respectively, and I could obtain no deviation from these results. Various other temperatures will be found by referring to the accompanying rough sketches, all of which were carefully taken —186° Fah. being the highest, found at No. 1 spring. (*See* Pl. XXIII.)

The banks of the creeks, which are narrow, and turn about in all directions, are covered in most places with shrubs and ferns of several genera, including *Pteris incisa*, which here attains a height of 6–7 feet, *Gleichenia flabellata*, also the grass *Paspalum scrobitulatum*, and several varieties of *Lycopodium*, all of very luxurious growth in the vicinity of the hot water, but at some distance off assuming a more stunted appearance.

Articles of silver placed in the water of the baths turn black, thereby indicating the presence of sulphur; and the water possesses a very strong saline taste.

That the water has curative properties can, I think, be no longer doubted. The Natives on the island hold the springs as excellent for the cure of rheumatism, and several Europeans have derived benefit by a short stay in the locality, and constant bathing. There are other diseases that might be, indeed are, benefited, if not cured, by these waters. Taking the water internally acts as a mild aperient.

In one of the creeks large deposits of red ferriferous clay are to be found, containing by analysis about 16 per cent. of iron, a specimen of which I have secured—marked "No. 1."

II.—On leaving the first lot of springs the traveller takes the track cutting across the creek into which the water from the two baths flows, and gradually ascends a low spur. After this he descends on to a flat, and the road is very easy. Soon the fern land is lost sight of, and the forest is again entered, and in about an hour the point is reached where the second lot of thermal springs are situated.

There is nothing to mark the locality, and, as the bush is very dense, no small amount of caution is requisite, otherwise the object of search is sure to be missed. Ferns greet one on all sides—the ground is covered with them. Fungi of various kinds are noticed on the trees, and graceful festoons of *Lygodium articulatum*, intermixed with vines of supplejack, (*Rhipogonum scandens*,) are in places difficult to avoid. The vegetation in this part of the forest is very rank, and will amply repay the labours of the botanist.

A small clearing is soon reached, and the dark outline of the creek in which the springs are situated is seen in the distance. A little caution is necessary in approaching, as quantities of mud will be found in the vicinity, for the most part hot, and in places steaming; and should the unwary traveller find himself knee-deep, the experience will be the reverse of pleasant.

All is quiet, save alone the sound of the water as it trickles over the stones and falls from one hole into another. Some of these holes are simply filled with muddy water; while others, and notably one of the natural baths, are full of clear hot water of a green colour. In exploring some of the many branches feeding the main creek it is necessary to take off one's boots and stockings; and in doing this no small amount of care is requisite, for in places where the water appears, and is in fact, cold, yet, on wading about, innumerable spots are found where the stones in the bed of the creek are quite hot, and where hot water is constantly coming up, though not in sufficient quantity to reach the surface. Steam rises from several holes, and on digging down a few inches almost boiling water can be obtained.

A strong sulphurous odour pervades the locality, and a good deal of silicious deposit is noticed that is not met with at the first springs. I have secured some of this deposit, which accompanies this paper, marked "No. 2." There are two rough natural baths found at these springs, with temperatures of 124° Fah. and 116° Fah. respectively, each holding a considerable amount of water, that runs out as fast as it runs in.

The water discolours silver, and has a strong saline taste with a slight sensation of bitterness. It is, in my opinion, much stronger than that found at the first lot of springs.

142° Fah. was the highest temperature that I here found. The Natives consider these waters to be specially useful in skin diseases, and would visit these springs in preference to the others (No. 1) on this account.

Owing to the fact of my time being limited, I was unable to further explore this locality, but I have reason to believe that within a radius of a quarter of a mile no small indications of thermal action will be found.

In closing my remarks, I must not forget to mention the discomfort that one has to contend with in the shape of our little enemy the mosquito. During the day this industrious insect is not so troublesome; but, so soon as the shades of evening draw upon the scene, these creatures assemble by the million—clouds of them, everywhere—the whole atmosphere becomes dense, and the difficulty is to find a chance to sleep during the night even for a little. I should strongly advise others to follow my example—viz., to create as many fires around the camp as possible, and, on retiring, to place quantities of smoking embers as near the blankets as convenient. In this way, and in this way alone, was I able to obtain an hour's repose. Should the smouldering embers die out, one is very quickly informed that fresh fuel is needed. It is therefore advisable to lay in a stock before going to bed.

Accompanying this paper are a few specimens of the ferns that I collected during my travels at and around the Hot Springs District. I append a few remarks anent some of them:—

Lomaria patersonii.—In great abundance; the ground covered within a radius of 50 feet from where I stood. A very pretty sight.

Schizæa dichotoma.—Very local, and scarce at that. The gum-diggers seem to be exterminating this pretty species.

Lindsaya viridis.—Very scarce, only one specimen found.

Asplenium trichomanes.—In great abundance.

Lycopodium consimilis.—Very plentiful.

Lomaria oligoneuron.—Very local.

Trichomanes tunbridgense.—Only discovered in one place, about 1,500 feet.

Several hundred specimens, and many belonging to several genera that are not represented amongst the lot I now bring forward, are still unpacked and unarranged for want of time.

In closing this paper, I cannot refrain from remarking that, with a very small expenditure, both these thermal springs might be utilized, doubtless proving of great service in curing many diseases. That they should for so long have been known, and never properly examined, is a mystery. The Natives of the Barrier have long used them medicinally with success, and there is no reason why Europeans should not do so. They are within easy access of Blind Bay, where a steamer calls regularly; and a good carriage road might easily be formed. As they now are, visitors can without difficulty go there, and to those who have not yet done so, I say, by all means go.

To the botanist and geologist I venture to promise an excellent field; and to the lover of nature abundance of material will be found, enough at any rate to prove the mighty workings of a strong but unseen hand.

Art. LII.—*On the Geology of the Trelissick or Broken River Basin, Selwyn County.*

By Prof. F. W. Hutton, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 3rd June,* 1886.]

Plates XXIV. and XXV.

Introduction.

The Trelissick Basin lies among the mountains which separate the River Rakaia from the Waimakariri, and it drains into the latter. The West Coast Road from Christchurch to Hokitika, on leaving the Canterbury Plains, does not follow up the valley of the Waimakariri, but ascends to Porter's Pass (3,097 feet), between the Thirteen-mile Bush Range and Mount Torlesse; then descending, and passing through the Trelissick Basin, it reaches the Waimakariri at an elevation of 1,808 feet above the sea. The road then ascends once more to Arthur's Pass (3,013 feet), which lies on the watershed between the east and west coasts. The ascent to Porter's Pass is rendered necessary by the deep, narrow, and almost impassable gorge, six miles in length, by which the Waimakariri reaches the plains (Pl. XXV., fig. 1). In this respect the Waimakariri differs from the Rakaia and Rangitata, further to the south, which enter the plains by broad shingle valleys. In the sequel, I will offer an explanation of this remarkable peculiarity.

The first notice that I can find of the geology of the district is in the "Catalogue of the Colonial Museum," (Wellington, 1870,) in which the fossils collected by J. D. Enys, Esq., are arranged in two groups—one in the middle tertiary or Cucullæa beds, the other in the lower tertiary or Ototara series. The fossils, however, had got rather mixed, and in 1872 Dr. Hector visited and mapped the district, dividing the rocks into three formations, which he called Lower Miocene, Upper Eocene, and Cretaceo-tertiary. The fossils in the Wellington Museum, coming almost entirely from the two upper of these formations, were rearranged by him, and in this new arrangement they were included by me in the "Catalogue of the Tertiary Mollusca and Echinodermata of New Zealand" (Wellington, 1873).

In 1879, Mr. A. McKay examined the district for the Geological Survey, and published, in 1881, a report which is illustrated by the map and sections made by Dr. Hector in 1872.* In this report, Mr. McKay retains the three formations originally established by Dr. Hector, but makes two important alterations—(1.) He places what was formerly considered as the base of the lower miocene into the upper eocene†; and (2) he places the fossiliferous tuffs and volcanic rocks of White-water and Coleridge Creeks into the cretaceo-tertiary instead of the upper eocene. Dr. Hector's map appears, also, to have been altered in conformity with this view, for it does not agree with Dr. Hector's statement that the volcanic outburst took place during the upper eocene‡; and certainly in 1873 Dr. Hector did not consider the fossils from White-water Creek to belong to the cretaceo-tertiary.

Last January I spent ten days examining the district, the result being to confirm Dr. Hector's classification of the rocks made in 1872; the later alterations of the Geological Survey being mistakes, as I hope to show presently. But I differ from Dr. Hector in his correlation of the lower limestone with the Weka Pass stone, as well as in several details of structural geology.

In the present paper I have been greatly helped by Mr. J. D. Enys, F.G.S., who showed me the localities for fossils and for eruptive rocks, and went over the fossils with me and explained my difficulties. The lists of fossils will therefore, I hope, be found tolerably accurate. They are compiled from the collections I have myself examined in the Wellington and Christchurch Museums, and in Mr. Enys' private collection. I have also availed myself as much as possible of the list given by Mr. McKay in his report already alluded to; but in this I have had to use great caution, as it contains many errors.§ The table of distribution in many cases does not agree with the fossil locality-numbers; and these locality-numbers often do not refer to the Trelissick Basin at all. Also, some fossils appear to have got into the list by mistake. This, I think, must be the case with *Fusus enysi*, (McKay, MSS.,) which is said to have been obtained in localities No. 231 and No. 235. The first of these localities is Ngaruroro River, Napier; the second is "Plant beds at the

* "Rep. Geo. Expl.," 1879-80, p. 54.

† "Rep. Geo. Expl.," 1881, p. 123; loc. No. 237 and No. 238.

‡ "Rep. Geo. Expl.," 1879-80; prog. rep., p. xxi.

§ I was much surprised to find this, after having read the excellent lecture on accuracy that Mr. McKay gave us in his report on the Curiosity Shop beds.

Road Cutting, Thomas River," collected by Mr. McKay in 1874. Mr. Enys, however, assures me that he has never seen this species from here, but that he gave a specimen, which he had collected at Pareora, to Mr. McKay, distinctly telling him at the time where it came from; and it is possible that in this way the species may have got into the list.

The map accompanying this paper is reduced from the topographical survey made by Mr. Adams in 1882, which Mr. Enys supplied me with. It is, of course, more accurate than the one Dr. Hector had in 1872. The geology will, I trust, be found correct in the main; but that portion bounded by the Porter River, the West Coast Road, and the fault south of the Thomas River is purely hypothetical, the rocks here being covered by a thick deposit of gravel, which is not cut through by any stream. I was also called back to Christchurch suddenly, before I could examine the inliers of the upper limestone lying on the western edge of the basin between Thomas River and Coleridge Creek, and without having sufficiently examined the eastern slopes of Castle Hill and Flock Hill.

General Geological Structure.

The physical features of this basin have been sufficiently described by Mr. McKay. It is a rock-basin, hollowed out of a *massif* of sandstones, mudstones, and greywackes belonging to the Maitai System. The rocks filling the basin are divided into three distinct formations, as follows, each resting unconformably on the rocks below it:—

3. Pareora System (Lower Miocene of the survey).—A series of blue clays, shales, and sandstones, sometimes unconsolidated, with a total thickness of 600 or 700 feet.

2. Oamaru System (Upper Eocene of the survey).—Coralline limestone, underlain by volcanic grits and tuffs, passing in the south into thick scoria beds. Thickness of sedimentary rocks, 150 feet.

1. Waipara System (Cretaceo-tertiary of the survey).—Argillaceous limestone and calcareous sandstone underlain by marl, below which are green and other coloured sandstones. Maximum thickness about 1,200 or 1,300 feet.

Speaking roughly, the rocks may be said to dip everywhere towards the centre of the basin; but as the basin is much longer than broad, they form a syncline which runs from the upper part of Coleridge Creek in a N.N.E. direction, west of Castle Hill, to Parapet Rock (where the Pareora System stops) and Cragieburn Saddle. The north-west corner of the basin, however, is formed by another short syncline which runs nearly parallel to the first. As the West Coast Road enters the basin on its eastern side, it does not run along the syncline until after passing the Thomas River. I observed three faults in the district, but there may be others. The first crosses the Porter River just above the first limestone gorge, south of Prebble Hill,* and runs north-westerly to the north side of Castle Hill; its downthrow is to the north-east; this fault is clearly seen on the left bank of the Porter River (Pl. XXV., Section IV.). The second fault runs from Parapet Hill south-west, and crosses the Broken River at the small gorge under Sugarloaf Hill (Pl. XXV., Section II.) with a downthrow to the south-east. The third fault runs east and west along Waterfall Creek, which is the first affluent the Broken River receives from the west after entering the basin; its downthrow is to the north.

River gravels are widely spread over the basin. They form the summit of Long Spur, and are found on the ridge behind Castle Hill, at an elevation of nearly 3,000 feet above the sea. I have, however, omitted them in the sections, as I paid no particular attention to them. I saw no marks of glacier action; indeed such marks could not be expected to occur, for during the last great glacier epoch the Trelissick Basin must have been a snow-field.

The following altitudes may be found useful:—

West Coast Road—	Feet.
Lake Lyndon	2,743
Crossing at River Porter ..	2,266
Terrace N. of River Porter	2,481
Terrace S. of River Thomas	2,285
Crossing at River Thomas	2,178
Terrace at Hotel	2,371
Terrace S. of Broken River	2,390
Crossing at Broken River	2,094
Terrace N. of Broken River	2,350
Craigieburn Saddle ..	2,619
Lake Pearson	2,085

Hills West of the Road.	Feet.
Castle Hill	3,023
Long Spur	2,747
Hog's Back	3,391
Hills East of the Road.	
Prebble Hill	2,959
Gorge Hill	2,614
Flock Hill	3,269
Junction of Porter and Broken River (estimated)	1,948
Castle Hill Station	2,520

WAIPARA SYSTEM.

This system is largely developed on the north and east sides of the basin: a detached portion also occurs at the most southerly point, in Coleridge Creek. Its upper member is a white argillaceous limestone (Amuri limestone) generally with a platy structure, breaking up into irregular flakes, more or less parallel to the bedding. Below this comes sandstone or grit, underlain by a thick bed of marl; whilst the lower part of the system consists of grey or green sandstones, very variable in

* This is the same as Ram Hill in Mr. McKay's Report. The name of "Ram Hill" is not known to Mr. Enys.

colour, and sometimes with brown coal or lignite. Its greatest elevation above the sea is at Hog's Back (3,300 feet), and Flock Hill (3,200 feet); at Prebble Hill its highest point is under 3,000 feet.

Beginning at the southern part of the basin, in Coleridge Creek, we find a small exposure of green sandstone, followed by grey marl, the thickness of which I could not estimate, but it must be more than 50 feet. These are succeeded by 200 or 300 feet of limestone, there being no appearance of the intermediate sandstone or grit. The dip is to N.E., at an angle of 50° in the lower part of the marl, gradually flattening to 28° in the limestone. Descending the creek, we lose the Waipara rocks for some distance, and then once more come across the marls underlain by green sandstone on the eastern side of the basin. The limestone is absent here, and the marls and sandstones are not well developed and rather obscure.

White-water Creek exhibits the following section (Pl. XXV., Section III.):—

9. Limestone. A few feet only, on the left bank of the creek.
8. Green calcareous sandstone, with fossils. 40 feet (?).
7. Pale grey or white marl: perhaps 300 or 400 feet thick.
6. Grey shale. 150 feet.
5. Dark greensands.
4. Dark soft sandstone with plant remains and efflorescences of sulphur. 40 or 50 feet thick.
3. Impure lignite. 3 feet.
2. Carbonaceous shales and sandstone.
1. Grey sandstone.

The dip of beds Nos. 5 to 9 is N.W., flattening from 55° in No. 5 to 40° in the upper beds. The beds Nos. 1 to 4 dip to the N. at angles from 70° to 55°, and there may be an unconformity above them. From this point northward the upper part of the Waipara System is covered by the gravel terrace along which the West Coast Road runs, and it does not reappear until the first limestone gorge of the Porter River, near Prebble Hill, is reached. The green sandstones, however, which underlie the marl, form the banks of the Porter between Table Hill and Prebble Hill, the river running more or less on the strike; just above the first gorge these sandstones, dipping 18° N.W., end abruptly in a fault, which has a downthrow to the north (Pl. XXV., Section IV.). This appears to be a reversed fault, the older beds overlying the younger ones, but, as a gully obscures the exact line of junction, I do not feel confident that appearances can be trusted.

The following section of the upper beds of the Waipara System is exposed in this gorge:—

6.	Limestone	30 feet
5.	Marl	10 ,,
4.	Limestone	50 ,,
3.	Calcareous grit	4 ,,
2.	Green sandstone	40 ,,
1.	Marl	150 ,,

No. 3 contains rolled fragments of volcanic rocks, and in the lower part of the marl (No. 1) there are several layers of calcareous concretions. On the south side of Prebble Hill the limestone is divided into two parts, the lower of which is composed of comminuted fragments of Bryozoa, Hydrocorallinæ, etc., forming what is called a coralline limestone, thus differing altogether from its normal character, and resembling the upper limestone, presently to be described. The dip of the upper beds just above the gorge is 40° N., increasing at the gorge to 56° N.

In the lower part of Broken River the greensands exhibit their greatest development (Pl. XXV., Section I.). I estimate their thickness here at about 850 feet, the dip being tolerably uniformly 25° W. They are covered in the Porter River by about 200 feet of grey marl, upon which rests a stratum of brownish green sandstone 20 feet thick. Then comes 26 feet of arenaceous marl, and then the limestone, about 100 feet in thickness at the second gorge. All these beds dip 25° W., but south of the Porter River the direction of the dip rapidly changes, as the beds sweep round through a right angle to the first gorge, and form Prebble Hill. I did not measure these beds in the Broken River, neither did I examine them closely in their northerly extension, although from the top of Flock Hill I saw, in the valley to the east, what I took to be a good exposure of the marl. The dip of the limestone at Flock Hill is about 25° W. (Pl. XXV., Section II.).

At Parapet Rock, on the West Coast Road, the limestone is compact and flaky, grey in colour, but weathering first red and then white. In the bed of Murderer's Creek it is underlain by about 30 feet of laminated calcareous sandstone, containing a bed of shale about 1 foot in thickness. The marl is not seen here, for to the north the greensands have been faulted upward against it. The limestone at Parapet Rock, on the right bank of Murderer's Creek, dips 77° E.S.E., but on the left bank it dips 40° S., gradually turning round to the west towards Flock Hill. The next place where I examined these rocks was at the upper gorge of the Broken River, near Sugarloaf Hill, where the same fault that occurs at Parapet Rock crosses the river (Pl. XXV., Section II.). Here the rocks have been so much disturbed by the fault that I was not able to interpret them intelligently. At the gorge itself the limestone dips 25° S.S.E. Immediately to the north, on the right bank of the river, white sands with rounded calcareous concretions occur, dipping 60° N.W.; while a little further up the river the limestone, apparently horizontal, is underlain directly by green sandstone with ferruginous concretions. Probably the white sands have slipped from above the green sandstone, as they occur in that position more to the west; but the locality requires further examination. Further up the river the green sandstone with concretions dips 25° W.N.W.

In Waterfall Creek, which flows into Broken River from the west, there is a very fine section. A fault goes up the bed of this creek having a downthrow to the north, and in consequence the left bank is formed of grey marl, and the right bank of green sandstone with ferruginous concretions. The exposure of the green sandstone here is about 300 feet in thickness, and on it rests white sandstone with concretions, about 100 feet, followed by another 100 feet of marl. This is followed by the limestone, which is here not less than 300 feet in thickness. The stream runs through a narrow gorge in the limestone, forming two waterfalls, and the dip is 40° W.S.W. The limestone covers a considerable amount of surface between here and the Hog's Back, forming a syncline (Pl. XXV., Section II.), with the axis lying about N. by E. and S. by W. At the north end of the Hog's Back the dip is 55° E., but more to the south the dip gets greater, until in Hog's Back Creek, at the southern end of the hill, it is nearly vertical. In Trout Creek, a small stream lying a little north of Hog's Back Creek, the eastern arm of the syncline is also highly inclined, the dip being 80° W.N.W.; so that this syncline is narrowed and steep at its southern end, while it broadens and flattens to the north.

Craigieburn Outlier.—This patch of the lower beds of the Waipara System lies outside the Trelissick Basin, from which it is separated by a low ridge of palæozoic rocks called the Craigieburn Saddle. It belongs to the valley in which Lake Pearson lies, and is 300 or 400 feet below the Craigieburn Saddle. On the left bank of the stream two seams of good brown coal are exposed. The upper of these seams is 7½ feet or more in thickness; the lower shows 8 feet of coal, but the bottom has not been laid bare. These coal seams are separated by a bed of brown clay 5 feet thick. The coal seams are overlain by pale soft sandstone with streaks of coaly matter, and this by a ferruginous conglomerate containing rounded pebbles of palæozoic sandstones and quartz mixed with pebbles of liparite, like those of the southern side of the Malvern Hills and the Rakaia Gorge. The dip of the coal beds is 25° N.W., and the whole series is overlain unconformably by horizontal beds of silt, which were probably deposited during the last great glacier epoch in a lake formed by the Waimakariri glacier blocking up the valley. The occurrence of pebbles of liparite in the conglomerate is very interesting. Similar pebbles have been noticed by Dr. von Haast in the Big Ben Coalfield on the northern side of the Thirteen-mile Bush Range,* which is about half-way between the liparites at Malvern Hills and Craigieburn; and as no rocks of the same kind are known to the west or north of Craigieburn, it seems necessary to suppose that these pebbles of liparite were brought from the Malvern Hills by a river running to the north. Now the High Peak Range, in the Malvern Hills, attains an altitude of 3,000 feet; the conglomerates at Big Ben are 2,800 feet above the sea; Lake Lyndon is 2,743 feet; Craigieburn Saddle, 2,619; and Lake Pearson 2,085 feet. So that there is, even now, sufficient fall in this direction for a river; and I shall show in the sequel that this gradient was probably steeper in the Waipara period. We are, however, met with the difficulty that the Big Ben conglomerates are, according to Dr. von Haast, surrounded by hills 4,000 to 5,000 feet high, the drainage now being from there into the Kowhai. Probably this ancient river passed over the southern flank of the Thirteen-mile Bush Range; but we must wait for more information before a complete solution of the problem can be attempted.

Fossils.—In the beds above the coal at Cragieburn I found fragments of leaves of angiospermous dicotyledons, and ferns have also been obtained from here. Both ferns and dicotyledons have been found in Murderer's Creek, about a quarter of a mile above Parapet Rock, in connection with a thin seam of coal.† The greensands at the lower part of the Broken River contain quantities of a large undescribed species of oyster, apparently identical with one found near the coal at Malvern Hills. Below these oyster-beds Mr. McKay collected, in 1877, *Conchothyra parasitica*, together with undescribed species of *Perna* and *Corithium*: and on the south side of Prebble Hill a *Tellina*. From this last locality, Mr. Enys has a tooth of *Myliobatis*, different from those found in the Pareora rocks. The marls contain *Ostrea subdentata*, Hutton,‡ on the left bank of the Porter, near its junction with the Broken River; also just above the first limestone gorge of the Porter River. According to Mr. McKay this species was collected by Dr. Hector in the greensands, but Mr. Enys knows it only from the marl. The so-called "fucoid markings" are also common in the marl at the first limestone gorge, as well as scales of Teleost fish.

* "Rep. Geo. Expl.," 1871-72, p. 21.

† *Potamogeton ovatus*, figured in the "Catalogue of Geological Exhibits, Indian and Colonial Exhibition," p. 61, probably came from here.

‡ Perhaps the same as *O. alabamamensis*, Lea, from the Eocene of Alabama.

Dr. Hector and Mr. McKay also mention *Pecten zittelli* (called *P. pleuronectes*) from the marl, but Mr. Enys has never seen this species in the Trelissick Basin, and it is not included in Mr. McKay's list of fossils at the end of his report.

In the sandy beds above the marl in White-water Creek, I noticed the cast of a *Flabellum* (?) and another of *Cardita*, (apparently *C. patagonica*). In his report Mr. McKay says that *Pecten hutchinsoni* comes from these beds at the first gorge of the Porter; but in the list of fossils at the end of the report it is said to have come from what he supposed to be the same beds in White-water Creek, but which I shall presently show belong to a higher horizon. I searched in vain for fossils in these beds at the first gorge of the Porter, and consequently I suppose that it is Mr. McKay's list and not his report that is correct. In the limestone at Coleridge Creek I noticed a *Waldheimia* (?), spines of an echinoderm, and a net-coral (*Retepora*).

Correlation of the Beds.—That these rocks belong to the Waipara System is admitted by all geologists, and the sequence is very like that at the Waipara.

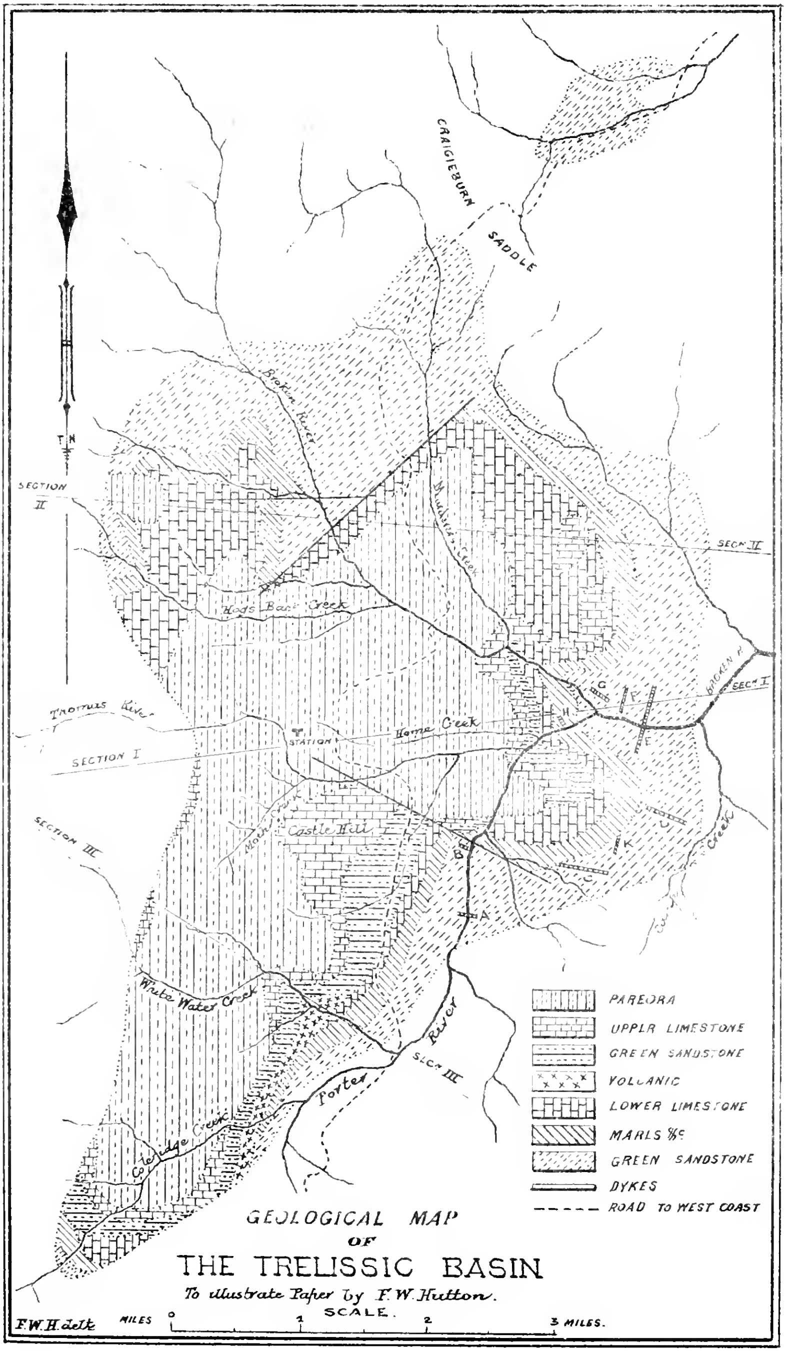
Waipara, after Dr. von Haast.*	Feet	Trelissick Basin.	Feet.
9. Grey marl (Amuri limestone)	60-100	Argillaceous limestone (Amuri limestone) ..	160-300
8. Sandy clays	60-100		
7. Greensand	80-100	Greensands	50
6. Blue marl	50-70	Grey marl	50-300
5. Calcareous greensand ..	80-100	White sandstone ..	20-100
4. Concretionary sandstone, with *Plesiosaurus*, etc. ..	200	Green sandstone, with concretions and *Myliobatis*	300-850
3. Soft sandstone, with *Ostrea* and *Conchothyra* ..	70-150	Sandstones, with *Ostrea* and *Conchothyra*	
2., 1. Sandstone and lignite, with leaves of Dicotyledons ..	30-60	Sandstone and lignite, with leaves of Dicotyledons	

* "Rep. Geol. Expl." 1870-71, p. 9.

In mineral characters the Amuri limestone at Waipara and Weka Pass closely resembles the limestone which forms the upper member of the system in Trelissick Basin, and I have elsewhere shown that in the Weka Pass District the Amuri limestone is the upper member of the Waipara System;† so that, stratigraphically and lithologically, they appear to be the same. Both are equally destitute of fossils. The officers of the Geological Survey correlate this limestone with the Weka Pass stone, but I cannot see on what evidence they rely. Certainly it does not contain any of the fossils characteristic of the Weka Pass stone, which are similar to those of the Curiosity Shop beds‡,

† Quar. Jour. Geol. Soc. of London, vol. xli., p. 266.

‡ Quar. Jour. Geol. Soc. of London, vol. xli., p.



GEOLOGICAL MAP
OF
THE TRELISSIC BASIN
To illustrate Paper by F. W. Hutton.

and these are represented in the Trelissick Basin by the upper limestone which forms Castle Hill.

The correlation of the Waipara System with any European equivalent at present presents considerable difficulties. The occurrence of *Plesiosaurus* above beds containing leaves of dicotyledonous angiosperms would seem to indicate an upper cretaceous age; but *Myliobatis* (which is here thought to be on the same horizon as *Plesiosaurus*) has never yet been found in the Northern Hemisphere in any mesozoic rock. I have often protested against the cretaceo-tertiary formation as defined by the Geological Survey; but this has been, not because I deny the possibility of the Waipara period extending into the tertiary era, but because I deny that the limestones, etc., of Weka Pass, Ototara, and other places belong to the Waipara System.

OAMARU SYSTEM.

Sedimentary Rocks.—These rocks attain their greatest elevation at Flock Hill (3,269 feet). At Castle Hill they go to 3,023 feet, and at Prebble Hill to 2,959 feet.

In the upper part of Coleridge Creek, tuffs, covered by limestone, rest on the rocks of the Waipara System, and dip 55° N.N.W. To the west an apparently isolated portion of the limestone requires further examination, as it appears to rest on Pareora beds; but probably this is deceptive. To the eastward the beds curve round to the north, and the limestone rests on the palæozoic rocks; they then again cross the creek, dipping at a high angle to the west. This is a famous locality for fossils, the tuffs under the limestone containing numerous teeth of *Lamna*, *Carcharodon*, and *Sparnodus*. On the north side of the creek the limestone is absent, the Pareora rocks resting on the tuffs. In White-water Creek the limestone is about 40 feet thick, and dips 15° W.S.W. It is underlain by a bed of conglomerate, formed of rounded fragments of volcanic rocks and limestone in a calcareous cement, which is full of fossils; below it comes dark-green tufaceous sandstone. The limestone can be followed continuously from here northward to Castle Hill, where it is cut off by the fault already mentioned. Between White-water Creek and Castle Hill the dip is 8° W. to 12° W. At Castle Hill it is 25° W.N.W., and near the fault 32° N. The eastern slope of Castle Hill I did not examine sufficiently; possibly the Waipara System may form the lower part. The limestone at Castle Hill is not less than 100 feet thick.

The Oamaru System again appears on the north side of the first limestone gorge of the Porter River, dipping 33° N.W. The greensands are here about 40 feet thick, but the limestone is very poorly developed, having been largely denuded before the deposition of the Pareora System. At the junction of the Thomas River with the Porter the limestone is about 50 feet thick, and is underlain by 10 feet of volcanic grit, below which comes 40 feet of tufaceous greensands, much current-bedded, and known as the "Fan coral-beds," from the occurrence of *Flabellum laticostatum*, Ten.-Woods. These rocks pass in an easterly direction up Prebble Hill, but they are not connected with those at the first gorge of the Porter. In Home Creek the limestone is 60 or 70 feet thick, and the tufac ous greensands 50 feet, with a bed of blue clay, 1½ feet thick, between them and the limestone. The dip in the Thomas River is 20° W. to 25° W., in the Home Creek about 20° W.S.W., and at the natural tunnel through which Murderer's Creek joins Broken River the dip is 10° N.W. In Broken River the tufaceous beds are thinner, but I did not examine them closely. At the natural tunnel they have passed into a calcareous tuff, which I did not recognize further north. An outlier of limestone occurs on Flock Hill, and two inliers on the west margin of the basin: one near the head of Moth Creek, the other a little north of the White-water Creek; but I did not examine them.

Volcanic Rocks.—Scoria beds and tuffs are largely developed in Coleridge and White-water Creeks. In Coleridge Creek some of the scoria beds might almost be called agglomerates, and evidently we are here near the orifice of a volcano which was in eruption during the early part of the Oamaru period. Some of the tuffs are fine-grained, compact rocks of a blue-black colour, and when broken present a sparkling crystalline surface, so that they might, at first sight, be readily mistaken for lava streams. But they effervesce with acid, and when thin slices are examined with a microscope they are found to consist of fragments of a deep brown-yellow palagonite, held together by a crystalline calcareous cement; some of the larger fragments contain crystals of olivine, and occasionally there are separate olivine fragments. Other tuffs are finer in grain, and effervesce very slightly. The specific gravity of these tuffs varies from 2·10 to 2·70, according to the amount of calcite they contain. In White-water Creek, just above the Amuri limestone, there is a tachylyte lava stream. It is compact, black, dull, breaks up irregularly under the hammer, and has a bluish tinge on the surface of the joints. Its specific gravity is 2·20. Under the microscope, in very thin slices, it is seen to be a vesicular tachylyte of an olive-brown colour, studded with globulites arranged in groups, either as clouds or as blackish spots.

In Home Creek, resting upon the Amuri limestone, another similar palagonite tuff occurs, compact, and of a blackish-green colour. This bed is 8–10 feet thick; the lower part is granular, effervesces freely, and has a specific gravity of 2·10; the upper part is finer in grain and effervesces slightly, its specific gravity is 2·00. Under the microscope this tuff is seen to be composed of angular fragments of brownish-yellow, or yellowish-green, vesicular palagonite in a calcareous cement. Olivine is rare, but there are occasionally small angular grains of quartz mixed with the palagonite. In the finer upper portion the palagonite fragments are smaller and greener, and there is less calcite. All these rocks break up into irregular cuboidal masses when struck by the hammer.

Dykes.—Eight dykes are known in the basin, all but one being clustered round Prebble Hill. Beginning in the south, we find the first (A) on both sides of the Porter River, near Table Hill (palæozoic), running east and west; I could not ascertain its thickness. The second (B) is just south of the fault at the first limestone gorge; it is nearly vertical, and runs W.N.W. through the greensands of the Waipara System. Turning eastward, along the south side of Prebble Hill, the next dyke (C) forms the crest of a long spur which runs W.N.W. The fourth (D) is on the ridge forming the watershed of the Broken River; it also runs W.N.W. The fifth (E) crosses Broken River; it is nearly vertical, runs N.N.E., and is 15 feet thick. Going up the river, the sixth dyke (F) is on the north bank, and runs N.N.E. The seventh (G) is also on the north bank of the Broken River, but above its junction with the Porter; it is 12 feet thick and runs N.W. The eighth dyke (H) is on the north bank of the Porter, in the marl; a small fragment, 12 feet long by 8 broad, is all that is exposed: it runs N.W. None of these dykes can be traced higher than the greensands, except H, and this one does not penetrate to the top of the marl. They are all dark bluish-black in colour, and are all composed of a micro-crystalline ground-mass of laths of plagioclase, rounded grains of pale-green augite and magnetite; but they can be divided into two groups. Dykes A, C, D, E, and H are basalt, with a specific gravity ranging between 2·82 and 2·95, the mean being 2·87. They vary from finely granular to crypto-crystalline. They all contain olivine, more or less abundantly, in rounded or broken crystals. This olivine is of two kinds: one is pale green, and shows brilliant colours with polarised light; the other is colourless, and when revolved between crossed nicols, either merely passes through grey into black, or else changes from pale bluish-green to pinkish purple. Dykes B, F, and G are augite andesite, with a specific gravity ranging between 2·59 and 2·70, the mean being 2·64. They contain no olivine, and have a finely granular texture. The position of these dykes, clustered round Prebble Hill and penetrating the green sandstones only, gives the impression, at first sight, that they may have been connected with a small volcano under Prebble Hill, and that they were formed before the marl and limestone were deposited. But there are no traces of contemporaneous volcanic action in the green sandstones, nor in the marl, while only one of the dykes has penetrated so far upward as the lower part of the marl. Between the marl and the limestone rolled volcanic pebbles are found, but these may have come from the same source as the liparite pebbles found at Craigieburn, which were certainly not erupted in the neighbourhood. Chemically these dykes appear to be closely allied to the tachylyte and palagonite tuffs of White-water and Home Creeks; so that we may, I think, conclude that they were erupted at the commencement of the Oamaru period, and that their failure to penetrate Prebble Hill was owing to the tough nature of the overlying rocks.*

I have considered that the tufaceous beds in White-water Creek are of the same age as those at the Thomas River and Home Creek, where they join the Porter; but as Mr. McKay holds a different opinion, it is necessary to state the evidence more fully:—(1.) Stratigraphically, the positions of the two are identical. Mr. McKay, unfortunately, missed seeing the outcrop of the Amuri limestone on the left bank of White-water Creek, which is now quite plain, although it might have been covered up at the time of his visit. (2.) Lithologically, the palagonite tuffs are the same in both places, and are quite different to the beds between the marl and the Amuri limestone, at the first gorge of the Porter, with which Mr. McKay would compare them. (3.) Palæontologically, the fossils from the two localities are identical. If the reader will compare the list of fossils given by Mr. McKay from the tuffs at White-water Creek (locality No. 241) with those from the Fan coral-beds at Thomas River (localities Nos. 239 and 243), he will find that there are in the first list 23 named species, (the undetermined species not being available for comparison,) all but three of which occur in the Fan coral-beds. And of these three, *Triton minimus* (= *T. pseudospengleri*, Tate) occurs elsewhere in New Zealand, only in the Pareora rocks; *Calyptra maculata* (= *Trochita neozelanica*, Lesson) is still living; and *Pecten hectori* (= *P. yahlensis*, Ten.-Woods) is a miocene shell of Victoria and South Australia. Consequently, none of these can indicate a greater age for the White-water Creek beds. Mr. McKay says: "The fossils collected from these beds at the first limestone gorge on the Porter River were too few to serve the purpose of this comparison; yet, as far as these may, they tend to show that those from White-water Creek belong to the lower tufas at present under consideration. The comparative list at the end of this report will show upon what grounds this opinion rests." † The locality

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* Since the above was written, Mr. Enys has brought me a specimen from another dyke on the south-west side of Prebble Hill, between dykes *c* and *d*. I have called it dyke *k*. Its specific gravity is 2·81, and no doubt it is a basalt; but I have not made a microscopical examination. It runs nearly north and south, and may be a continuation of dyke *e*, which has, however, a specific gravity of 2·92.

† "Reps. Geo. Expl.," 1879-80, p. 64.

here mentioned is "No. 240, below Weka Pass stone, Porter River;"* but on looking over his list for the fossils collected here I was surprised to find that none are recorded. (4.) Also, if the large development of tuffs and scoria in Coleridge Creek belonged to the Waipara System, there would certainly be some indications of them in the upper part of the creek, between the lower limestone and the marl, which is not the case.

Fossils.—The following is a list of all the fossils I know from these beds:—

(1.) From the limestone—

Pecten hochstetteri, Zittel; and *Waldheimia triangularis*, Hutton. Both from the quarry at Castle Hill.†

(2.) From the tuffs and greensands—

1. *Cylichna enysi*, Hutton.
2. *Marginella dubia*, Hutton.
3. *Marginella ventricosa*, Hutton.
4. *Voluta elongata*, Swainson.
5. *Voluta attenuata*, Hutton.
6. *Mitra enysi*, Hutton.
7. *Ancillaria hebera*, Hutton.
8. *Triton pseudospengleri*, Tate.
9. *Natica ovata*, Hutton.
10. *Natica hamiltoni*, Tate.
11. *Trochita neozelanica*, Lesson.
12. *Crepidula striata*, Hutton.
13. *Turritella ambulacrum*, Sowb.
14. *Trochus nodosus*, Hutton.
15. *Zizyphinus spectabilis* (?), Adams.
16. *Cantharidus tenebrosus* (?), Adams.
17. *Teredo heaphyi*, Zittel.
18. *Panopæa orbita*, Hutton.
19. *Panopæa worthingtoni*, Hutton.
20. *Pholadomya neozelanica*, Hutton.
21. *Paphia attenuata*, Hutton.
22. *Cardium patulum*, Hutton.
23. *Cardium serum*, Hutton.
24. *Lucina dentata*, Wood.
25. *Cardita patagonica*, Sowb.
26. *Crassatella attenuata*, Hutton.
27. *Arca decussata*, Sowb.
28. *Limopsis aurita*, Brocchi.

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* "Rep. Geo. Expl.," 1881, p. 123.

† Mr. Enys informs me that a very large shark's tooth—probably *Carcharodon angustidens*—has also been found here; but he has not been able to secure it.

29. *Mytilus striatus*, Hutton.
30. *Crenella elongata*, Hutton.
31. *Lima jeffreysiana*, Tate.
32. *Pecten hutchinsoni*, Hutton.
33. *Pecten athleta*, Zittel.
34. *Pecten yahlensis*, Ten.-Woods.
35. *Pecten chathamensis*, Hutton.
36. *Pecten polymorphoides*, Zittel.
37. *Terebratula bulbosa*, Tate.
38. *Waldheimia gravida*, Suess.
39. *Waldheimia taylori*, Etheridge.
40. *Waldheimia patagonica*, Sowb.
41. *Waldheimia radiata*, Hutton.*
42. *Terebratella sinuata*, Hutton.
43. *Terebratella aldingæ*, Tate.
44. *Terebratellina suessi*, Hutton.
45. *Rhynchonella nigricans*, Sowb.
46. *Rhynchonella squamosa*, Hutton.
47. *Leiocidaris australiæ*, Duncan.
48. *Echinus woodsii*, Laube.
49. *Pericosmus compressus*, McCoy.
50. *Brissus eximius*, Zittel.
51. *Flabellum laticostatum*, Ten.-Woods.
52. *Flabellum spenodeum*, Ten.-Woods.

Of the 46 species of Mollusca here enumerated, ten have not been found elsewhere, nine have been found elsewhere only in the Pareora System, and six elsewhere only in the Oamaru System. But as the known Pareora species are more than two and a half times as numerous as the known Oamaru species, this leaves a balance in favour of the beds belonging to the Oamaru System. The four *Echinoidea* belong only to the Oamaru System. *Flabellum laticostatum* is not recorded from elsewhere, but *F. sphenodeum* occurs also at Mount Caverhill, in the Amuri District. Five or six species of the Mollusca are still living, that is about 10 per cent. I therefore agree with the Survey that these beds are the equivalents of the Curiosity Shop beds, which I have elsewhere shown to be the equivalents of the Weka Pass and Ototara limestones.†

Relation to the Waipara System.—At the first limestone gorge of the Porter River, the Oamaru System is seen resting on the Waipara System quite unconformably, as has already been

* *Waldheimia radiata*, sp. nov. Shell broadly ovate, with a deep ventral ridge and dorsal furrow, but very irregular. Surface with strong longitudinal ribs—about 18 on the ventral valve, of which 4 or 5 are on the ridge—imbricated with coarse growth-lines. Beak prominent, acute, the foramen sub-triangular, the deltidial plates disunited. Length, 0·56; breadth, 0·5; thickness, 0·3 to 0·4 inch. A well-marked punctate shell.

† "Quar. Jour. Geol. Soc. of London," vol. xli., p. 547.

pointed out by Mr. McKay. At White-water Creek the Amuri limestone had been denuded down to a few feet before the Oamaru System was deposited; and in the lower part of Coleridge Creek the Oamaru System rests on the marl, the Amuri limestone having been entirely removed, although it still retains a thickness of between 200 and 300 feet at each end of the basin. In the upper part of Coleridge Creek an unconformity can also be made out, the Waipara System striking N.W., and the Oamaru System, in contact with it, W.S.W. The unconformity is therefore well marked.

Pareora System.

This system rests on palæozoic rocks along the west margin of the basin, and extends eastward to the Oamaru System. More to the north it rests on the Waipara System. It attains its greatest elevation (3,390 feet) at the Hog's Back, while in the southern part of the basin it does not reach to 3,000 feet.

The following is the section, in descending order, seen in an affluent of White-water Creek from the north. (Pl. XXV., Section III.)

	Feet.
7. Blue shales (plant beds)	150
6. Soft grey sandstone, current-bedded	200
5. Grey sandstone, or sand, with layers of broken shells, *Struthiolaria spinosa*, etc.	80
4. Sandy clay full of Lamellibranchs	2
3. Grey sandstone, with shells and concretionary layers	15
2. Sandy clay, full of Lamellibranchs	3
1. Grey calcareous sandstone, with shells ...	15

No. 1 rests upon the denuded surface of the limestone of the Oamaru System (Weka Pass stone), which dips 15° W.S.W., while the Pareora System dips 10° W.N.W. Further up the creek the dip of the Pareora System remains the same in direction, but increases to 25° in No. 7.

In Moth Creek the beds are obscure, but they consist of blue sandy clays with marine shells, probably representing No. 6 of the White-water Creek section. In the Thomas River, from the road crossing downwards, the following are seen :—

6. Dark grey clay and shales, with plant remains.
5. Pale grey-yellowish sands, and thin seams of shale, with plants.
4. Grey sandy clays and shale.
3. Lignite.
2. Grey sandstone, full of Lamellibranchs.
1. Grey sandstone, current-bedded—200 feet.

The lower beds dip 23° N.W., but higher up the river they appear to be horizontal (Pl. XXV., Section I.), although much disturbed by slips. The plant beds on the right bank of the river, near the road, dip 65° N.N.W. This high dip is probably due to the fault which has thrown the beds down. On the right bank of the Broken River, where the road crosses, the following section is seen, the rocks dipping 12° S.W.:—

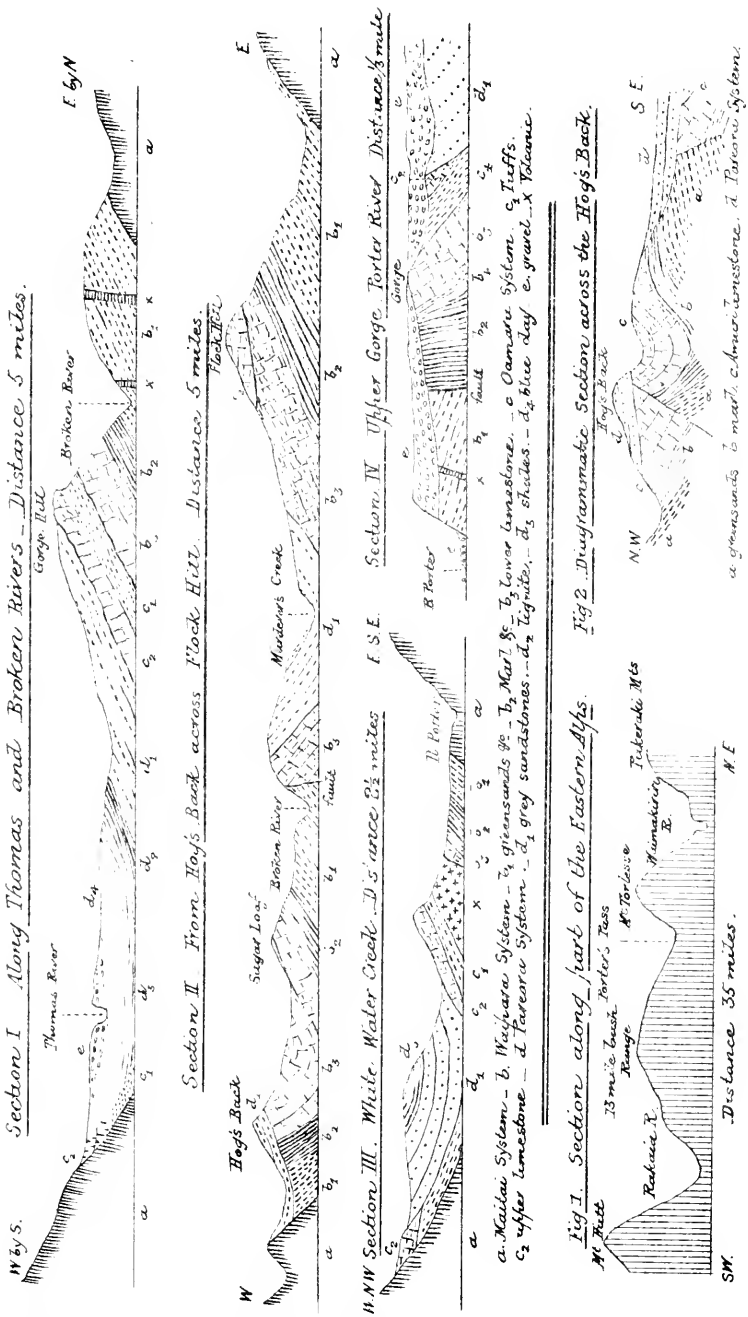
5. Brown and blue shales.
4. Grey sand.
3. Lignite, 2½ feet.
2. Clay, 3 or 4 feet.
1. Sands, current-bedded.

The sandy beds with *Struthiolaria spinosa*, etc., were not seen by me in the Thomas River section, although they are well-developed in the Porter River between the two gorges; it is possible, therefore, that an unconformity may occur below the lignite. However, the lignite is found in the Porter River, between the two gorges, overlying the *Struthiolaria* beds, and I could see no evidence of unconformity; but the beds are disturbed and the sections obscure.

An outlier occurs on the Hog's Back, in the north-west corner of the basin, where the beds, resting unconformably on the Waipara System, dip 15° W.S.W. (Pl. XXV., fig. 2).

Relation to Oamaru System.—In White-water Creek I have already mentioned that the Pareora System is unconformable to the Oamaru System; on the north side of Coleridge Creek the Pareora rocks rest on the tufaceous beds of the Oamaru System, the limestone having been entirely denuded away, and in the north part of the basin it rests on the Waipara System. In fact, the unconformity between the Pareora and Oamaru Systems is manifest, and admitted by all. Mr. McKay, however, takes the beds lying on the upper limestone, at the junction of the Thomas with the Porter, as the upper part of the Oamaru System, his reason being that boring molluscs have penetrated some of the shells after the matrix with which they are filled had consolidated, proving unconformity with the upper beds (*l.c.*, p. 68). But this is not a good reason, as the same thing may be seen in many consolidated beaches at the present day; and as these particular rocks are very calcareous, they probably consolidated as fast as they were formed. The locality is very difficult, indeed dangerous, to get at, and the stratigraphical relations of the rocks cannot be easily examined; but the fossils (localities Nos. 237 and 238 of the Survey) are entirely Pareora, and I therefore include them in that system, as was done by Dr. Hector in 1872.

Fossils.—As the fossils have been collected from two different horizons, it is better to keep them distinct. The lower horizon



F.W.H. delt.

To illustrate Paper by F. W. Hutton.

includes 1 to 4 of the White-water Creek section, and 1 to 2 of the Thomas River section. The upper horizon includes the beds between these and the lignite or plant beds.

Lower Horizon.

1. *Cominella carinata*, Hutton.
2. *Voluta kirkii*, Hutton.
3. *Triton pseudospengleri*, Tate.
4. *Crepidula monoxyla*, Lesson.
5. *Crepidula costata*, Quoy and Gaim.
6. *Turritella gigantea*, Hutton.
7. *Turritella rosea*, Quoy and Gaim.
8. *Vermetus moniliferus*, Hutton.
9. *Turbo superbus*, Zittel.
10. *Dentalium giganteum*, Sowb.
11. *Venus oblonga*, Hanley.
12. *Venus yatei*, Gray.
13. *Cytherea assimilis*, Hutton.
14. *Dosinia magna*, Hutton.
15. *Dosinia subrosea*, Gray.
16. *Tapes curta*, Hutton.
17. *Cardium spatiosum*, Hutton.
18. *Crassatella ampla*, Zittel.
19. *Arca decussata*, Sowb.
20. *Cucullæa ponderosa*, Hutton.
21. *Cucullæa worthingtoni*, Hutton.
22. *Cucullæa alta*, Sowb.
23. *Pectunculus laticostatus*, Quoy and Gaim.
24. *Pectunculus globosus*, Hutton.
25. *Pectunculus cordatus*, Hutton.
26. *Modiola australis*, Gray.
27. *Lima crassa*, Hutton.
28. *Hinnites trailli*, Hutton.
29. *Rhynchonella nigricans*, Sowb.

Upper Horizon.

1. *Stenorhynchus* (?), caudal vertebra.
2. *Myliobatis*, teeth.
3. *Purpura textiliosa*, Lamarck.
4. *Siphonalia mandarina*, Duclos.
5. *Cominella carinata*, Hutton.
6. *Cominella maculata*, Martyn.
7. *Oliva neozelanica*, Hutton.
8. *Ancillaria australis*, Sowb.
9. *Voluta pacifica*, Solander.
10. *Voluta gracilis*, Swainson.
11. *Voluta kirkii*, Hutton.
12. *Conus trailli*, Hutton.

13. *Pleurotoma sulcata*, Hutton.
14. *Clathurella hamiltoni*, Hutton.
15. *Natica darwinii*, Hutton.
16. *Natica gibbosa*, Hutton.
17. *Natica ovata*, Hutton.
18. *Natica hamiltoni*, Tate.
19. *Cerithium nodosum*, Hutton.
20. *Struthiolaria spinosa*, Hutton.
21. *Struthiolaria obesa*, Hutton.
22. *Struthiolaria cingulata*, Zittel.
23. *Trochita neozelanica*, Lesson.
24. *Crepidula incurva*, Zittel.
25. *Turritella tricincta*, Hutton.
26. *Turbo superbus*, Zittel.
27. *Cantharidus tenebrosus*, Adams.
28. *Dentalium conicum*, Hutton.
29. *Mactra discors*, Gray.
30. *Cytherea enysii*, Hutton.
31. *Cytherea assimilis*, Hutton.
32. *Chamostræa albida*, Lamarck.
33. *Crassatella ampla*, Zittel.
34. *Cardita patagonica*, Sowb.
35. *Pectunculus laticostatus*, Quoy and Gaim.
36. *Mytilus latus*, Chemnitz.
37. *Perna*, sp. ind.
38. *Anomia undata*, Hutton.

In the plant-beds, above the lignite, casts of two small bivalves have been obtained. They have been referred doubtfully to *Unio*, but they are much smaller than any species known to me, and one of them appears to have been radiately ribbed; they have the shape of *Callista*.

Origin of the Trelissick Basin.

Mr. McKay appears to be of opinion that the form of this basin is due, in large part, to foldings of the rocks by compression, subsequent to the deposition of the Pareora System; and it is to these foldings that he would attribute the upheaval of the surrounding mountains.* This opinion is, perhaps, to some extent, due to the very exaggerated sections which accompany his report; but in reality there is no dip in either the Pareora or the Oamaru rocks which cannot be easily accounted for (1) by original deposition; or (2) as the effect of subsequent landslips or faults; or else (3) by being in the immediate neighbourhood of a volcano. The only localities where the dip is more than 30° are in Coleridge Creek, near the volcano; in the upper gorge of the Porter; and the plant beds at the Thomas where the road

* "Rep. Geol. Expl.," 1879-80, p. 59.

crosses, close to faults; or else in places where landslips have evidently taken place. There is no stratigraphical evidence of folding by lateral pressure of a general character, involving the palæozoic rocks; and if the tertiary rocks had been folded by compression they would have been to some extent altered by the heat and pressure, as are the eocene and miocene rocks of the Swiss Alps and the Himalaya. Here, however, the tertiary rocks are quite like their equivalents on the plains and at Oamaru.

With the Waipara System some folding may have occurred, but I think the evidence is not much in favour of it. The steep dips at Parapet Rock and in the Broken River near Sugarloaf are no doubt due to the fault which crosses at both places. In the lower part of Whitewater Creek we find dips varying from 45° to 70°, but these may be owing to subsidence of the volcano which burst through them in the Oamaru period. At the Hog's Back true folding may have occurred; although even here the steep syncline at the south end may have been formed in connection with the fault; indeed, it looks much as if it had been squeezed together between two faults (Pl. XXV., fig. 2). But this movement, whatever may have been its cause, took place before the deposition of the Pareora System, which rests at a slight angle upon the upturned edges of the Amuri limestone.

The valley in which the Trelissick Basin lies evidently owes its origin to a pre-cretaceous river, which ran in a northerly direction from Coleridge Creek to Craigieburn, and joined the Waimakariri. But the question arises: Was the present rock-basin, in which the Waipara and younger rocks lie, hollowed out by a glacier? Or is it due to unequal movements of lava? I was formerly of opinion that it had been hollowed out by a pre-tertiary glacier coming from the Waimakariri and emptying down the Acheron into the Rakaia; but I have now abandoned this idea, partly because of the great fall between Craigieburn Saddle and Lake Pearson, but chiefly on account of the discovery of pebbles of liparite at Craigieburn, which could hardly have been brought from the Malvern Hills if a lake had lain in the way. It now seems to me more probable that the northern part of the valley was elevated more than the southern part, during the elevation that followed the deposition of the Pareora marine strata; for such an unequal elevation would account for all three rock systems being now found at higher elevations in the northern than in the southern end of the basin, notwithstanding the northerly downthrow of two of the faults. This greater elevation of the northern or lower part of the valley would throw the drainage of the basin over the low eastern rim, and the present gorge of the Broken River would then be cut. This would have occurred during, or after, the last great glacier epoch. This same unequal elevation would also account for the narrow gorge, already mentioned, by which the Waimakariri enters the Canterbury Plains, and which, according to Dr. von Haast, has been entirely cut since the glacier epoch.* If this hypothesis be correct, it follows that the inland sea in which the Waipara, Oamaru, and Pareora rocks were deposited, must have entered the Trelissick Valley from the Waimakariri by Craigieburn; the Broken River gorge not having been cut until long afterwards; and as all these rock systems bear marks of an epoch of subaërial denudation following that of their deposition, it follows that the sea entered by this channel at three different times, each time followed by an epoch of upheaval.

[Addendum.]

Christchurch, 30th September, 1886.

Mr. J. D. Enys has informed me that, since my visit to Castle Hill Station, he has discovered a dyke nearly at the top of Gorge Hill—between Broken River and the Porter—which he believes to be a continuation of dyke D. This furnishes absolute proof that one of the dykes, at any rate, is younger than the Waipara System; and probably, therefore, all are younger.

F. W. H.

Art. LIII.—*On the so-called* Gabbro *of Dun Mountain.*

By Professor F. W. Hutton, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 4th November,* 1886.]

This is a very coarsely-crystalline rock composed of two minerals only. One is a foliated greenish-brown mineral, like bronzite or diallage, in irregular crystalline masses. The other is an opaque-white or greenish-white felspar, like saussurite. The specimen was given to me by Sir J. von Haast, and I do not know its field relations further than that it comes from the Dun Mountain, near Nelson. Its specific gravity is 3·15.

The foliated mineral.—Under the lens the principal cleavage planes are seen to be finely striated; this striation being due to the development of a second plane of cleavage, less perfect than the first, and crossing it at an angle of about 67°. In thin sections, showing both cleavages, the mineral gives brilliant polarization colours, and always extinguishes parallel to the fine striations and oblique to the principal cleavage. This shows

* "Geology of Canterbury and Westland," p. 213.

that these sections must be transverse to the principal axis; for if not, the cleavages would either be at right angles to each other (Rhombic System, or Ortho-pinacoid), or else the extinction would be oblique to both cleavages (Clino-pinacoid). The edge formed by these cleavage faces is therefore parallel to the principal axis, and as the principal cleavage is not on an axis of elasticity, it must be parallel to one face of the prism: no cleavage seems to be developed parallel to the other face.

A section, approximately at right angles to the principal axis—as proved by the angle between the cleavages—shows, with convergent polarized light, a symmetrical bisectrix with wide axial angle, and the axial plane in the direction of the striations. Cleavage flakes from the principal cleavage (210) give straight extinction, and show an optic axis on the margin of the field, with the axial plane in the direction of the striations; thus giving a further proof that this cleavage is parallel to the face of the prism.

Cleavage flakes of the second cleavage show no striations, but extinguish apparently parallel to the first cleavage; this, however, is not very exactly marked. They show no interference figure with convergent polarized light.

These straight extinctions, and the bisectrix seen on 001, prove that the mineral belongs to the Rhombic System. Now, in the Rhombic System, the angle between 110 and 100 must lie between 0° and 45°, while the angle between 110 and 010 must lie between 45° and 90°. Consequently, as in our case the angle between the two cleavages is about 67°, it follows that the second cleavage, and the plane of the optic axes, are parallel to the brachy-pinacoid.

The angles of the prism will be 134° and 46°, but the measurements are not very exact, owing to the want of proper instruments; they are however sufficiently so to show that the mineral is not a rhombic pyroxene but a rhombic amphibole, and probably, therefore, anthophyllite. Pleochroism is well marked in sections more or less parallel to 001. The colour for α being greenish-yellow, and for β reddish-brown. Sections parallel to the cleavages do not show any marked pleochroism, so that the colour for γ is greenish-yellow, like that for α. Before the blow-pipe the mineral is infusible, or fusible only with great difficulty. All these characters agree with anthophyllite, but the typical form of that mineral is said by E. S. Dana to have its principal cleavage parallel to 100, and the relative lengths of the lateral axes are not so unequal as in our variety.

The felspar.—This mineral is so much altered as to show merely a number of granules and rods in a transparent base, which is generally quite amorphous, but occasionally crypto-crystalline. No doubt it is some kind of plagioclase, but whether it has been anorthite or labradorite can only be determined by chemical analysis; at present it is saussurite.

The question now arises, What name are we to give the rock? There is no special name applied to plagioclase-anthophyllite rocks—apparently because anthophyllite is rare. But as anthophyllite is a rhombic amphibole, it may be grouped with hornblende; so that perhaps the name corsite might be made to include our rock. The typical corsite—*i.e.*, the orbicular diorite of Corsica—is said by Cotta to be composed of anorthite, blackish-green horn-blende, and some quartz. Later writers have omitted the quartz as undoubtedly of secondary origin, and corsite is now defined as an anorthite-hornblende rock. The hornblende is generally the foliated variety called smaragdite, and is supposed to be a decomposition product of augite; so that, from this point of view, a corsite would be an altered eucrite or gabbro, and in the latter case could hardly be distinguished from euphotide, as restricted by Professor Bonney. Mr. Teall looks upon corsite as a variety of diorite in which the felspar is anorthite.*

Now, although hornblende is undoubtedly often a secondary product after augite, we cannot suppose that all hornblende has been thus derived; that all syenites have been augite syenites, and that all diorites have been gabbros or dolerites. Evidently hornblende is often an original constituent of a rock, and therefore, under certain conditions, we have no reason to suppose that it may not become schillerised as augite does; smaragdite answering to diallage, and anthophyllite to bronzite or hypersthene. This being so, it would seem to be advisable to have a name to represent this particular condition of amphibole rocks, and I would suggest that the name corsite be enlarged to include all rocks essentially composed of plagioclase and a foliated amphibole (such as smaragdite and anthophyllite); it would then bear the same relation to diorite that gabbro and norite do to dolerite. With the pyroxene rocks the kind of felspar is not always taken to warrant a separate name, as shown by norite, which is a plagioclase-enstatite rock; and gabbro is often made to include eucrite. Why, therefore, should the amphibole rocks be treated differently to the pyroxene rocks? In the rock from the Dun Mountain, there is nothing to indicate that the anthophyllite is a changed pyroxene, but it is itself altered in places into a green fibrous mineral which may be smaragdite.

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* "British Petrography," p. 73, footnote.

ART. LIV.—*On the Geology of the Country between Oamaru and Moëraki.*

By Professor F. W. HUTTON, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 16th July,* 1886.]

Plate XXVI.

INTRODUCTION.

THE Hon. W. Mantell was the first geological observer in this district. In 1850 he described the Ototara limestone of Oamaru, the Onekakara clay of Hampden, and the volcanic ash of Kakanui. The fossils collected by him were examined by Dr. Mantell, Professor Morris, and Professor Rupert Jones. The Ototara limestone was referred, with doubt, to either the cretaceous or the eocene period; while the Onekakara clay was considered to be either pleistocene or newer tertiary; but, at this time, it must be remembered, the recent fauna of the New Zealand coasts was very imperfectly known. Mr. Mantell remarks that he had no opportunity of ascertaining the relative positions of the Ototara limestone and the volcanic ash of Kakanui.*

In 1865, Dr. Hector placed the Moëraki series (including the Onekakara clay) below the Oamaru series, and considered both to be miocene; the volcanic rocks he considered to be pliocene.†

In 1869, Mr. C. Traill, after examining the fossils from Hampden and Awamoa, came to the conclusion that both were probably miocene.‡

In 1870, Dr. Hector placed the Hampden and Awamoa beds in his Upper, or Struthiolaria series, and the Oamaru limestone (including the Hutchinson's Quarry beds) in his Older, or Ototara series.§

In my "Catalogue of the Tertiary Mollusca and Echinodermata of New Zealand" (1873), as also in my "Report on the Geology of Otago" (1875), I followed Dr. Hector, but called his upper and his older series the Pareora and Oamaru formations respectively. In this latter report I also pointed out that the volcanic rocks of Moëraki overlie the Onekakara clay, thus belonging to a later period of volcanic activity than those supposed to be associated with the Hutchinson's Quarry beds at Oamaru.

In December, 1876, and January, 1877, Mr. A. McKay examined the district, and made several important alterations.‖

* "Quar. Jour. Geol. Soc. of London," vol. vi., p. 324.

† "Quar. Jour. Geol. Soc. of London," vol. xxi., p. 128, and section.

‡ "Trans. N.Z. Inst.," vol. ii., p. 167.

§ "Cat. Col. Mus.," 1870, pp. 178, 179, and 189.

‖ "Rep. of Geol. Expl.," 1876-77, p. 41, etc.

He ascertained that volcanic rocks underlie the Ototara limestone; while others, he thought, were associated with the Hutchinson's Quarry beds. He maintained that the Hutchinson's Quarry beds are unconformable to the Ototara limestone, and stated that the fossils prove them to be members of the same formation as the Awamoa beds (*l.c.*, p. 58). Dr. Hector, also, in his Progress Report for the same year, says: "These higher [Hutchinson's Quarry] beds it has been impossible to separate, either stratigraphically or otherwise, from the Awamoa series which overlies them" (*l.c.*, p. ix.). Nevertheless they are always separated in all the classifications of the Geological Survey, the latest of which will be found in the "Reports of Geological Explorations for 1883–4," p. xiii.

In 1881, Dr. Hector says that the Ototara limestone is separated from the Hutchinson's Quarry beds by a series of volcanic rocks which belong to the upper part of the cretaceo-tertiary (=Waipara) period.*

In 1882, Mr. A. McKay again visited the district, and extended his observations as far south as Moëraki.† In his report, the blue clay and dark-green sandstones of Hampden and Otepopo (Moëraki series) are stated to underlie the Ototara limestone: thus returning to the first arrangement of Dr. Hector.

Last November I re-examined the district, and arrived at the following results:—(1.) Mr. McKay is right in saying that volcanic rocks underlie the Ototara limestone. (2.) He is probably right in his conclusion that an unconformity exists between the Hutchinson's Quarry beds and the Ototara limestone, although wrong in the reasons he adduces for it. (3.) He is wrong in his opinion that the rocks of Hampden and Otepopo are older than the Ototara limestone; and (4.), we are probably all wrong in supposing that any volcanic eruptions took place between the deposition of the Ototara limestone and the Hutchinson's Quarry beds, or during the deposition of the latter.

Before proceeding to give the evidence on which these conclusions rest, I wish to remark that my mistake as to the true position of the volcanic rocks at Oamaru arose from supposing that the pieces of limestone found in these rocks were fragments of the Ototara limestone which had been altered by heat; a defective observation, which led me to assume that the limestones which rest on volcanic rocks at Kakanui and the south-west end of Cape Wanbrow must be younger than the Ototara limestone, and consequently must belong to the Hutchinson's Quarry beds. I now find that these pieces of limestone are parts of veins in the volcanic rocks which have been formed after consolidation of

* "Rep. Geol. Expl.," 1881, p. xxvii.

† "Rep. Geol. Expl.," 1883-84, p. 58, etc

the rocks. If I had examined the Waireka Valley during my first visit to the district I should probably have found out my mistake. As the Ototara limestone is younger than the volcanic rocks, the inference naturally follows that the Hutchinson's Quarry beds, which also rest on volcanic rocks, may be unconformable to it; but the stratigraphical evidence is not conclusive, as the Ototara limestone may, perhaps, never have extended so far to the east. This question must be solved by palæontology, as I will presently point out. The specific gravities mentioned in the paper were all taken by Walker's Specific Gravity Balance, and by Jolly's Spiral Balance.

OAMARU DISTRICT.

Volcanic Rocks.

I noticed four principal centres of eruption, but no doubt there are others.

1. *Oamaru Volcano.*—In passing along the shore from the breakwater at Oamaru towards Cape Wanbrow, we first find rocks dipping 25° N. The upper beds (Pl. XXVI., Section I., *a*), under the Flagstaff, are basaltic agglomerate and ash, the former with bands and pieces of fine-grained limestone. It is this limestone that in 1874 I mistook for included fragments of Ototara stone, altered into a kind of lithographic limestone. By Mr. McKay they are shown as regular beds, interstratified with the agglomerate. A careful inspection, however, has convinced me that they are all veins running between blocks of lava in the agglomerate. They are segregation veins, formed from the calcareous cement in the agglomerate and ash beds, and are of later age than the main body of the rock. The volcanic rocks in contact with these veins are not in the least altered, and the veins are usually compact and solid throughout, often with a banded structure parallel to the margin. In one instance I noticed that there was a compact layer on each side, while the central portion, varying from 6 to 12 inches in thickness, was filled in with broken shells and corals; the two inner surfaces of the limestone were quite smooth, and the organic fragments appear to have been washed in from above. Associated with these beds are tachylyte breccias, consisting of angular fragments of glossy tachylyte, rarely exceeding an inch in thickness, cemented together by crystalline calcite. Round their margins the fragments are often altered into a rich yellow-brown palagonite. The basalt of the agglomerates is compact, bluish-black in colour, finely crystalline, and with olivine more or less abundant; S.G. = 2·80. Under the microscope it is seen to consist of a microcrystalline ground-mass of felspar laths, magnetite, and pinkish-brown augite grains, containing here and there crystals of slightly dichroic olivine, much decomposed round the margins

into a dark-brown mineral. The tachylyte is formed of a pale smoky-brown glass, in which are numerous felspar laths. Here also the olivine has undergone much decomposition, a description of which I reserve for another occasion. Its specific gravity is 2·72.

Below the agglomerates comes a series of thin-bedded greenish-brown sandstones (*b*) containing fossils, and interstratified with ash beds. Below these is a coarse scoriaceous sandstone, which is underlain by grey current-bedded sandstones. Then, at the next point, comes a remarkable agglomerate (a^1) formed of large basalt bombs, the interstices between which are filled up with compact fossiliferous limestone. These bombs vary from one to six, or more, feet in diameter, and some of them on the lower surface curve round those below, showing that they were soft when they fell into their places. Each bomb is encased by a coating of tachylyte about 1 inch thick, which is decomposed in places into reddish-yellow palagonite. The basalt of these bombs is rather coarser in texture than that of the agglomerate first mentioned, and I could detect no olivine with the naked eye; but under the microscope both the basalts and the tachylytes are much alike. Beyond the agglomerate, in descending order, comes (3) a series of thin-bedded sandstones and clays, dipping 20° N. Next below are (2) coarser scoriaceous sandstones, dipping 30° N., and then (1) agglomerate, (a^2 in section,) which gradually changes round to an easterly dip, so as to look nearly horizontal in the cliff. Then comes a *fault* with a *hade* to the north. On the south side of this fault the beds dip 25° S.E. At the top of the cliff are the thin-bedded sandstones and clays (3), underlain by the coarser scoriaceous sandstones (2), so that the downthrow of the fault is to the south, or, in other words, it is a reversed fault; the throw, however, is small. The sandstones and clays (3) extend to the next point, which is quite low; and in the following bay all the rocks are obscured by the silt deposit, which here comes down to the sea. The next point is Cape Wanbrow, formed of grey scoriaceous sandstones, dipping 10° S.E. I have given a somewhat detailed account of this section, for I am under the impression that it is at the fault that Mr. McKay supposes an unconformity to exist between his upper eocene and cretaceo-tertiary formations; but, if so, he is undoubtedly wrong. At the same time, I saw no other place where any break occurred at all.

Past Cape Wanbrow the dip changes gradually to 15° S.S.E.; then to S., then to 15° S.S.W.; and ultimately to 35° S.W. The grey scoriaceous sandstones of Cape Wanbrow occupy most of this section (Pl. XXVI., Section II.), but are overlain by a bed of pale grey tuffaceous limestone, 6 or 7 feet in thickness, containing minute fragments of coral. This is followed by sandstones with fossils, and then the Otatara limestone, 45 feet thick. The details of this part of the section I will defer until treating of the Hutchinson's Quarry beds.

It will be seen that the beds all round the east side of the Oamaru Peninsula form a single periclinal curve, as shown by me in 1875.* Mr. McKay's section† is very different, and I am at a loss to account for it, as he gives no details.

2. *Deborah Volcano.*—Between the Deborah railway-station and Totara are the relics of another volcano, which has been almost entirely destroyed by denudation. The rocks are basic, but I neglected to collect specimens. So far as I could see, they always underlie the Ototara limestone, which surrounds the volcano on all sides but the south-east. Mr. McKay, however, mentions a lava flow overlying the limestone somewhere in the neighbourhood.‡ He gives no precise locality, and I failed to find it; but as I arrived late in the day I could not make a sufficiently careful examination. In the Waireka Valley, opposite Deborah, a tachylyte tuff, probably erupted from this volcano, underlies the Ototara limestone, but I will give its position when describing the sedimentary rocks of the Ototara series. This tuff is compact, grey in colour, and with a lens shows minute black shining spots, and occasionally small pieces of vesicular tachylyte. It effervesces freely with acid, S.G.=2·47. Under the microscope it is seen to be made up of minute angular fragments of vesicular tachylyte in a calcareous cement. The tachylyte is of a pale yellow-brown colour, without any felspars, but contains a few scattered microliths. The vesicles are ovoid, not much elongated. It is much like a tachylyte tuff, presently to be described, from Lookout Bluff.

3. *Enfield Volcano.*—The railway at Enfield runs through an old volcano which extends as far as Elderslie (Section III.). It is formed principally by lava flows, which are compact and finely crystalline. Some are dark grey in colour, with small white pearly flecks, and cavities filled with limonite; these rocks weather reddish-grey. Others are darker, and without white flecks. S.G.= 2·64. I could see no olivine in any of them. Under the microscope these rocks are seen to have a micro-crystalline ground-mass of felspar laths, brownish augite grains and ilmenite, more or less decomposed into leuxocene. There are no porphyritic crystals. In the absence of chemical analysis, I feel inclined to call these rocks augite andesites. At the road cutting close to the Waireka Presbyterian Church, there is a palagonite tuff composed of fragments of tachylyte and fragments of black magma-basalt with olivine. S.G.=2·35. The tachylyte is altered in places into a yellow-brown or brownish-green

* "Geology of Otago," p. 55, fig. 7.

† "Rep. Geol. Expl.," 1876-77, p. 50, section No. 3.

‡ "Rep. Geol. Expl.," 1876-77, p. 58.

palagonite. I could obtain no direct evidence of the age of these rocks, and it is quite possible that the andesitic lava flows may belong to a later period than the palagonite tuffs. This is a point that requires more investigation than the time at my disposal would allow.

4. *Kakanui Volcano.*—The Kakanui River runs into the sea between two low hills formed of scoriaceous sandstone overlain by the Ototara limestone, here generally more compact than usual. (Section IV.) The sandstones of the northern hill form a periclinal curve, which extends across the river so as to include the rocks seen in the river-bed between the bridge and the sea. The south head is a separate and smaller periclinal curve, showing two foci of eruption; but I did not ascertain which of the two is the younger. I saw no lava streams.

Sedimentary Rocks.

Ototara Series.—This series consists of the Ototara limestone, known as the Oamaru building-stone, together with all the conformably underlying rocks. The Ototara stone is a rather friable and very pure limestone, capable of absorbing one-third its bulk of water. It is made up of minutely comminuted Bryozoa and Hydrocorallinæ, with Foraminifera in the interstices. The underlying beds differ in different places. In Cave Valley the rocks immediately underlying the limestone are obscured; but the railway passes through a bed of pale-yellow, non-calcareous, diatomaceous ooze, which is cut by a dyke 20 feet thick and running E.N.E., with a dip to N.N.W. (Section V.). This dyke is a compact, very dark basalt, without olivine, but with aggregations of greenish-brown augite grains with felspar laths, giving it a semi-ophitic texture. S.G. = 2·80. The dyke does not penetrate the Ototara limestone; but this cannot be taken as positive proof that it is older than the limestone, for its upper termination is not seen. I did not observe the chalk marl with flints, mentioned by Mr. McKay.

Further down the valley, at the School, volcanic rocks underlie the ooze. These volcanic rocks are seen in many places in the Waireka Valley below the Ototara limestone, and I have never seen any above it. In 1874, I observed, in a valley a little south of Cave Valley, thin-bedded, hard, dark sandstones underlying the Ototara stone. I believe that these beds come in between the limestone and the diatomaceous ooze, but I could not find them again this time. About a mile and a half south of Cave Valley the following section may be seen:—

6. Ototara limestone.	3. Palagonite tuff.
5. Clay.	2. Diatomaceous ooze.
4. Tuffaceous clay.	1. Volcanic rocks.

The lower part of the limestone contains small rounded fragments of volcanic rocks. The palagonite tuff I have already described when mentioning the Deborah volcano.*

A little north of Totara, on the west of the railway, the limestone rests on tuffaceous clays which dip 10° S.W., but which, towards the south, flatten to 4° S.W. In the railway cutting at Teschemaker's the limestone, here horizontal, passes down into a coarse rubble of broken shells, coral, sand, etc., and is underlain by about 8 feet of alternating beds of marl and limestone, below which is a brown volcanic sandstone, 10 or more feet thick, which appears to be derived from the degradation of volcanic ash, and not a true ash itself. It therefore appears, so far as my observations go, that volcanic action took place before and during the deposition of the marls and clays underlying the limestone, but there are no volcanic ashes in the limestone itself. The volcanic action was chiefly submarine, but the water was shallow.

The geographical distribution of the Ototara limestone has been described by Mr. McKay. The dips I observed were as follows:—At Cave Valley, 5° E.N.E.; near Totara railway-station, on west side of the road, 5° N.W.; on the east side, between the road and the railway, 4° to 10° S.W.; at north side of Deborah, 5° N.N.E.; on south side of Oamaru Peninsula, 35° S.W. Now, Oamaru Peninsula, Deborah, and Enfield are old volcanoes, consequently the Ototara series dips away from the nearest volcanic centre. This shows, in my opinion, that the Ototara limestone is the remains of several old coral reefs built up round small volcanic islands near the coast, and that it usually retains its original plane of deposition. Limestones are known to be forming at the present day, at angles as great as 33° and 35°, on the coral-reefs of Florida and the Solomon Islands.

Hutchinson's Quarry Beds.—This quarry is situated in the town of Oamaru, on the east side of Oamaru Creek, close to the path leading to the reservoir. It is now abandoned, but was formerly used for lime for burning. The following is the section displayed:—

	Feet.	
8. Dark-green sandstone	6	fossils.
7. Calcareous sandstone	8–10	fossils.
6. Conglomerate of volcanic rocks and compact limestone	10	
5. Volcanic clay	$1\frac{1}{2}$–2	
4. Compact limestone	$0\frac{3}{4}$	
3. Volcanic clay	$0\frac{3}{4}$	
2. Rubbly limestone	3	
1. Volcanic clay, with calcareous veins ...	13	

* To find this interesting outcrop, take the road from the Deborah railway-station to the quarry, and, leaving the quarry on the right, strike across the fields to the crest of the ridge. Then, looking down into the Waireka Valley, the section will be seen on the left hand.

Owing to a slip, the relation of Nos. 7 and 8 to the rest is not clear in the quarry, but higher up the creek No. 7 is seen resting on No. 6. All the fragments in the conglomerate are well rolled, and the volcanic clays appear to be detrital only. The beds are surrounded to the west and south by the volcanic rocks upon which they lie; to the east they are covered by silt; while to the north they extend for some distance along the east side of Oamaru Creek. I could find, however, in this part of the district, no junction with either the Ototara limestone or with the Awamoa series.

At Deborah, in a small railway-cutting, a little north of the station, the following rocks are seen, dipping 15–20° N.E.:—

3. Calcareous greensand.
2. Conglomerate of rolled volcanic rocks and limestone.
1. Ototara limestone.

The junction between Nos. 1 and 2 appears to be unconformable, but the cutting is too small to feel confident on this point.

At the south end of Oamaru Peninsula, we get the following section, all the beds dipping 35° S.W.:—

	Feet.
12. Blue sandy clay with calcareous concretionary layers.	
11. Green sandstone, with calcareous concretions near the top	25
10. Hard compact limestone	4–5
9. Limestone, with rolled volcanic fragments	12
8. Ototara limestone	33
7. Clay, with three bands of Bryozoon limestone	7
6. Ototara limestone	5
5. Volcanic conglomerate, with calcareous matrix	3
4. Blue ashy sandstones, with shells ...	150
3. Thin bedded sandstones	12
2. Grey tuffaceous limestone	6–7
1. Scoriaceous sandstones	200 +

No. 12 belongs to the Awamoa series; Nos. 9, 10, and 11 to the Hutchinson's Quarry beds; and all below to the Ototara series; but I could make out no unconformity between any of them. Here, as elsewhere, I came to the conclusion that volcanic action had ceased before the deposition of the Ototara limestone, and that it was not renewed during the deposition of the Hutchinson's Quarry beds.

At the south-west end of the southern hill, at Kakanui mouth, where the plains begin which stretch to the Otepopo River, the Ototara limestone, dipping 20° S.W., is overlain unconformably by dark-blue sandy clay, dipping very slightly to S.W. at the point of junction, and then getting horizontal as it passes south along Allday Bay. In this clay I obtained *Dentalium mantelli*, *Ostrea edulis*, *Waldheimia patagonica*, and *Cellepora nummularia*: but many more species could be obtained with plenty of time. I believe this clay to be the equivalent of the Hutchinson's Quarry beds, but more palæontological evidence is required. The unconformity between it and the underlying limestone is plainly to be seen in the coast section, not only in the difference of dip, but also in the denuded surface of the limestone (Section IV.).

The Hon. W. Mantell makes the following remarks on this locality: "A mile south of Kakanui, strata of tertiary blue clays first appear; they contain numerous shells of species that inhabit the neighbouring sea, corals, a few traces of fishes, and small portions of wood. In some localities the clay is capped by a thin layer of sandstone."* If the Hutchinson's Quarry beds are the same as this clay, then they must no doubt be placed, for reasons that will presently be given, in the Pareora System with the Awamoa series. I have already mentioned that Mr. McKay formerly held the opinion that the fossils were the same in both, although the Geological Survey has never grouped them together.

Pareora System.—I have already mentioned the Awamoa beds on the south side of Oamaru Peninsula, so well known from the collections made by Mr. C. Traill in 1868. The same beds occur on the eastern side of the hills north of Oamaru, as far as the Waitaki Valley. The only other place in the district where I saw rocks which I should refer to the Pareora System was in the Waireka Valley. Here, in going from Elderslie to Windsor, we see blue clay, which, further north, passes upwards into white quartz sands and gravels, covered from Corriedale to Ngapara by a hard conglomerate, formed by well-rounded white quartz pebbles in a ferruginous cement (Section III.). These form conspicuous cliffs, which cap the hills on both sides of the railway. I did not find any fossils in these beds, and cannot, therefore, pronounce positively as to their age, but it was from somewhere in this neighbourhood that Mr. C. Traill made a collection of Pareora fossils some years ago. I cannot, indeed, conceive these beds to be older than the Ototara limestone, as supposed by Mr. McKay; and in November, 1873, I found the quartz pebble beds resting on the limestone near Mr. R. Gillies' farm, in the Awamoko District. The lignite, which lies also above the limestone, is here generally covered by the ferruginous conglomerate. These beds appear to me to be like the Pareora gravels and conglomerates of Waihao and other places, and to occupy a valley of erosion in the Oamaru System.

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* "Quar. Jour. Geol. Soc. of London," vol. vi., p. 324.

In his earlier report, Mr. McKay says: "The outlier of these rocks [Pareora] between the Kakanui River and the Upper Waireka shows them to be quite unconformable to the Ototara limestone and the tufas and greensands underlying the limestone, as the limestone is absent and the conglomerates and blue clay seem there to lie on the tufas and basaltic rocks which are the northern continuation of the Mount Charles rocks at Otepopo. This conclusion is quite irresistible, if we consider the upper part of the valley of the Waireka as due to denudation, and not to a fault, which latter it could not well be."* It will be seen that my observations confirm this (except the relation to the rocks of Mount Charles); but in his last report Mr. McKay abandons his former views without any remark except the statement that these beds are overlain by the Maerewhenua limestone,† for which he adduces no evidence, and gives no section nor list of fossils. Mr. McKay, however, collected fossils in the Upper Waireka Valley, as well as beyond the first tunnel on the Windsor-Livingstone railway, which will, I hope, settle the question when they have been accurately named.

Silt Formation.—In my report on the Geology of Otago in 1875, I gave a section of the silt deposit, or *loëss* as it has been called, on the north side of Oamaru Peninsula, and stated that it rested upon gravels with marine shells. Quite lately Dr. Hector has called this in question. He says: "As far as I have observed, the presence of such shells under silt can always be accounted for by landslips of the slope deposit."‡ I therefore paid particular attention to this point, and can state confidently that on the north side of Oamaru Peninsula gravels with marine shells undoubtedly underlie the silt conformably. The cliffs have here been cut back for some distance to form the railway to the port; all traces of raised beaches, if they formerly existed, have been removed, and a true section has been exposed; as is proved by the intercalations of gravel and silt. But more than this: at the place where the railway sidings commence at the port, the cutting has exposed a large cave in the volcanic rocks which has been filled up to the roof with silt. On the floor of this cave are the gravel beds with marine shells, and these are covered by well-stratified sandy beds, passing up gradually into the silt, which is continuous with that of the rest of the cliff, as is clearly seen in the cutting. In this case a landslip is impossible, for the beds are covered by the roof of the cave; and if the fossiliferous beds pass under the silt here they must also do so in other parts of the cutting. On the south side of the peninsula, slips have, no doubt, occurred in places; but even

* "Rep. Geol. Expl.," 1876-77, p. 57.

† "Rep. Geol. Expl.," 1883-84, p. 59.

‡ "Rep. Geol. Expl.," 1883-84, Progress Report, p. xxv.

here it is quite evident that the gravels have slipped with the silt, and that both retain their relative positions. North of Oamaru many road sections show the silt to be distinctly interstratified with gravel beds, but I observed no fossils in them.

Hampden District.

Sedimentary Rocks.—Onekakara Bay lies between the Peninsula of Moëraki and Lookout Bluff, just south of the mouth of the Otepopo River. Hampden is a little to the south of the centre of the bay (Section VI.). The sedimentary rocks consist of blue clay (Onekakara clay), overlain by a soft dark volcanic sandstone, or rock-sand, which weathers greenish; the whole being covered by beds of gravel and silt. The sandstone is found chiefly north of Hampden, but it also occurs at Moëraki. It is in the blue clay, south of Hampden, that the Moëraki septaria are found.

The sandstone consists largely of well-rounded volcanic débris, and is black on first breaking, but soon turns greenish. A similar soft sandstone is largely developed in the banks of the Otepopo River, near the railway; it differs in being almost entirely a volcanic sand, and in weathering to a distinct green colour. The sandstone here is also underlain by blue sandy clay, with dark soft sandstone again below it. It is this latter sandstone which occurs at the Herbert tunnel. Small beds of lignite are associated with it, which were explored by Mr. Fenwick in 1875.

As I have already mentioned, the age of these beds is a matter of difference of opinion. In 1884, Mr. McKay divided them into three divisions, all of which he considered to belong to the cretaceo-tertiary or Waipara System. The stratigraphical evidence he produces in favour of this view is the mistaken idea that they are overlain by the tuffs below the Ototara limestone in the Waireka Valley; this relation depending entirely on the supposed equivalence of the volcanic rocks of Mount Charles and of Kakanui. Of palæontological evidence, Mr. McKay adduces none, for he gives no list of fossils; but to get rid of the evidence in favour of their miocene age, he makes two most extraordinary statements :—

(1.) Previous collectors have "imperfectly collected at points where slips have mixed them [fossils] with the recent shells of the coast-line."

(2.) Previous palæontologists have examined a mixture of cretaceo-tertiary and recent shells, "hence possibly one reason why these beds have been by some previous observers referred to the miocene period."*

* "Rep. Geol. Expl.," 1883-84, p. 62.

With reference to the first statement, it is not easy to believe that either the Hon. W. Mantell or Mr. C. Traill mixed together fossil and recent shells. Mr. Traill's collection is still in existence, partly in the Wellington Museum and partly in that at Dunedin; and, as most of the fossils are still in their original matrix, it is easy to disprove Mr. McKay's statement in this case. Mr. Mantell's collection is not in the Colony, but his list does not contain any of the commoner shells found on the coast. South of Hampden there is a raised beach with recent shells (Section VI., *f*,) formed into a quartzose sandstone, which, at first sight, might be supposed to pass below the clay. The commonest fossils in it are *Barnea similis*, *Mactra discors*, *Paphia spissa*, *Venus mesodesma*, *Venerupis reflexa*, and *Ostrea edulis*; but as none of these genera, except the last, occur in Mr. Mantell's list, he could not have made any part of his collection here. The idea that a palæontologist, having before him a collection of cretaceous and recent shells, should, as it were, strike a mean and consider the whole to be miocene—although, of course, not a single characteristic miocene shell would be among them—needs no refutation.

To test the accuracy of these statements, I collected myself for an hour or two, in the blue clay north of Hampden, at the place marked "Fossils" in Section VI., with the following result:—

1. Ancillaria australis
*2. *Voluta corrugata.*
*3. *Pleurotoma fusiformis.*
4. *Turritella ambulacrum.*
*5. *Turritella ornata.*
6. *Trochus* (? impression only).
7. *Dentalium mantelli.*
8. Venus stutchburyi.
*9. *Solenella funiculata.*
*10. *Limopsis insolita.*
11. *Cucullæa*, sp. (fragments).
12. *Pecten hutchinsoni* (right valve).
13. *Pecten hochstetteri* (? fragment).
14. Ostrea edulis.
*15. *Trochocyathus mantelli.*
16. *Notocyathus pedicellatus.*

Of these 16 species, the three in Roman are still living, and the six marked with an asterisk are characteristic Pareora (*i.e.* miocene) species. This is, I think, quite sufficient to show that Mr. McKay is in error, but I will give a list of all the fossils reported from this locality:—

1. *Aturia ziczac*, Sowb.
2. *Fusus australis*, Quoy. and Gaim.
3. *Siphonalia nodosa*, Martyn.
4. *Siphonalia nodosa*, var. *conoidea*, Hutton.
5. *Cominella*, sp. ind.
6. *Nassa tatei*, Tenison-Woods.
7. *Ancillaria australis*, Sowb.
8. *Voluta pacifica*, Solander.
9. *Voluta corrugata*, Hutton.

10. *Pleurotoma fusiformis*, Hutton.
11. *Pleurotoma buchanani*, Hutton.
12. *Triton spengleri*, Lamarck.
13. *Natica neozelanica*, Q. and G.
14. *Natica suturalis*, Hutton.
15. *Cerithium cancellatum*, Hutton.
16. *Struthiolaria papulosa*, Martyn.
17. *Trochita neozelanica*, Lesson.
18. *Crepidula monoxyla*, Lesson.
19. *Turritella rosea*, Q. and G.
20. *Turritella tricincta*, Hutton.
21. *Turritella ambulacrum*, Sowb.
22. *Turritella ornata*, Hutton.
23. *Trochus* (?), sp. ind.
24. *Dentalium mantelli*, Zittel.
25. *Venus stutchburyi*, Gray.
26. *Cytherea multistriata*, Sowb.
27. *Trigonia pectinata* (?), Lamarck.
28. *Solenella funiculata*, Hutton.
29. *Pectunculus laticostatus*, Q. and G.
30. *Limopsis insolita*, Sowb.
31. *Cucullæa*, sp. ind.
32. *Mytilus magellanicus*, Lamarck.
33. *Pecten hochstetteri* (?), Zittel.
34. *Pecten hutchinsoni*, Hutton.
35. *Ostrea edulis*, Linneus.
36. *Entalophora zealandica*, Mantell.
37. *Notocyathus pedicellatus*, Tenison-Woods.
38. *Trochocyathus mantelli*, M. Edw. and H.
39. *Trochocyathus hexagonalis*, Mantell.

Some of the recent shells of this list may have been wrongly named, but it must be noticed that of the 32 named species of Mollusca (including the variety), all but *Struthiolaria papulosa*, *Cerithium cancellatum*, and *Trigonia pectinata* have been found in Pareora rocks in other places in New Zealand; and, of the exceptions, the first two occur in the Wanganui System, while the third (doubtfully identified) has not been found in any other part of New Zealand. Of the 29 Pareora species, 14 are not known older than the Pareora, 5 are not known younger than the Pareora, 7 are found in the Pareora only, and 3 go through all our tertiary rocks. *Aturia ziczac* occurs in New Zealand at Waihao Forks, with numerous Pareora fossils. The genera *Cominella* and *Ancillaria* are not known from mesozoic rocks in any part of the world. *Entalophora zealandica* is found at Wanganui, and in miocene rocks in South Australia. *Trochocyathus mantelli* occurs in the Pareora beds at Mount Horrible, near Timaru.

The evidence is, I think, conclusive that the Onekakara clay belongs to the Pareora System. And this being so, it follows, almost certainly, that the clay overlying the limestone a mile south of Kakanui, which has been followed by Mr. Mantell through Allday Bay to the Otepopo River, also belongs to the Pareora System; and if it is the equivalent of the Hutchinson's Quarry beds, as I suppose, they too must be put into the Pareora. The only evidence wanting is the comparison of the fossils from Hutchinson's Quarry with those from the clay near Kakanui, and this I am not able to do as my lists are not sufficiently complete.

Volcanic Rocks.—The north side of Moëraki Peninsula is formed by dolerites (S.G. = 2·88), which are seen on the shore to overlie the Onekakara clay, here dipping 0° to 60° S.S.E. In one place I noticed, in 1873, that the blue clay had been altered by contact of a lava flow, and turned white for a distance of 2 to 4 feet. These volcanic rocks are therefore much younger than those described from the Oamaru District. Mount Charles, between Herbert and the Otepopo River, is also formed of dolerites, which appear to overlie the greensands and blue clay; at the same time the greensands are formed almost entirely of volcanic detritus derived from still older rocks. These dolerites closely resemble those from Moëraki, but are sometimes coarser in grain, and a less specific gravity (2·73), owing probably to their being more altered. They are compact, and dark greenish-grey in colour, or paler, owing to scattered greyish-white flecks which sometimes become very abundant. Under the microscope they are seen to be holocrystalline, without any older generation. The felspars are in lath-shaped crystals, usually polysynthetic. Sections, more or less parallel to the brachydiagonal, gave extinction angles up to 15° with the twinning plane; while long narrow sections, more or less at right angles to the brachypinacoid, gave extinction angles up to 45°. From this I judge the felspar to be labradorite. Augite of a pale olive-brown, sometimes with black margins, occurs in imperfect crystals; and in a slide from Mount Charles I found a well-defined crystal of rhombic pyroxene, giving straight extinctions. This pyroxene is slightly dichroic, the vibrations parallel to the macrodiagonal being pinkish-green, and those parallel to the brachydiagonal olive-green. This pyroxene is not striated, and, therefore, I suppose it to be enstatite. Ilmenite is abundant, generally in thin plates from Moëraki, but more irregular from Mount Charles; it is much altered into leucoxene, which makes the white flecks. No olivine was seen in any of these rocks.

Lookout Bluff (the "White Bluff" of Mr. Mantell's paper already referred to) is an old and much-denuded volcano, composed chiefly of agglomerate and ash beds. To the north, scoriaceous sandstones, dipping to W. at various angles up to

45°, reach the Otepopo River, and their relation to the blue clay in Allday Bay cannot be ascertained; but to the south a series of dark-green soft sandstones, weathering reddish-brown, dipping 25° W., and underlain by blue clay, are apparently interstratified with tachylyte tuffs. I could find no fossils in these rocks; and, unfortunately, they are separated from the Onekakara clay by a mass of silt and gravel, so that here also their relations are not quite certain, although I saw no reason to doubt their identity with the Onekakara clay. One tachylyte which I collected is a compact, dull, earthy, black rock, and looks like a dark clay; it breaks up irregularly into small fragments, generally with curved surfaces (S.G.=2·14) It is minutely cracked in all directions, is not vesicular, and of a clear olive-brown, in places paler with globulites, sometimes scattered, sometimes collected into irregular but sharply defined patches, generally angular, but often in lines. Other parts are darker, with abundant globulites. There are no microliths. Another specimen was dark blue-black, with a crystalline texture, and rounded black globules among the crystals (S.G.=2·38). Under the microscope this is seen to be a tuff, made up of fragments of a brownish-yellow vesicular tachylyte in a crystalline calcareous cement. The vesicles are elongated in the same direction, but there is no other fluxion structure. These tachylyte rocks resemble those from Waireka Valley and White-water Creek in the Trelissick Basin, all of which belong to the Oamaru System. Whether they are or are not of the same age must remain for the present an open question. Their peculiar structure is probably due to lava streams, which have run rapidly into water and have been shattered into minute fragments.

CONCLUSION.

In a paper read before the Geological Society of London, in June, 1885,* I have taken it for granted that the Hutchinson's Quarry beds formed part of the upper eocene, or Oamaru System; and that the volcanic outbursts at Oamaru were contemporaneous with them. This was my former view, but I know now that I was wrong in one, and perhaps in both, of these points. The alterations, however, do not affect in any way the general drift of that paper, which is to show that the fossils of the upper part of the cretaceo-tertiary and of the upper eocene formations of the Geological Survey are identical, and that there is no stratigraphical break between them—*i.e.*, between the Curiosity Shop beds and the Otakaika limestone as representing the upper eocene, and the Ototara and Maerewhenua limestones as representing the cretaceo-tertiary. My repudia-

* "Quar. Jour. Geol. Soc. of Lond.," vol. xli, p. 547.

tion of Mr. McKay's arguments in favour of unconformity between the Hutchinson's Quarry beds and the Ototara limestone remains intact, although I now, for other reasons, think his conclusion probable. The only alteration necessary to make in my paper is to erase the words I have italicised in the following sentence:—"Cape Oamaru is formed by an old volcano, *which has broken through the Ototara limestone, and was active when the marine beds of Hutchinson's Quarry were being deposited.*" (*l.c.*, p. 561.)

Art. LV.—*Note on the Geology of the Valley of the Waihao in South Canterbury.*

By Professor F. W. Hutton, F.G.S.

[*Read before the Philosophical Institute of Canterbury, 6th May*, 1886.]

In 1875, Dr. von Haast sent to the Otago Museum a collection of fossils from Whiterock River; Mount Harris; Point Hill, Waitaki; and Waihao Forks, with the request that I would examine them. The results of my examination went to show that the whole collection belonged to the Pareora System.* Dr. von Haast agreed with me as to the age of the fossils from the first three localities, but had doubts about those from the greensands at Waihao. He says: "These greensands are overlaid by calcareous greensands with all the characteristic fossils of the Oamaru formation, on the edges of which the Pareora formation reposes unconformably; consequently a careful study of the more extended collections from these beds is needed to settle this point to my satisfaction."† In October, 1880, Mr. A. McKay examined the district for the Geological Survey of New Zealand. In his report he classes these beds, which he calls "marly greensands," with the cretaceo-tertiary series of the Survey, and in his map he marks them as lower cretaceo-tertiary.‡ He thus agrees with Dr. von Haast that they underlie the Waihao limestone, but he makes no reference to the disagreement between the palæontological and the stratigraphical evidence, and appears to see no difficulty at all in the structure of the district. Last year I examined the collection of fossils in the Canterbury Museum from Waihao, and in December I paid a visit to the district to try to clear up the difficulty.

* "Trans. N.Z. Inst., vol. ix., p. 594.

† "Geology of Canterbury and Westland, 1879," p. 315.

‡ "Reports of Geological Explorations for 1881," p. 71.

The right bank of the Waihao River, from a little above the Forks down to the bridge by which the road from Arno to Waikakahi crosses the river—a distance of about three miles—is formed by rocks of the Oamaru System. A northerly extension of these rocks, rather more than a mile in breadth, crosses the river about half a mile below the Forks; so that, for this distance, the Oamaru System* forms both banks of the river. On these points all are in agreement. The rocks belonging to the Oamaru System here are—

3. Pale-yellow arenaceous limestone, about 50 feet thick, known as the Waihao limestone.
2. Calcareous sandstone, with green grains, 150 feet.
1. Dark-grey marl, getting more sandy at the top, with ferruginous bands or veins; thickness, 50 feet +; contains *Pecten zittelli*.

No rock is seen to underlie this marl anywhere between the forks of the Waihao and its mouth.

On the left bank of the river, both above and below this northerly extension of the Oamaru System, we find thick (200 feet +) beds of soft dark-green or grey argillaceous sandstone, sometimes with calcareous concretions, and containing numerous fossils (*see* fig.) It was from these beds that Dr. von Haast collected the fossils sent me in 1875. They are also the "marly-greensands" of Mr. McKay's report. The point to be settled is: Do these greensands underlie the marl of the Oamaru System? or do they lie unconformably against the eroded edges of that system?

The palæontological evidence is decidedly in favour of the second of these suppositions, as the following list of fossils from the Waihao Forks will show:—

1. Teeth of crocodile (?).
2. *Aturia ziczac*, Sowb.
*3. *Siphonalia nodosa*, Martyn.
*4. *Ancillaria australis*, Sowb.
5. *Ancillaria hebera*, Hutton.
*6. *Voluta corrugata*, Hutton.
*7. *Pleurotoma fusiformis*, Hutton.
*8. *Pleurotoma buchanani*, Hutton.
*9. *Pleurotoma awamoaensis*, Hutton.
*10. *Clathurella hamiltoni*, Hutton.
11. *Natica gibbosa*, Hutton.
12. *Natica hamiltoni*, Tate.
*13. *Natica suturalis*, Hutton.
14. *Dentalium mantelli*, Zittel.

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* For a list of fossils found in these rocks, and a discussion as to their age, *see* "Quar. Jour. Geol. Soc. of London," vol. xli., p. 559.

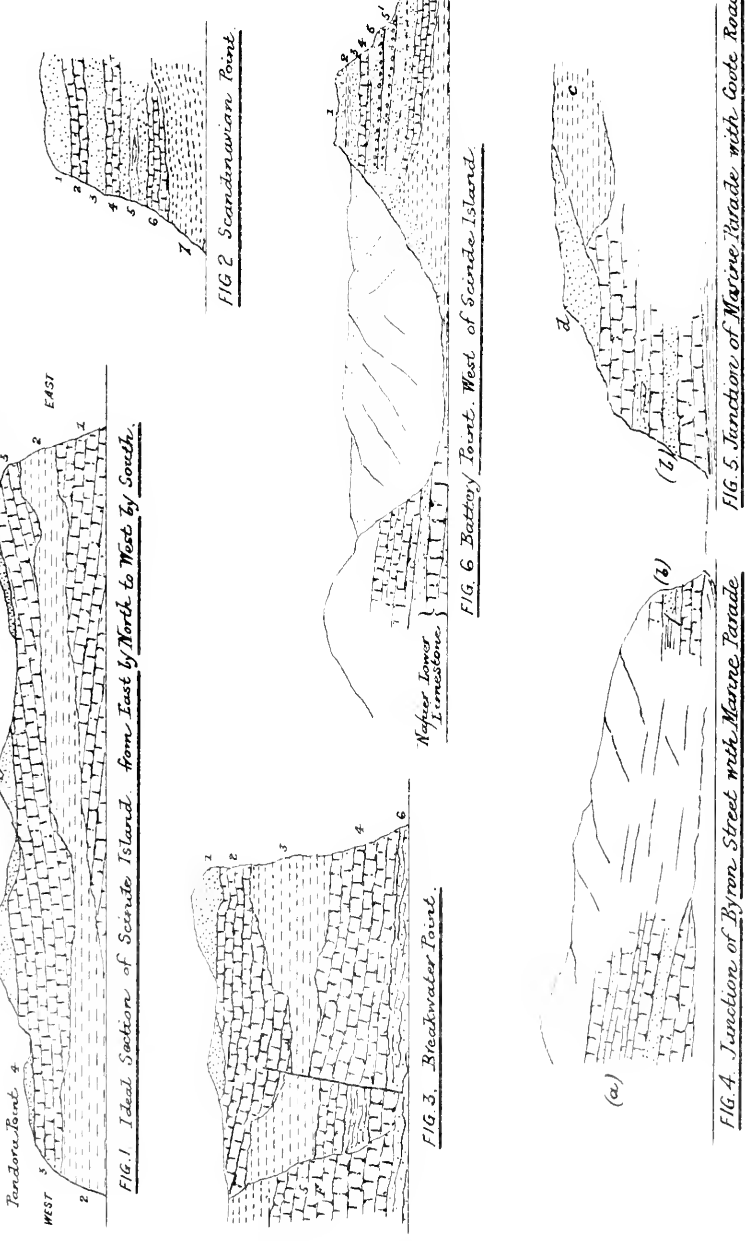
15. *Teredo heaphyi*, Zittel.
*16. *Leda fastidiosa*, Adams.
17. *Pecten hochstetteri*, Zittel.
18. *Flabellum circulare*, Tenison-Woods.

Of these 17 species, all have been found in rocks of Pareora age except *Leda fastidiosa*, which is a recent species, only known fossil at Wanganui, and *Flabellum circulare*, which, however, occurs in both the Oamaru and Wanganui Systems. The nine species marked with an asterisk are not known anywhere in rocks older than the Pareora. *Ancillaria hebera*, *Natica gibbosa*, and *Dentalium mantelli*, are common Pareora species, but rarely found in the Oamaru System. *Aturia ziczac* occurs in Europe and in North America in the upper eocene and lower miocene only; in Australia it is found, according to Professor McCoy, in the oligocene, the miocene, and the pliocene. Consequently the palæontological evidence is decidedly in favour of these greensands belonging to the Pareora System.

The stratigraphical evidence is not so satisfactory, for no clear sections exist. It is possible—from a stratigraphical point of view—that these greensands might pass under the marl of the Oamaru System, although they occur at a higher level than the marl; because there is some evidence that the northerly extension of the Oamaru System lies in a flat syncline. But in no case are they seen either to pass below the marl or to lie upon it: consequently the palæontological evidence must be taken as proving the superior position of the greensands.

Mr. McKay, in making out his case, says (*l.c.*, p. 72) that at Elephant Hill these greensands are succeeded directly by the Pareora System, which would be quite in accordance with the view that they themselves belong to that system; but Mr. McKay, in his section, shows an unconformity between them. This unconformity, however, does not appear to have been directly observed by Mr. McKay; and his section is evidently a hypothetical illustration of his views, and not a simple record of observed fact. This is at once seen by looking at his section, which is an impossible one. Mr. McKay says: "In the section above sketched, the marly greensands terminate at a peculiar fucoidal band, which in the Waihao River is seen to occupy the middle part of these greensands; the succeeding beds are the characteristic marine part of the Pareora formation, and unconformity *is therefore manifest at this point*. Not half a mile distant from the point of unconformity represented above, the lower part of the section is complete as high in the series as the Waihao limestone, which is overlaid unconformably by the Pareora beds. On the south side of the Maerewhenua River the marly greensands and coal rocks underlie in direct sequence the Maerewhenua limestone, and at no point do they come in contact with marine tertiary rocks" (*l.c.*, p. 73).

GEOLOGY OF SCINDE ISLAND.



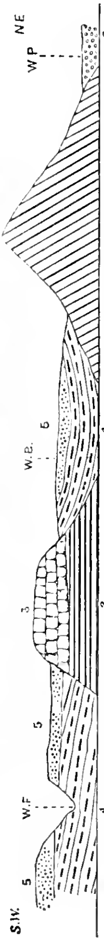
H. H. delt.

To illustrate Paper by H. Hill.

I have elsewhere examined Mr. McKay's statements as to the age of the greensands at Maerewhenua and Wharekauri,* and I will here only remark that he gives no evidence to show that they are the equivalents of the greensands at Waihao. Indeed, unless his *Nautilus danicus* is *Aturia ziczac*, he does not mention a single species common to both. For the present, therefore, the position of the Maerewhenua greensands cannot be taken as furnishing any evidence of the age of the greensands at Waihao.

With reference to the first part of the paragraph I have quoted, not much weight can be attached to the position of the "peculiar fucoidal band," which is not mentioned elsewhere by Mr. McKay, and if unconformably overlain, could not always form the top of the greensands here. The evidence for the unconformity really rests on the absence of the Waihao limestone at this place, although found half a mile off. This, however, proves nothing; because it is the relative position of the limestone and the greensands which is the doubtful point; and to introduce an unconformity into the section because the limestone is absent, is to assume as true the very point which it is wished to prove.

Another exposure of the Oamaru System occurs on the right bank of the Waihao River just before it enters the plains. The rocks here are much obscured, and I failed to make out the section given by Mr. McKay. To me it appeared more like an inlier, surrounded unconformably by the Pareora System. According to Dr. von Haast, the Pareora System fills up valleys denuded out of the Oamaru System north of Elephant Hill,† and there is no difficulty at all in supposing that these Pareora rocks cross both the south and north branches of the Waihao, and wrap round the rocks of the Oamaru System as far as the Waimate Hills. The annexed woodcut illustrates my view of the relation of the rocks, but it is of course to some extent hypothetical, as no positive stratigraphical evidence is available.



Section on Left Bank of Waihao River.—Distance: 6 or 7 miles.

1. Maitai System, 2. Grey marl. 3. Waihao limestone. 4. Greensands belonging to Pareora System. 5. Silt. 6. Gravel of Plains.

W.F. Waihao Forks. W.B. Waikakahi Bridge. W.P. Waimate Plains.

* "Quar. Jour. Geol. Soc. of London," vol. xli., pp. 558 and 562.

† "Geology of Canterbury and Westland," Sheet of Sections No. 5, Section No. 4.

Art. LVI.—*The Waihao Greensands, and their Relation to the Ototara Limestone.*

By Alex. McKay, Assistant Geologist.

[*Read before the Wellington Philosophical Society, 20th October,* 1886.]

Differences of opinion possibly are never wanting in connection with material advances in such sciences as are dependent on accurate observation and sound judgment, and in this respect geology in New Zealand has nothing to complain of; for whether as regards Tertiary, Secondary, or Primary formations, differences of opinion exist, and have led to the necessity of supporting particular views at greater length than would otherwise have been needful.

In the particular case I have to refer to on this occasion, the dispute concerns localities and beds rendered classical by the observations of the Hon. Mr. Mantell more than 40 years ago, differences of opinion even now existing with respect to the stratigraphical position of the Onekakara and Hampden beds, in the Moëraki District of Otago. These beds are placed by the Geological Survey as belonging to the Cretaceo-tertiary series; by Sir Julius von Haast as being of older Tertiary date; and by Professor Hutton they are referred to the Upper Miocene period. The Survey and v. Haast support their contentions with facts both stratigraphical and palæontological; Hutton's contentions are based almost wholly on palæontological grounds.

South of the Kakanui River the beds in dispute are not overlaid by the Ototara limestones of Oamaru, these being denuded from the Moëraki District; but in the district north of the Kakanui, and in Southern Canterbury, the Survey and v. Haast agree in placing the equivalent beds under the Ototara limestone; and in the Waihao Valley it has been held that this position of the greensands can be demonstrated. Hutton admits that the Waihao limestone is the equivalent of the Ototara stone, or at all events belongs to the "Oamaru formation," and also admits that the Waihao greensands are the equivalents of the Onekakara beds, but holds that the greensands are younger than the limestones, and, with the Onekakara beds, belong to the Pareora formation. North of Timaru the same greensands occur in the valley of the Kakahu River, and here also, by v. Haast and the officers of the Geological Survey, are said to underlie a representative of the Ototara limestone. Hutton believes that the greensand beds only appear to pass under the limestones in the Kakahu, and considers them as showing this apparent relationship in consequence of a fault, supposed to be present, but which has not yet been observed.

In 1865, the Director of the Survey placed the Hampden (Onekakara) beds below the calcareous rock of Oamaru, and the Caversham sandstone near Dunedin, referring both to the Eocene period; and in 1877 included them in the Cretaceo-tertiary series. In 1873, Hutton referred both the Hampden and the Kakahu beds to Upper Miocene; and in 1875, after having examined the stratigraphy, was confirmed in his opinions respecting the Miocene age of the Hampden beds. During 1867-68, v. Haast made collections from the Waihao greensands, etc., which he forwarded to Otago Museum in 1875. These were examined by Hutton, who in the following year published a description of the new species the collection contained, and at the same time referred the Waihao greensands to the Pareora formation. In 1879, v. Haast took exception to the reference of the Waihao greensands to the Pareora formation, and, detailing the sequence, showed clearly that they underlaid the limestones belonging to the Oamaru formation. In 1880, I examined the geology of the Waihao Valley, and agreed with v. Haast that the greensands of the Waihao Forks underlaid the limestones in the near vicinity, and differed from him only in this, that I ascribed his Oamaru formation to the Cretaceo-tertiary period. In 1884, Lindop arrived at the same conclusion, as far as concerned the relative position of the greensands and the limestones.

In 1873, Professor Hutton expressed the opinion that our young secondary and tertiary rocks are in many instances deposits accumulated in the narrow valleys of a submerged land;* and in 1875 he argues that, after the close of the Eocene period, these valleys were in some instances re-excavated and others formed, within areas covered by cretaceous and upper eocene deposits; and, in Upper Miocene times, were again filled with marine deposits. In this way he finds the stratigraphy of some districts of the east coast of the South Island very perplexing, and would have us believe that the so-called miocene beds appearing to pass under the upper eocene deposits in reality flanked them on the inland side, or filled valleys excavated in them.† This theory, though it obviated the necessity of grappling with a serious palæontological difficulty, led but to another, as it implied the existence in cretaceous times not merely of the principal outlines of the physical configuration of the country, but of many of the minuter details, and at the same time the existence of a profusion of fiords and islands along the coasts of eastern Otago and South Canterbury during miocene times. Most other geologists holding that the phenomena thus to be explained were capable

* "Geological Reports," 1873-74, p. 37.

† "Geology of Otago," 1875, p. —.

of being accounted for in another way, this theory has not been generally accepted, and for a time seems to have been lost sight of even by its author.

This theory was intended to explain how the Onekakara and Waihao greensands might appear as though they underlaid the Ototara limestone and yet be younger than the limestones. In 1885 Hutton appears to have altered his opinion respecting the position of the Waihao greensands, as he includes them with other beds in the Oamaru System, and as in position underlying the Ototara limestone. However, having in the meantime examined the Lower Waitaki Valley, the neighbourhood of Oamaru, Kakanui, and Hampden, and the Waihao Valley, where the greensands and limestones appear, he revives the fiord-island theory as the only one consistent with the palæontological evidence he brings forward.

Selecting the Waihao Valley, as affording most convincing proofs of the correctness of his theory, on the 6th of May, 1886, he read before the Canterbury Philosophical Institute a paper, in which he discusses the relative age of the Waihao Forks greensands and the limestones on the south side, opposite the Forks, and further down the river. In thus selecting the lower basin of the Waihao as the battle-ground within which the issues of the dispute are to be decided, he promised himself one or two advantages not afforded by other localities that might have been chosen. Here the stratigraphy was less decisively in favour of the opposing view than at the Kakahu, and the palæontological evidence as much in his favour as at Hampden.

In the Waitaki Valley there was no disputing the position of the greensands in relation to the limestone members of the Oamaru formation; while at Mount Royal, and near Palmerston, the greensands had afforded him no palæontological evidences. Hampden and Onekakara, from the absence of the limestone there, failed to yield that measure of stratigraphical proof which was requisite to set off the superior claims of palæontology; while at the Waihao, if v. Haast did not support his views, at least he did not favour those of the Geological Survey.

After examination, he decided that the stratigraphical evidence is obscure, but more in favour of his own theory than that of v. Haast, or of the Geological Survey. He discredits the evidence of sections he does not understand, and characterises as impossible others that he did not see.* He totally ignores v. Haast's description of the sequence, and is equally silent as to the nature of the beds upon which the greensands rest. He proves in nothing the correspondence of the greensands with

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* The sections on the Waihao, at the south end of the Waimate Hills, and that at Elephant Hill, are here alluded to. With reference to the last, there is nothing in Professor Hutton's "Note on the Geology of the Waihao Valley" leading to the belief that the locality was visited by him.

any of the beds forming Mount Harris, and seems to think that most characteristic greensands may, through a vertical thickness of 200 feet, alter to beds of a totally diverse character in the horizontal distance of a few feet; and, amazed at the difficulties that beset his own explanation of the sequence, marvels that I could not discover the like from my point of view. Yet, regardless of what may follow, he decides that there is no proof of the greensands underlying the limestone; and, dismissing this part of his subject, is satisfied that the palæontological evidence is less unsatisfactory. This would indeed seem to be the case.

According to Hutton's lists of fossils, the palæontological evidence is to all appearances decisive. Sixteen species of Mollusca are known; all of them said to have come from the Waihao greensands: the collections of 1867–68, named by him in 1876; and collections (of latter date?) now in the Canterbury Museum, 8 more, making 24 in all. Twenty-four, it would appear, then, are known to him, and in the Canterbury Museum; yet only 16 species are now cited by him—what of the remaining 8 species? They were sent by v. Haast to the Otago Museum and named by Prof. Hutton in 1876. They are cited as fossils of the "Waihao" in the "Geology of Canterbury and Westland," and now they are not! What has become of them? Lost? No; for their record remains. But we have 16 left, the 16 that now constitute the fauna of the Waihao greensands. What of them? They have all been found in the Pareora formation: 9 of them have never been collected from beds of greater age, and 5 of them are actually living forms. Of the 16 species from the Waihao greensands, 9, or nearly 57 per cent. are unknown as coming from the Oamaru formation, and 60 per cent. are in like case, taking the Pareora formation as a whole; therefore the Waihao greensands are typical Pareora beds; and there is no need to inquire how their fossils stand related to those found in the neighbouring Mount Harris beds. The stratigraphy has been wrongly read hitherto, is difficult of decipherment, and at best obscure.

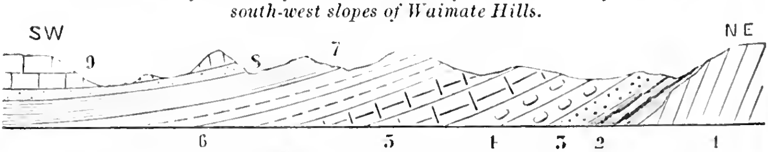
If we admit all these premises, there can be no doubt, identifying myself with the stratigraphists, that ours is a desperate case; at least, it looks so on paper—hardly so bad along the banks of the Waihao.

Last June I paid a short visit to the Waihao, and first examined the section at the Waihao Forks, south to the limestone scarp. I could not avoid the conclusion that the greensands dipped south and passed under the limestone. I followed up the first creek below the junction, and in the west branch of that found it had cut through the limestone and exposed the greensands. I tried the middle branch with the like success, and that to the east with the same result. I examined the south bank of the river more to the east, and, opposite the western end of the limestone, on its north bank, had further proof of the inferior position of the greensands.

Here a small stream, coming from the northern slopes of Mount Harris, joins the Waihao. Part of its course is through a limestone gorge; nearer its junction with the river the limestone walls diverge, but again approach towards the infall of the creek. The basement beds of the limestone are 20 to 30 feet above the creek at its junction with the river on the east side, and higher on the west side. On the west side the limestone forms a high bluff overlooking the river, which sets as a deep pool at its foot. The lowest beds seen are dark, almost black, with greensand grains. The creeklet ripples over these into the pool. On the right hand (down the river) they form a flat ledge above ordinary flood-mark. Fossils were collected here, the same species as at Waikakahi Bridge farther down the river. The fossiliferous beds are overlaid by the "marl beds" under the limestone, and the dip of the conformable junction line can be traced from the side of the cliff facing the river round the corner, and up the little creek till it crosses and returns on the opposite bank. This carries us to the road-line, the creek being crossed by a bridge, above which greensands overlie the marly beds. The limestone frowns above, on the right bank of the stream; the greensands and other beds just described pass under the limestone. And again we are satisfied that the Waihao greensands cannot and do not overlie the limestone. The same beds are seen at Waikakahi Bridge; and if the passage of the greensands under the marl is less evident, on account of the junction being in low ground and obscured by the alluvial banks of the river, there is, at least, from what is seen, every probability that they do.

A section on the north or left bank has been given by Professor Hutton (see *ante*, p. 433). That part of the same section from where the greensands (4) are made to rest on the east end of the limestone ridge (3), and thence across the valley marked "W.B." on Hutton's section, I sketch below, but subdividing the strata as I read the section in 1880. There is certainly some difference in the rendering, which the reader must try to reconcile if he can.

Section on Left Bank of Waihao River, from east end of limestone to south-west slopes of Waimate Hills.



1. Matai slates and sandstones. 2. Shales, fire-clays, and coaly-beds. 3. Quartzose grits, etc. 4. Grey sands (sulphurous), with hard bands and concretions. 5. Waihao greensands (lower part). 6. Waihao greensands (upper part). 7. Clay marls. 8. Greensands. 9. Waihao limestone.

North of Arno railway-station the reading of a similar sequence in the same relation of the beds to each other is unavoidable; and the same occurs in the west branch of the Waihao, above the road to Pudding Hill station; and evidence can scarcely have been looked for by those who say there is little evidence to be found, and that little not of a decisive character. No stratigraphy could be plainer than in some of the sections, and the evidence of those that are less clear supports, as far as it goes, that which the others exhibit.

Beyond all question, the greensands underlie the Waihao limestone: and as explanations of the contrary view, islands and fiords without number, crush, faults, contortions, and, in short, all that might render the geology of a district complicated and obscure, are invoked in vain. Not merely do the sections specially examined show this; the general structure of this district, and that of all Southern Canterbury and North-Eastern Otago, points to the same conclusion; and it is rare, almost never, that the Pareora rocks rest on other beds than those of Upper Eocene or Cretaceo-tertiary age. Sir J. v. Haast, in "The Geology of Canterbury and Westland," points out no instance of their doing so, but says: "The strata belonging to this series lie either conformably upon the Oamaru formation, or, what is still more usual, unconformably upon it."

I might here stop, and only ask the palæontologists to bend their pliant facts to conformity with the stratigraphical facts; and would have done so, but that I may be expected to say something respecting the nine species of Mollusca that, coming from the Waihao greensands, are said to occur only in Pareora or younger beds. The rest are acknowledged to be fossils of the Oamaru formation. The following is a list of the nine species referred to:—

1. *Siphonalia nodosa*, Martyn.
2. *Ancillaria australis*, Sowb.
3. *Pleurotoma fusiformis*, Hutton.
4. *Pleurotoma buchanani*, Hutton.
5. *Pleurotoma awamoaensis*, Hutton.
6. *Clathurella hamiltoni*, Hutton.
7. *Voluta corrugata*, Hutton.
8. *Natica suturalis*, Hutton.
9. *Leda fastidiosa*, Adams.

1. *Siphonalia nodosa*, or a form as like Martyn's species as that which from the Waihao receives the name, I collected from the Whaingaroa clay, Raglan, at the time Mr. Cox's first examination of these beds was made. This is, therefore, a fossil of the Oamaru formation of Hutton.

2. *Ancillaria australis*.—All the specimens from the Waihao greensand that could possibly be referred to this species, agree

badly with specimens now living, and closely resemble *A. fusiformis* from the Eocene deposits of Britain.

3. *Pleurotoma fusiformis* was described from Mount Harris. Von Haast does not mention it as coming from the Waihao greensands. I have collected it often, but not at the Waihao, and think it should be dropped from the list.

4. *Pleurotoma buchanani.*—This is mentioned by Dr. von Haast as a fossil of the Waihao greensands. A distinction of the Waihao specimens from those coming from younger formations might be shown, but I choose to admit it a fossil of the Waihao greensands.

5. *Pleurotoma awamoaensis.*—This, in the first lists, was given as a variety of *P. awamoaensis.* Why should it now be otherwise?

6. *Clathurella hamiltoni.*—I do not know this species, and accept it as coming from the Waihao.

7. *Voluta corrugata.*—That such a prominent fossil in all the beds in which it occurs should be absent from the collections made by v. Haast and myself, leads me to think that the specimen from the Waihao greensands must, in the first list, have been named *V. elongata*, Hutton. I have a species of this genus from the beds, but it is neither *V. corrugata* nor *V. elongata*; therefore, until its occurrence be verified, I cannot accept *V. corrugata* as a fossil of the Waihao greensands; though, at the same time, I suspect that it occurs in the Oamaru formation.

8. *Natica suturalis* comes from Mount Royal, near Palmerston, Otago, where the beds are most certainly the same as those elsewhere referred to the Oamaru formation of Hutton.

9. *Leda fastidiosa* comes from beds belonging to the Oamaru formation in the Trelissick Basin; that it is recent, concerns us not at the present time.

Thus, of these nine species, there are only three that can be fairly claimed as being unknown in rocks of greater age than the Pareora beds. *Pleurotoma fusiformis* is very doubtfully a fossil of the Waihao greensands. *Pleurotoma buchanani* and *Clathurella hamiltoni* are, therefore, the only evidences that the Waihao greensands belong to the Pareora formation.

Are the palæontological proofs, then, of such a character that we must disregard the clear stratigraphical evidence as above stated?

ART. LVII.—*Geology of Scinde Island, and the Relation of the Napier Limestones to others in the surrounding District.*

By H. HILL, B.A.

[*Read before the Hawke's Bay Philosophical Institute, 11th October*, 1886.]

Plate XXVII.

IN the last volume of the "Transactions," two very interesting and, so far as they relate to the geology of this district, two important papers, appear on the geological structure of the Napier hills. One of the papers is by Captain F. W. Hutton, F.G.S., Professor of Geology at the Canterbury College, and it is headed "On the Geology of Scinde Island." The other paper is by Mr. A. McKay, of the Government Geological Department, and bears the title "On the Geology of the Napier Limestones."

Napier, or, more properly, that portion of it which is known as Scinde Island, has formed for years past a kind of battle-ground for the geologists; and, if we may judge from the two papers referred to, it is likely to remain so for some time to come. The questions to be decided are: 1st, As to the age and conformity of the Napier limestones; and, 2nd, As to the relation they bear to the other limestones in the surrounding district.

I cannot do better than state in their own words the conclusions arrived at by the authors of the above-named papers, after paying special visits to this district to prosecute their inquiries.

Captain Hutton says ("Transactions," vol. xviii., p. 329): "The result of my examination is to show that the northern end of the island is formed by the Petane series. This series rests unconformably on the Scinde Island limestone, which forms, with the underlying sandstone, all the southern part of the island." On page 371 of the same volume, Mr. McKay, after an examination of the Napier beds extending over three days, concludes that "there is an upper and a lower limestone in Scinde Island," but he sees no reason to suppose that these are unconformable to each other. "To me," continues Mr. McKay, "the evidence was quite clear that the lower limestones and overlying sands are connected by passage-beds, and shade into one another;" and, further, "that not the northern, but the western side of Scinde Island shows the presence of the younger series." Nor could Mr. McKay "arrive at the conclusion that the lower beds [of Scinde Island] are the equivalents of the Te Aute limestones, nor of any formation containing no more than 35 per cent of recent species." I am informed that Dr. Hector agrees entirely with the conclusions arrived at by Mr. McKay, as here quoted.

It is useless to point out how entirely different are the opinions of these geological experts, and it seems to me that this Society, or at least those members who take an interest in geology, should endeavour to clear up the points of difference as soon as possible.

It is a curious circumstance that each geologist who has written about Scinde Island differs as to the dip of the beds. Mr. Cox* says: "At Scinde Island, Napier, where the typical development of these beds occurs, they are forming a low anticline, dipping on the sea face S. 10°, but on the harbour side N.W. 25°." Mr. McKay† says: "These marls form the west side of the Napier Harbour . . . the lowest beds exposed on the south-west side of the island . . . they dip N.E., bringing the limestones to the sea level at the north end of Shakespeare Road." As Mr. McKay says in his recent paper that there is no unconformability between the upper and lower Napier limestones, and as the marls are certainly not the lowest beds, but are above the lower limestones, I infer that he wishes it to be understood that the general dip of the Napier rocks is to the north-east.

On the other hand, Captain Hutton, in the paper from which I have already quoted,‡ says: "On the south-east side of the island this series [*i.e.* the Ahuriri series] dips about S.E. 5°. To the northward it gets horizontal, and then dips to the north-west. On the east side, at Curling's Gully, the dip is N.W. 20°, and on the west side, at Taradale Bridge, it is N.N.W. 10°."

These quotations will serve to show how wide are the differences of opinion between the geologists on a question of fundamental importance, and to me they constitute strong presumptive evidence in favour of unconformability between the Napier series.

The conclusions at which I have arrived with respect to the Napier series are that, exclusive of the comparatively recent surface-deposits of brick and pumiceous clays and sands and ordinary soils, there are three distinct series of rocks forming the Napier hills. These series are unconformable to one another, the lower limestones being succeeded by marls, and the marls by limestones, which in this paper are termed the upper Napier limestones. My reason for arriving at these conclusions will be found in the following evidence:—

In a journey round the base of the Napier hills the following principal alterations in the dip of the beds will be seen:—

Commencing at the junction of Byron Street with Beach Road, there is at this point an important exposure of what I

* "Geological Report," 1874-76, p. 100.

† "Geological Report," 1876-77, p. 84.

‡ "Trans. N.Z. Inst.," vol. xviii., p. 329.

venture to say are the lowest of the lower characteristic Napier limestones, in bands of a steel-grey colour and interbedded with yellow and grey calcareous sands and breccia. These beds dip N. by W. at an angle of about 5°. At the junction of Coote Road with Beach Road the rocks forming the bold cliffs along the seaward side of the island are seen to dip to the S.E. at an angle varying from 5° to 10°. Thus, at the point where the prisoners from the gaol carry on their work of stone-breaking, a syncline is observable in the lower beds. Further on, along the beach, the rocks of the lower series dip to the N. by W. at a low angle, in no case exceeding 12°. On the Ahuriri side of the island, at the junction of Hospital and Battery Roads, an anticline is formed by the lower limestones, where they are to be seen dipping N.E. and N.W., at varying angles from 10° to 25°. Along the S. and S.S.E. sides of the hills, extending from the recreation-ground to the starting-point on Beach Road, none but the lower limestones are to be seen—overtopped here and there by marls—and these dip to the N.W. at slightly varying angles, but in no case exceeding 15°. At the places known as Battery Point and Pandora Point, on the west side of the hills, the limestones and sands overlying marls are seen dipping W. and S.W. at an angle of 10°; but near to the large exposure of marls, limestones, and sands belonging to the Railway Department, and locally-known as Scandinavian Point, the lower limestones are just exposed, and are seen to dip to the N.W., or N. by W., at a low angle, whilst the upper limestones have a similar dip to those exposed at Pandora Point.

My own opinion is that the general dip of the lower Napier limestones is N.W., at angles varying from 5° to 25°, and that the oldest rocks exposed in the Napier hills are those seen between the Napier public school and the quarry at the junction of Byron Street and the Marine Parade.

1st. Now, as to unconformability or otherwise of the Napier series.

Captain Hutton says: "The upper limestones in Scinde Island are unconformable to the lower;" whilst Mr. McKay says "there is no unconformability between the upper and lower limestones." After a detailed examination of the numerous exposures to be seen on and around the island, I agree with Captain Hutton as to unconformability between the limestones; but I am prepared to go a little further by stating that there is unconformability between the lower limestones and the marls which rest upon them, except where denudation has taken place, and between the marls and the upper limestones.

My reasons for holding this opinion are to be found in the following evidence:—

Along the east side of the island, extending from Beach Road on the south to Lyndon's corner, at the Ahuriri end of

Shakespeare Road on the north, all the principal exposures of the Napier series are to be found. I have already pointed out the existence of a syncline at the junction of Coote Road with Beach Road in connection with the lower limestones. If these limestones are followed along the ocean side from Coote Road in a northerly direction, a marl-bed will be seen to make its appearance about half-way between Coote Road and what is locally known as the First Bluff. This marl is exposed about 100 feet above high water-mark, and where first seen is only a few feet in thickness. It is readily distinguished from the overlying beds and from the limestones by its yellowish straw-colour. A little further on the marl thickens out rapidly, but at the point the marl seemingly disappears, and the limestones are overlaid by the reddish-coloured pumiceous clay sands—the *loëss*, or brick-earth, of Hutton. A little further to the north the marl again reappears, and at the highest point in the island, immediately above where the breakwater operations are being carried on, the marl is seen to thicken out, in a distance of not more than 120 yards, from about 15 feet to more than 60 feet, and the upper series of Napier limestones make their appearance, resting, as they do, unconformably upon the marls, and being in their turn overlaid by extensive deposits of brick-earth, pumiceous sands, and black soils composed of vegetable matter, volcanic dust, scoria, and pumice grit. Structurally, the upper Napier limestones are quite unlike the lower ones, and, once seen, their peculiar compact and dark shelly structure is readily distinguishable. At the time when the pumiceous clays, sands, and grits were deposited, it would appear that denudation had washed away a large proportion of the upper limestones and the underlying marls, and that the lower limestones, equally with the marls and upper limestones, had become surface-rocks.

Between Coote Road on the south-east and Taradale Bridge on the south-west the lower limestones have undergone a large amount of denudation, and in one place only is the marl to be found, this being on the town side from the residence occupied by Dr. Hitchings, and nearly opposite Holt's sawmill. Near the Taradale Bridge there is a large exposure of the marls, and the unconformity between the lower limestones and the marls and between the latter and the youngest beds of the upper (?) limestones is well defined. Near Mr. Glendinning's brickyard the upper or higher marls become somewhat sandy in character, as compared with those seen on the east and north sides of the island, and in one place they are overlaid unconformably by a remarkable bed of pure pumice, dipping to the S.S.E. at an angle of about 40°, and occupying the place of the otherwise denuded fossiliferous sands and craggy limestones. This pumice-bed is the one, I imagine, referred to by Mr. McKay, in one of his reports, as underlying the limestones. An inspection of the sections a little further to the westward shows that Mr. McKay was in error in this surmise. At the quarry used by the Railway Department, at Scandinavian Point, the marl is at least 50 feet thick; and when the exposure is viewed from the second bridge along the Taradale new road, the unconformability between the different series can be readily distinguished. At this point several new overlying beds make their appearance, being similar to the upper beds at what is known as Battery Point, some half-mile further to the north-west in the direction of Ahuriri. I am doubtful, however, as to whether these new beds belong to the same horizon as the upper Napier limestones, as seen at the Bluff Point, or whether they are the representatives of the limestones as seen on the Pukekuri Hill and the other hills lying between Napier and Puketapu. I am inclined to the latter opinion, because behind Mr. Glendinning's brickyard, immediately E. by N. of the craggy limestones containing pebbles, and which are the highest limestone beds at Scandinavian Point, the dark compact shelly limestones are met with, dipping S. by W. at an angle of about 15°. Where the compact limestone is found, the sequence of the beds in ascending order is—

Marls.
Compact limestone.
Craggy limestone, with nests of broken and loose shells.
Coarse and impure limestone.

At Scandinavian Point the sequence is :—

Limestones (lower)
Marls.
Compact limestone.
Cretaceous sands, with thin beds of coarse nodular sandstone.
Craggy limestones with pebbles.
Fossiliferous sands, with thin chert bands.

At Pandora Point, which is about midway between Scandinavian and Battery Points, the marl appears to be the only exposed rock, but this is true only of the south side of the point. On the north side the craggy limestone is seen to rest unconformably upon the marls, the evidence being quite clear.

At Battery Point the sequence of the rocks exposed is :—

Marls.
Hard compact limestone.
Sands.
Brecciated limestone with pebbles.
Black pebble bed, 12 inches thick.
Sand beds (fossiliferous), with thin chert bands.
Pumice sands.
Clays.

Here the marls are largely developed, and unconformability clearly exists between the marls and overlying beds. None of the lower limestones are seen at this point. On the Ahuriri or Port side of the island the marls are exposed in one or two places only, one being near the junction of the Battery and Lighthouse Roads, where the anticline appears to which reference has already been made. In several places on the N.E. side of the island, between Curling's Gully and Breakwater Point, the marls are exposed. Near Sturm's Gully they are interbedded with the pale blue sandy clays, similar to the rocks on the western side of the Napier harbour. From their position in the cliffs, I have been unable to obtain good sections at this point, but I hope to do so shortly, Mr. Goodall, C.E., the harbour board's engineer, having promised to render me some assistance in this matter.

Summarizing the foregoing, it appears to me that the lower Napier limestones, if denuded of the marls, upper limestones, and overlying beds, would resemble a wedge in appearance, having the thicker beds facing S.E. and slanting off in a N.W. direction. Upon the irregular surface of this imaginary inclined plane come the marls, of varying thickness, being somewhat sandy above, earthy below, and having their chief development along the east and west sides of the island. The upper Napier limestones have their chief exposures on the east and west. They dip to the south-west, and near Mr. Glendinning's these limestones must be at least 100 feet thick. On the denuded surfaces of the three series come the pumiceous clays, with grits, pumice sands, brick earth, and black soils, which are to be found more or less over the island, and which, I am inclined to think, will be found the Napier equivalents of the Redcliffe and Kidnapper pumice and conglomerate beds.

2nd. As to the relation of the Napier limestones with those of the surrounding district:

With a single exception, the Napier lower limestones are not represented, as far as I can find, among the rocks to the west and north-west of Napier within a radius of fifteen miles. This exception is to be found in the hills on the west side of the inner harbour and lagoon, having Pukekuri, the hill at the back of Greenmeadows Station, near Taradale, on the southern boundary, and the island known as Quarantine Island as the northern. Considered in connection with the limestones covering the hills between Napier and Tiwhinui Hill, a few miles to the south of Lower Mohaka, these limestones form an important link. Pukekuri is a hill 472 feet high, and consequently 140 feet higher than the highest point on the Napier hills. It is mostly composed of marls similar to those exposed on the saddle at the back of Taradale, on the road to Puketapu. Its summit, however, is covered with limestone similar to the upper limestones found at Battery Point and Scandinavian Point, containing well-worn pebbles. These limestones do not appear on the old coast hills between Pukekuri and Petane, but they top the hills further to the west as far as Puketapu, and they are seen to overlie the Napier marls which are exposed in a small cutting on the Petane-Puketapu Road, near Alexander's pleasure-gardens. The beds exposed at the place known as Quarantine Island belong to the lower Napier limestones, and are similar to those seen near Mr. Dolbel's brickyard; and it would seem as if Scinde Island were once joined to the mainland in this direction. Between Napier and Lower Mohaka, along what is known as the Napier-Wairoa Road, the whole of the country as far as Waikaari River is covered with limestone. At Tiwhinui (1,289 feet), which is the highest point reached on the Napier-Wairoa Road, the limestones and sands similar to those seen at Battery Point are exposed as the highest beds in the perpendicular cliffs. Underlying them unconformably are light sands and marls similar to the Napier marls, which are here interbedded with the pale blue-clay bands. These are followed by the leda marls (fault?), which rocks, Mr. Cox, in his report upon the country between Poverty Bay and Napier,* places among the cretaceo-tertiaries. The leda marls at Tiwhinui are similar to those that are exposed near the mouth of the Mohaka River, and which are seen dipping S.S.E. at an angle varying from 10° to 20°.

These leda marls form, so it appears to me, the northern bend of a syncline which extends to Patangata, near Kaikora, on the Tukituki River, where the leda marls are seen on the right bank of the river, nearly opposite the hotel, dipping to the N.E. at an angle of about 15°. It is at Tiwhinui, to the north of Napier, and at Patangata to the south, where the limestones are met with resting unconformably upon the lower tertiaries, and it would seem that within this syncline all the limestones, marls, sands, and conglomerates found between Patangata and Tiwhinui must be classed. They rest within the syncline as in a basin, and the Napier limestones occupy almost the central position in the trough of the syncline. The limestones, marls, and sands which are so largely developed on the Tiwhinui, Moaeangiangi, Arapanui, and Tongoio Hills, to the north of Napier, undoubtedly belong to the Napier upper limestones only, as seen at Battery Point and Scandinavian Point. There is no trace whatever of the lower Napier limestones north of Tongoio; but on a small rise about midway between the Maori pahs at Petane and Tongoio traces of the lower Napier limestones are seen, overlaid by marls, followed by a conglomerate bed.

Between Napier and Patangata, *viâ* Havelock, through what

* "Geol. Report," 1874-76, p. 97.

is known as the Middle Track, the marls similar to those at Napier are to be met with among the higher rocks only. The lower rocks are classed by Mr. McKay as belonging to the Te Aute limestones. If such is the case, I venture to disagree with Mr. McKay in his conclusions that "the Napier lower limestones are not the equivalents of the Te Aute limestones." There is no doubt in my own mind that the limestones behind Havelock correspond stratigraphically with the Napier lower limestones; and I believe that palæontological evidence will shortly be forthcoming to prove the correctness of this statement.

I have purposely omitted all reference to the fossils collected in the different beds to which reference has been made, my aim having been to show, as far as I could, (1) that the Scinde Island rocks are made up of three distinct series, which are unconformable to one other; and (2) that the upper Napier limestones are related to the limestones to the N. and N.W. of Napier, whilst the lower limestones have their equivalents in what have been termed the Te Aute limestones.

DESCRIPTION OF PLATE XXVII.

Fig. 1. Ideal section of Scinde Island, from east by north to west by south:—
a. Pandora Point.—1. Lower limestones. 2. Marls and clays.
b. Breakwater Bluff.—3. Upper Napier limestones. 4. Pumiceous clays and sands.

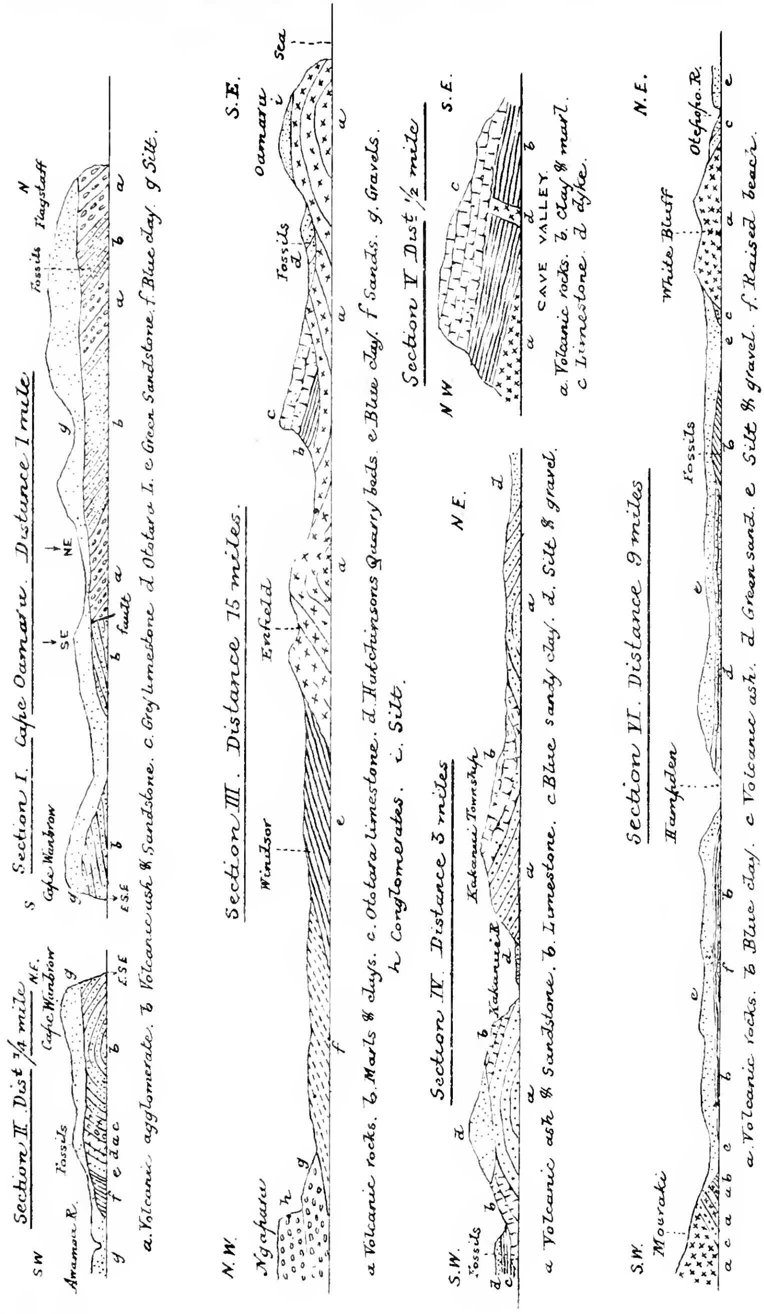
Fig. 2. Scandinavian Point.—1. Pumiceous sands and clays. 2. Brecciated limestones. 3. Calcareous sands. 4. Limestone and pebbles. 5. Sands and marls. 6. Compact limestone. 7. Marls and sands (blue paper).

Fig. 3. Breakwater Point.—1. Pumiceous sands and clays. 2. Compact limestone. 3. Marls. 4. Lower Napier limestones. 5. Fault (downthrow). 6. Blue sands (fossiliferous).

Fig. 4. Junction of Byron Street with Marine Parade.—*a*. Lowest exposed Napier beds, dipping N.N.W. *b*. (see description fig. 5.)

Fig. 5. Junction of Marine Parade with Coote Road.—*b*. Showing syncline; *c*. marls; *d*. clays and pumiceous sands.

Fig. 6. Battery Point, West of Scinde Island.—1 and 2. Pumiceous clays and sands. 3. Fossiliferous sands (calcareous). 4. Limestone (brecciated). 5. Calcareous sands with nodular chest-band (fossiliferous). 5′. Black pebble bed. 6. Calcareous sands (fossiliferous). 7. Limestone—compact, similar to 2, Breakwater Point, Fig. 3. 8. Marls and sands.



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To illustrate Paper by F. W. Hutton

Art. LVIII.—*Notes on the Age and Subdivisions of the Sedimentary Rocks in the Canterbury Mountains, based upon the Palæontological Researches of Professor Dr. C. Baron von Ettingshausen in Gratz (Austria).*

By Sir Julius von Haast, K.C.M.G., D.Sc., Ph.D., F.R.S., etc.

[*Read before the Philosophical Institute of Canterbury, 2nd September,* 1886.]

For many years past a great diversity of opinion has prevailed concerning the age and relative position of the Mount Potts beds in the Rangitata River, containing only fossil shells and saurian remains in one, and some plant remains in another, locality, not far distant from each other; and the Clent Hill beds in the Upper Ashburton District, in which only fossil plant remains have hitherto been found.

Whilst Professor McCoy, in Melbourne, as far as 23 years ago, assigned the Mount Potts beds to the Lower Carboniferous or Upper Devonian, and the fossil plants of the Clent Hills to Jurassic times, I always maintained, based upon the stratigraphical relations of those two groups of beds to each other, that they were of the same age, having shown at the same time, and as I hope conclusively, that both occur near the base of the whole series. Since then, the Geological Survey of New Zealand has repeatedly examined these localities, the result being that the shell-beds were first called Liassic, then Triassic, and now Permian; and the plant-beds in the Clent Hills, Jurassic, with which those of the Malvern Hills and some other localities were associated.

The principal point of difference between Professor McCoy and myself on the one hand, and the Geological Survey of New Zealand on the other, was not the real age of the Mount Potts and Clent Hills beds, but the great difference of age assigned to them.

In a paper on the "Geological Structure of the Southern Alps of New Zealand,"* I once more reiterated my views on the subject; and my researches for the last twenty years have amply confirmed this. Dr. Hector, however, has continued to defend his own views, of which his attempted refutation of my paper in the same volume† is a proof.

For many years past, together with other New Zealand geologists, I have waited in vain for a reliable description of our fossil plants by a competent palæontologist, so that the data upon which the different views were based could be verified. I

* "Trans. N.Z. Inst.," vol. xvii., p. 322.

† "Notes on the Geological Structure of the Canterbury Mountains," etc., *l.c.*, p. 337.

availed myself, therefore, gladly of the kind offer of Professor von Ettingshausen, an eminent Austrian palæontologist, who has made palæo-botany his special study, to describe our fossil flora, and to bring light into the chaos which hitherto has reigned. I sent to him not only all the fossil plants collected by myself in New Zealand, but Professor Parker forwarded all those contained in the Dunedin University Museum, so that ample material was in the hands of Professor von Ettingshausen to go carefully into the whole subject. This eminent palæobotanist has just finished his labours, for which he had not only to go repeatedly to Vienna, but had also to pay a visit to London to study and compare the material there.

His paper, illustrated with numerous plates, will appear in the "Transactions" of the Imperial Academy of Science in Vienna, but in the meantime he has kindly favoured me with a short *résumé* of the results of his labours, of which I hasten to lay a translation before you.

Professor von Ettingshausen states as follows:—

"In the first instance, you will doubtless like that I should place together all the localities according to the flora contained in them:—

"*To the Trias belong:* Mt. Potts, Clent Hills (Haast Gully), Malvern Hills (older series), Mataura, and Waikawa.

"*To the Cretaceous period belong:* Grey River, Pakawau, Wangapeka.

"*To the Tertiary period belong:* Shag Point, Malvern Hills (younger series), Murderer's Creek, Radcliff Gully.

"Now some few observations on the characteristic plants of each locality, and the flora in general:—

"*Mt. Potts* offered only very few distinguishable plant remains. However, I could recognise amongst them with certainty *Asplenium hochstetteri*, *Tæniopteris pseudo-vittata*, which belong also to the other Triassic beds. I found amongst them also a *Baiera*, which confirms the age of the locality as Triassic, A fragment, though rather defective, is doubtless a *Thinnfeldia*, which again does not militate against such a designation, which however excludes older beds, like Permian for instance.

"*Clent Hills* (*Haast Gully*).—These shales contain very interesting plant remains, and appear to promise still a greater harvest of valuable things. To the leading and characteristic remains belong four species of *Tæniopteris*, *Asplenium hochstetteri* and *palæo-darea*, *Palissya podocarpites* and two species of *Thinnfeldia*. A very peculiar *Comptopteris* and an *Equisetum* are closely allied to Triassic forms.

"*Malvern Hills* (*older beds*).—*Tæniopteris*, analogous to other Triassic species, *Asplenium hochstetteri*, *Thinnfeldia*, a *Podozamites*, and a *Pecopteris*, are the most remarkable plant remains from this locality.

"*Mataura and Waikawa.*—The *Tæniopteridæ*, *Zamites*, *Pterophyllum*, *Nillsonia*, altogether in forms analogous to Triassic genera, with *Asplenium ungeri*, of such universal occurrence, prove the identity with the last-mentioned beds.

"*Grey River*, *Pakawau*, and *Wangapeka* contain a flora which is well distinguished from that of other localities of the Cretaceo-tertiary formation, and which decidedly ought to be placed with the Cretaceous formation. However, the material at my command will not allow me to state at present with certainty to which of its subdivisions these remarkable beds belong.

"The flora contains four *Filices*, amongst them one form, *Martensia*, specially characteristic of Cretaceous beds; one *Dammara;* one new genus of *Taxinea;* four species of *Podocarpium;* one *Dacrydium;* one most interesting genus uniting the genera *Ginkgo* and *Phyllocladus:* two *Gramineæ;* one *Musacea;* one *Palma*, closely allied to a Cretaceous species; one *Casuarinea;* three species of *Quercus;* one *Dryophyllum;* two species of *Fagus*, *Nemophylon;* one genus of *Ulnacea*, uniting *Ulmus* and *Planera;* one *Ficus*, *Cinnamomum haasti*, two *Proteaceæ;* and several *Dialypetalæ*.

"From the Tertiary deposits, Shag Point and the Malvern Hills furnished the most interesting plant remains.

"The flora contains three *Filices*, amongst them one form closely allied to European Tertiary species, a *Sequoia*, closely allied to the European *Sequoia couttsia;* *Araucaria haasti:* two species of *Dammara;* two of *Podocarpus:* one *Dacrydium;* one *Najadea;* one *Palma;* one *Casuarinea;* three species of *Myrica* (!), amongst them one almost identical with a European Tertiary species; one *Alnus* (!), most remarkably near a European Tertiary form; four species of *Quercus;* three of *Fagus;* one *Ulmus;* one *Planera;* one *Ficus;* one *Hedycarya;* three *Laurineæ;* one *Santalacea;* one *Protacea;* three forms of *Gamopetalæ;* and several *Dialypetalæ*."

I need scarcely point out that this information is very valuable, and will gladly be received by New Zealand geologists; and I have no doubt that, if once in possession of Baron von Ettingshausen's interesting paper, a great step towards the elucidation of many obscure questions in our stratigraphical geology will have been accomplished.

Art. LIX.—*Notes on the Geology of the Bluff District.*

By W. S. Hamilton.

[*Read before the Southland Institute, 21st January*, 1886.]

Now that the Bluff is becoming a sea-side resort to the inhabitants of the district, as well as a place of call, and often of a little detention, to strangers passing to and from the Australian Colonies, it may be interesting to some to know a little of its geology. The first thing that will attract the attention of the visitor who has an eye to the rocks will be the ragged slaty strata standing on edge, and striking N.W. and S.E., exposed between low and high water, and in some places considerably above, and flanking the hill from the pilot station to the jetty. These, according to Dr. Hector, belong to the Devonian period, and to the great series of palæozoic rocks that form the backbone of New Zealand, or, in other words, the axis of the great mountain system extending from Auckland to Stewart Island. On closer examination, these argillaceous slates are seen to be, at least near the jetty, interstratified with bands of syenite, or granite, from a few inches to several feet thick, becoming more granitoid towards the base of the hill, which is a solid mass of syenite. This would almost lead one to suppose that the hill itself had once been a mass of slate formations of similar age, and that it has been granitized by metamorphic action, and that, at the present junction with the slates, the bands of interstratified granite are only the more silicious layers which have become granitized; while the more argillaceous layers have withstood the dying-out metamorphic action.

This appearance Captain Hutton says he is "positive is fallacious," and holds the opinion that the whole range from the New River Heads to Ruapuke is an immense dyke of intrusive syenite. I am not aware that Dr. Hector gives an opinion on this point; but from the fact that in his Geological Map it is coloured as metamorphic, instead of true granite or volcanic, it would appear that he inclines to this view. It may also be observed here that Mount Anglem, and the northern half of Stewart Island, is also coloured in his map as metamorphic, while the southern half of the island is coloured as true granite, the same as the West Coast. There can be very little doubt, however, that Captain Hutton's view is the correct one, and that both Mount Anglem and the Bluff Range are of volcanic, or at least of eruptive, origin. Conclusive proofs of this are seen in following round the beach from the Bluff to the Greenhills railway-station. For a mile or two the interstratified bands of syenite or diorite are parallel with the slate and the base of the hill; but as soon as the range trends to the north, the outlying dykes strike still parallel to the base of the hill, but almost at right angles to the strike of the slates, cutting them transversely, and crumpling and contorting them in every conceivable way, just as a wedge driven into wood transverse to the fibre would bend and crumple the parted ends towards the right or left. Many instances of this are seen where the slate beds are cut at different angles by dykes of syenite, or diorite, from 4 to 20 feet thick, and bent by the intrusion of the latter sidewise in curves, in some instances almost semicircular.

In the débris of these dykes I found two large crystals, apparently of amphibole; one a thick hexagonal prism about 7 inches long, and as much or more in circumference, dark greenish-grey, and rough on the faces; the other about 4 inches long, also hexagonal, but instead of ending in a pyramid its ends consisted of only two planes meeting at an angle of about 60°, but I did not measure it, intending to examine it more carefully at home. This, unfortunately, I was precluded from doing. As they were somewhat heavy to carry, and I had a day's walk before me, I put them aside, meaning to get them on my way home. On my return the tide had risen higher than my calculations, and had taken temporary charge of my crystals; and notwithstanding that I have twice sought for them since, I have not been able to pick them up again.

In these dykes also blade-like crystallizations are not rare, of large size, and sometimes ending in an imperfectly-shaped four-sided pyramid. Small rough crystals are also frequently observable of undoubted hornblende or augite. All these could not have been the result of metamorphism, and prove conclusively that the range itself, of which these are but the outliers, must be a truly instrusive mass.

The age of the syenite, or, in other words, the period of intrusion, is the next question: and this can only be inferred from the characters of the rock itself. In many respects these are quite peculiar. It is heavily charged with sulphides and bisulphides, and so full of magnetite that a piece of the size of the hand will, in many cases, deflect the compass-needle 8° or 10°. The whole mountain is an immense magnet; and, in walking over it, the needle is constantly varying both in declination and dip. Iron is therefore present in far larger quantity than is usual in ordinary granitic rocks. Copper is present in every specimen I have tested, and often in considerable quantity. It is not at all improbable that a workable lode may yet be found of this metal at some of the points of junction with the slate. Manganese occurs plentifully in the detritus on the shore, from the wearing down of the rock by the sea. Black ironsand, auriferous and platiniferous, occurs under the same conditions so plentifully that it has been profitably washed for gold. Molybdenum, tungsten, tin, antimony, and arsenic are also found in small quantities in many parts of the range. The great quantity of iron and sulphur alone would argue a younger age than that of ordinary intrusive granite. The argillaceous slate through which it has burst is, as has been said, according to Hector, of Devonian age, and, according to Hutton, of carboniferous; and corresponds in this respect with the formation of Longwood, the Takitimos, Lake Te Anau, and the south of Lake Wakatipu. As there are no fossils, this can only be inferred from the lithological character of the strata. There is, however, little room to doubt that it is at least not younger than the Devonian. The outburst must, therefore, have taken place posterior to this period, but probably at no great distance of time, geologically speaking.

It is probable that the basin of the Southland Plain, now filled up by younger formations, was formed at the time of this outburst, and that the elevation of the Bluff Range was at the expense of Southland, by the extrusion of material in a plastic condition from under the surrounding district. There is evidence to show that strata may become plastic at no great elevation of temperature in many parts of the Hokonui District, in formations ranging, according to Hector, between the Permian and the Cretaceous. In many places, where there is not the least sign of any volcanic agency, patches occur, often not more than an acre or two in extent, of true trap rock full of small round boulders, and rock of a basaltic character, which must have resulted from the ordinary strata becoming plastic through chemical agency, and presenting all the appearances of an incipient volcano on the smallest possible scale.

The Cannon Ball sandstone of the Bastion and the Otapiri (so named by the officers of the Geological Department) seems to have originated in a similar way. If this be so, it is quite conceivable that the ancient strata under the Southland Plain, underlying the great Silurian and Devonian period, had, from chemical agencies, become plastic on a large scale, and, under pressure from the slow evolution of gases, had ruptured the overlying strata that imprisoned the sulphurous semi-fluid mass at the weakest places—in this case, along the line of the Bluff and New River Ranges—and by exuding a great viscid drop-like irregular excrescence, formed, on solidifying and recombination of material, the present range of granitic hills, extending from Ruapuke to the New River Heads.

Whether this hypothesis will fit in with all the facts, or not, must be left to the judgment of observers. It may at least serve till a better is found. Between the Greenhills quarries and the Mokomoko, the slates flanking the syenite are dark-blue, and of a fine compact texture, intersected here and there by veins and dykes of white quartz, which, being in the vicinity of much finely-crystallized iron pyrites, are likely to be auriferous in parts. Indeed, alluvial gold can be obtained in small quantities almost everywhere along the flank of the range. The beds are here, as at the jetty, quite perpendicular, and even more contorted and crumpled. As they recede from the range they flatten out to a gradually-decreasing N.E. dip, and change in character to a massive indurated sandstone of a greenish colour, often studded with splendid crystals of iron pyrites that stand exposure for a long time without rusting.

It is in these blue compact slates that fossils are likeliest to be found. I have often seen what I took to be fragments of shells, but have never been able to prove conclusively that such was the case; but from the abundance of lime in the composition of these blue slates it is almost certain that shells were embedded with them, and may still be found where the conditions of preservation are most favourable. They are not so much metamorphosed as might have been expected from their close proximity to the granite, and in some places fossils are quite likely yet to be found. The Bluff Harbour itself seems to have been at no distant date a freshwater lake. The floor of the harbour is a soft bluish-green very friable sandstone, scarcely more than hard-pressed sand with a little clay in it, and highly micaceous. There is not even a spectroscopic trace of lime in it, which must have been the case had it been a marine deposit. There is a good deal of sulphur, as sulphide of iron, which sea-water would have decomposed. There is also timber, quite fresh, and apparently *in situ*, from the roots being dredged up by the dredging-machine, with the embedding clay still adhering to the curly gnarled roots as naturally as if the tree had been pulled out of the ground on which it grew. The timber dredged up was evidently that of rata (*Metrosideros lucida*), which is still abundant in the vicinity.

Art. LX.—*On the Formation of Timaru Downs.*

By John Goodall, M. Inst. C.E.

[*Read before the Hawke's Bay Philosophical Institute, 12th July,* 1886.]

Plate XXVIII.

Dr. von Haast, in his work on the "Geology of Canterbury and Westland," p. 367, ascribes the formation of the Timaru plateau to a sub-aerial origin, and compares its structure to the *loëss* (or loam) deposits of China, the Rhine, and Danube, as described by Baron von Richthofen, the eminent German traveller and geologist, who, he says, "has shown in his last publications that the *loëss* in China could only be of sub-aerial origin, deposited by *apnais*, which at the present time are still at work in forming that rock. Atmospheric currents, together with the growth of grass and other vegetation, during an untold number of years, are the principal agencies by which the *loëss* has been deposited. In the first instance, rain water, running down the more or less steep slopes of the country, carries with it fine particles, which are partly retained by the grass or amongst its roots; whilst the wind, blowing across the land, takes up a great amount of fine sediment, afterwards also partly caught and retained by the grass. However, a third and most important agent is to be found in the roots of the plants themselves decaying, and thus raising the ground. *There is a peculiar vertical capillary texture observable in the true loëss*, deriving, doubtless, its origin from the decaying of numberless rootlets during many past generations of grasses." Dr. Haast goes on to state, "during the Great Glacier Period of New Zealand, beginning towards the end of the pliocene and ending in the post-pliocene period, during quaternary and recent times, the *loëss*-beds have gone on accumulating steadily so as to reach such a considerable thickness, as we find them, amongst other localities, as the lower slopes of Banks Peninsula, and on the Timaru plateau."

This view has been opposed by Professor Hutton, who, in an article on the silt deposit at Lyttelton, laid before the Philosophical Institute of Canterbury,* clearly shows that those deposits do not belong to the *loëss* formation. After weighing all the evidence he could obtain, he arrives at the conclusion "that the evidence in favour of the marine origin of this deposit preponderates enormously over the evidence in favour of its sub-aerial origin," including in this judgment the Timaru formation. Not having seen much of Banks Peninsula, I am unable to make any personal remarks on the silt formation there; but with Timaru it is different, as having been resident there for some time, I have had the opportunity to obtain such information as makes me differ from Dr. von Haast as well as from Professor Hutton.

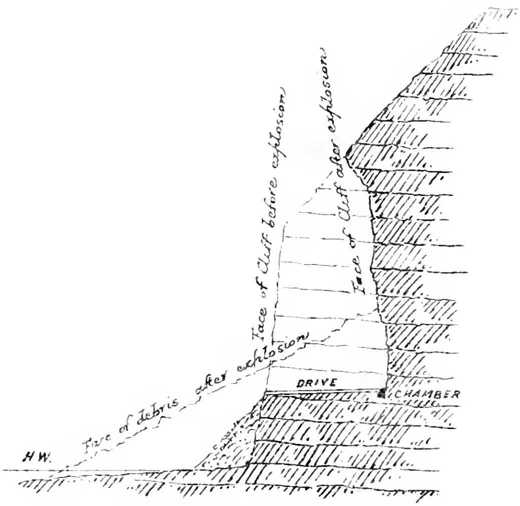
The Timaru Downs are situated to the south of the Canterbury Plains; they are about six miles broad, and extend inland from the sea about ten miles. They consist of gentle undulating country, well adapted for agriculture. The structure of these rolling downs is very peculiar. It is very evident, from abundance of data, that the Canterbury Plains at one time extended all along where these downs now exist, and that actually the plains are there at present (beneath), and that the downs have been built on the plains. The plains beneath the downs have been covered over with beds of dolorite or basalt, and over the

* "Trans. N.Z. Inst.," vol. xv., p. 411.

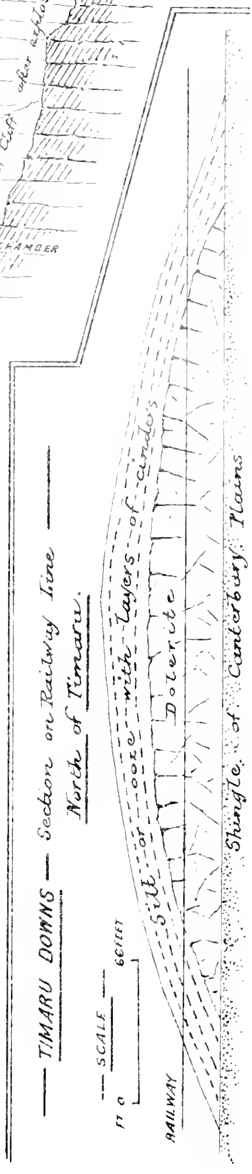
— BY 2 TONS OF DYNAMITE —

— Scale —

FT 0 100 200 FEET



— BY 8 TONS OF BLASTING POWDER. —



— SECTIONS SHOWING EFFECTS OF —
— TWO BLASTS AT AHURIRI BLUFF —
— NAPIER . N.Z. —

J.G. delt

To illustrate Papers by J. Goodall M Inst.C.E.

dolorite occur beds of fine brownish-yellow material, interlaid with regular streaks of volcanic ash. These beds *curve* with the hill, and do not occur in flat beds, as in marine deposits. The regular streaks of volcanic ash are very evident in any new cutting, and the pieces of ash can be readily picked out. That dolorite exists below the downs, and resting on the shingle plain, there is ample evidence, as both can be traced up all the deep gullies; and has also been proved from wells that have been sunk, from bores put down, and from quarries. The shingle beneath the dolorite beds shows evidence of having been subjected to great heat, and the dolorite in many places is scoriaceous; in fact, many pieces can be found that could not be distinguished from Auckland (Mount Eden) scoria. Nobody can for a moment doubt but that this dolorite was emitted as lava from some volcano situated above these downs—probably near Mount Horrible. This lava spread over the country in two or three layers, pouring down in ridges. The volcano being spent as to lava, it then, doubtless, belched out ooze and mud, with occasional showers of cinders and ash. The ejected material would overlay and envelope the dolorite beds. There is an excellent section north of Timaru, formed by a railway cutting, showing the dolorite bed, and above it the beds of ooze, with unmistakable layers of cinders (Pl. XXVIII.). In this bed of ooze, deep down, I have found moa bones, but no trace of land or marine shells; and I have not observed *the peculiar vertical capillary texture* observable in the true *loëss*, as described by Dr. von Haast. The occurrence of moa bones would tend to prove that these beds were comparatively recently formed, as might be from a sudden volcanic outbreak, and not from a slow formation as that of the *loëss*, which would take ages, and so reach the time prior to advent of the moa.

I am led the more strongly to uphold the volcanic origin of these downs from having seen very similar formations elsewhere, when there could not be the slightest doubt of their formation. That was in Auckland, during the execution of the Auckland improvement works at Albert Barracks. Heavy cuttings had to be made for the streets, and one of these cuttings went actually into the cinder cone of an old crater. Further away from the cone were similar beds to those at Timaru, with layers of cinders through them.*

There is a peculiar feature in these downs which is a puzzle to all, and that is the occurrence of small lagoons or shallow ponds on the brows of the hills. Almost invariably, as you mount a hill you will find a lagoon on top. Had these lagoons only occurred anywhere else, they would not have caused any

* A drawing of this in section can be seen in the "Trans. N.Z. Inst.," vol. vii., p. 144.

attention; but, occurring as they do, it does seem strange how they could have been formed. The only suggestion I can offer to explain this circumstance, is that—having adopted the volcanic theory in the formation of these downs—immediately after the lava or dolorite beds were spread over the country, the mud and ooze were deposited on them. The great heat of the beds—greatest when thickest—would for a long time keep the mud boiling, and so a quantity of solfataras or mud volcanoes would be formed, and when the whole cooled a shallow basin would be left where they existed.

IV.—CHEMISTRY.

Art. LXI.—*On the Occurrence of Bismuth at the Owen, N.Z.*

By William Skey.

[*Read before the Wellington Philosophical Society, 18th February*, 1887.]

On the 23rd December last (1886), four specimens of auriferous quartz, as collected from four claims at the Owen diggings by Dr. Hector, were submitted to me for a quantitative analysis for gold.

One of these specimens (No. 1), when treated with mercury for gold, yielded an amalgam which, rather early in the process of sublimation, darkened feebly upon its surface, and towards the end of the process slightly decrepitated.

These phenomena showed, of course, that the mercury used had gathered a minute quantity of some base metal from the quartz operated on.

This metal I found to be bismuth; but the whole of my operations were upon so small a scale, (being limited as they were by the size of the specimen itself,) that I could get no quantitative determination of it—having barely enough, indeed, of the metal to get those various reactions of this metal necessary to establish its presence.

As yet I am unable to announce whether the bismuth exists in a separate state in this quartz, or as an alloy with its gold; but this I hope to be able to determine at an early date, upon receipt of further specimens from the claim where this was obtained. In the meantime, I may remark that I could not observe any metallic bismuth in the rock, nor, after panning it off, did I find any metal but the gold.

Bismuth as a constituent of native gold is stated for in gold from Australia analysed by Northcote.*

Last Sample for Bismuth from the Owen District.

"Sir,—Having separated the gold from this sample by simply panning off, without the use of mercury, I was able to get sufficient gold to test for bismuth, when I was unable to find a trace of this metal in the gold. But bismuth was present in

* Dana, p. 5.

the quartz, though quite undetectable to the eye. The bismuth present is, therefore, certainly native—occurring quite independent of the gold, only accidentally associated with it. Bismuth being a very brittle metal, would be crushed beyond all recognition in the pounding or stamping of the quartz; so would escape detection visually, except in the quartz uncrushed. The quantity of bismuth present in either of these samples is very minute, and of no economic account.—W.S.—To Dr. Hector."

V.—MISCELLANEOUS.

Art. LXII.—*Address.*—By James Hector, M.D., President of the Wellington Philosophical Society.

[*Delivered before the Wellington Philosophical Society, 30th June,* 1886.]

Abstract.

After thanking the members for re-electing him to office, Dr. Hector said that the Society had been very successful during the last year, and the papers read before the Society formed by no means an inconsiderable portion of the contents of the volume. Several very important events which had taken place during the past year had received notice on the part of the members of the Society. One of these was the eclipse of the sun, on the 9th September, 1885, a phenomenon only rarely witnessed from any one particular spot of the earth's surface. A very full account of that eclipse was embodied in the "Transactions." The outcome of all the observations tended to show that the sun had only a moderate degree of activity at the time of the eclipse, that the scarlet prominences were only moderately developed, and that they were clustered and combined in a very irregular outline. No laminated structures—that is to say, no structures parallel with the sun's surface—were observed; but there were several other minor phenomena. He stated that he had been very fortunate in securing a number of photographic negatives of this eclipse, all of which he had sent Home and lodged with the Royal Society, where they will be preserved and compared with views obtained on future occasions. Another interesting phenomenon was the late occultation of Jupiter and its satellites, under very favourable circumstances for determining whether anything of the nature of an atmosphere surrounds the moon.

An event of considerable importance was the visit of the United States exploring ship "Enterprise," under Commander Barker. When she left New Zealand she was to make for the coast of South America, and Captain Barker was good enough to consult the speaker as to whether there was any particular course that could be of more use than others for the purpose of taking soundings. He informed the meeting that he had lately received from Captain Barker the results of the soundings taken, and was able to lay before them a sketch-map showing the form of the Pacific, tinted according to the soundings he had obtained. The first result was that the sea area between New Zealand and the Chatham Islands had a depth of about 1,300 fathoms. The water gradually shoaled, until when close to the Chatham Islands the depth is found to be 160 fathoms, or about the same as in Cook Straits. Immediately beyond the Chathams there was a sudden plunge, just the same as to the west of New Zealand. Deep soundings of 3,000 fathoms were carried to long. 118° W., when the water suddenly shoaled and a great bank was found, on which the depth was determined by a number of soundings shown in the return sent by Captain Barker. Another plunge reached 3,000 fathoms; then the depth shoals to about 1,500 fathoms, at 500 or 600 miles from South America. Near the coast 1,200 fathoms was found, which appears to be the ruling depth of the South Pacific, subject to these great depressions. From New Zealand to the Chatham Islands the bottom is found to be level. From the Chatham Islands, Captain Barker first met with a grey mud, passing into brown mud with minute white shell-sand. Yellowish sand was found in the South Pacific "pot-hole," after which a brown mud, followed again by grey mud with shells. This information confirmed the views of Professor Hutton, in opposition to the views of Wallace, that in the South Pacific there is a submarine plateau, indicating the former existence of a great continental land connection between South America and Australia.

Dr. Hector next referred to a report which he had made to the Hon. the Minister of Mines, dated the 23rd inst., for full particulars of the observations he had been able to make regarding the recent eruption of Mount Tarawera. He pointed out that the eruption of Ngauruhoe in 1870 was really much more important than the late outburst, though less advertised by sad incidents, for then great lava and steam eruptions continued for a considerable period. Referring to a large geological map, he gave a general sketch of the geology of the district. Omitting the Post-pliocene and newer coastal formations, the whole country, from the sea-level in the neighbourhood of Wanganui, was originally covered by a crust of limestone of Older Pliocene age, that rose up to 4,000 feet on the slopes of the Kaimanawa Range. Under this there was the middle tertiary, or blue papa (or marlstone); but the whole series did not exceed 2,000 or 3,000 feet in thickness, and rested on much older rocks wherever its base had been observed. The crust of limestone presents the same character throughout, from the sea-level to the greatest altitudes. It did not now constitute a continuous sheet, but occurs only in isolated masses that have remained perched on the hill tops. As it is largely composed of shells of huge oysters of the same species throughout, this limestone must have been deposited in the same depth of water marking the period of the close of the deposit of the great blue papa formation. Since that period this limestone has been inclined by the gradual dome-like upheaval of the central area of the North Island of New Zealand. During this period of upheaval there was no trace whatever of the contemporaneous existence of any of the volcanic rocks that played such an important part in the later history of the district. Thus, it was not until we got on the top of the limestone that we found, near Ruapehu, on its south side, outliers of conglomerate and gravel, showing water-carried material derived from these volcanic rocks; but in the opposite direction, towards the Bay of Plenty, and towards the Thames and Waikato Valleys, or any part of the northern half of the dome, we nowhere find any trace of the marine tertiary rocks. If present, they had been completely smothered by subsequent volcanic deposits. In explanation of this, it may be suggested that all the ejected volcanic matter has, in past times, by a prevailing southerly direction of the wind, been carried to the north, and so smothered the country as to completely obscure the tertiary rocks. Be that as it might, what was found was that the southern flank of this dome was composed of marine tertiary rocks, while the northern is a sloping plateau, superficially composed of volcanic detritus.

Dr. v. Hochstetter, who first examined and gave an account of this district, long ago pointed out that all over this sloping plateau great valleys have been eroded and then filled up again by the products of eruptions, cones have been built up by volcanic matter, and great flows of lava have taken place of an extremely siliceous type, so siliceous that they are barely fusible, along with others which set in a glossy mass called obsidian, or in a vesicular form as pumice stone, which is nothing but glassy lava blown out by steam.

Now, wherever this kind of lava has been accumulated so as to form great volcanic cones, of which you find many instances at Tauhara, Tarawera, Mount Edgecumbe, Ruapehu itself, there has been sooner or later formed a corresponding depression, simply, as v. Hochstetter pointed out long ago, by the local subsidence of the surface over the vacuity from which some part of the ejected matter had been abstracted; and for long after a mild generation of steam was kept up round the basins enclosing the lakes by the expiring energies of the former great volcanic activity. That applies to every part of the country except Ngauruhoe, where there still remains part of the primitive form of volcanic activity, as evidenced in the ejection of actual masses of lava, which forms on cooling into stony rock. Such was the lava exuded in 1870. With that exception, all volcanic action in this district has always been considered to belong to the solfatara type, as distinguished from the more active form of volcano. The formation of the terraces at the Hot Lakes was due to the action of steam, derived from water heated at a great depth from the earth's surface, forcing its way through the siliceous rocks at a high pressure and temperature, and carrying with it an extract, as it were, of everything soluble in water of very high temperature and pressure. These matters were immediately deposited at the surface, on the water escaping as steam, slowly, and film after film. Extensive deposits of almost pure silica formed in this manner constituted the magnificent terraces at Rotomahana. Now that action, although not always so beautifully exemplified as at Rotomahana, is going on at other points, such as Whakarewarewa, Rotorua, Orakeikorako, Karapiti, Wairakei, Tokano; and no one ever expected that action would suddenly become more violent. It was now the question: were we dealing with any new force, or was this merely a gigantic display of the same force which up to the present time had been exercised in a moderate manner, and, he believed, due to the influence of lavas still retaining their original heat, upon deep-seated strata saturated with underground waters? He was inclined to the latter view, or, in other words, that the phenomenon was due to a sudden accession of hydro-thermal activity, and not a renewed volcanic force.

Tarawera Mountain was a most conspicuous land-mark all over this country, standing up boldly above the other hills in the district, and very similar in appearance to Horohoro, which was the southern termination of the plateau-topped ridge extending from Cape Colville to this point. It was composed of a rock called trachyte breccia, a volcanic rock consisting of mudstone, cementing huge masses of trachyte and porphyry rock, and there was but little doubt that it was of submarine formation, and altogether antecedent to the superficial volcanic rock. v. Hochstetter considered that the Tarawera Mountain also belonged to this older formation. This is not quite correct, because its composition is of different origin. Seen from Tarawera Lake it showed great precipices of columns like those at the Giant's Causeway in Ireland, but composed of obsidian, or unannealed natural glass; and in every respect Tarawera resembles in structure the island called Tuhua, or Mayor's Island, in the Bay of Plenty. Now, it would have been a very different thing if Tarawera had belonged to the older formation, which must have been quiescent for an incalculably greater period than the recent. If we considered it a mountain of the recent formations, it would be much easier to understand how the energy may have given one last dying kick; and that, in the opinion of the speaker, when the matter is fully investigated, would prove to be the source of the whole disaster.

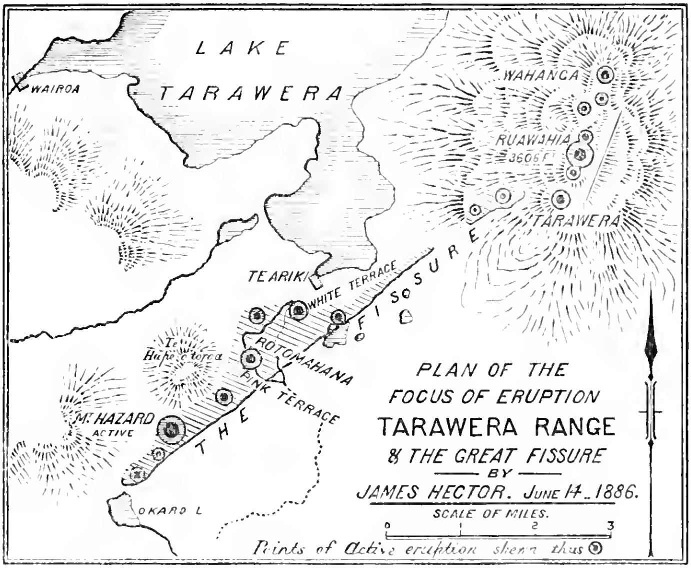
Tarawera Mountain, he continued, stood a little way back from Rotomahana, and consists of three tops—Wahanga, separated from the others by a deep chasm, and two others, Ruawahia and Tarawera proper; but he could not say how the latter came to have separate names. It was at the south foot of Tarawera that Rotomahana was situated, and around this lake a continual outpouring of boiling water was going on, throwing up huge geysers; and enormous deposits had been accumulating round the lake of siliceous matter, which completely sealed any escape other than the immediate geyser vents. He had already stated to the Society many years ago that all these terraces seemed to have the power of building up to about 70 feet; and he recommended it to engineers to think that question out, and see whether any relation can be established between the temperature and an hydraulic head of 70 feet. This was very obvious at Whakarewarewa. The result remains that this action ended in cementing over the surface with 70 feet of hard and heavy siliceous rock. The continual outpouring of this matter from beneath, and the continual action of hot water on the rock, must have absorbed a great deal of heat. That heat was really derived from a remnant of the uncooled lava in the core of the Tarawera Range.

On the 9th of this month (June) we had very stormy weather, and on that day there set in all over this country a complete change of weather. For nine months previous, he had been informed, they had hardly had a shower of rain in the Tarawera District; but on the 9th down came an enormous flood of rain, and a change set in to very wet and cold weather. Another circumstance deserves attention. This year we had had a most unusual arrangement of atmospheric pressure in the Southern Hemisphere. When passing the Equator, on the whole, barometric pressure gradually declines towards the poles. It declines much more rapidly towards the South than towards the North Pole, so that while the barometer averages over 30 at the Equator, in New Zealand it is about 29·8, and a very little way south the usual reading is only 29·2 or 29·3. But for some reason an area of high pressure is generally situated to the N.E., which this year has passed down much nearer to the South Pole. When at the Antipodes Islands, in March, Captain Fairchild found the unprecedented high reading of 30·8, the barometer being in perfectly good order. In consequence of that, there had been a great deal of continued easterly weather in New Zealand. In any case, there were exceptional conditions of weather and atmospheric pressure; and, in connection with this, he mentioned that a difference of an inch in the barometer meant a difference of pressure of nearly one million tons to the square mile.

The earliest trace that he had been able to discover of any symptoms was reported by Mr. Godfrey, who resides at Tawaite, a whaling-station at the entrance to Tory Channel. At that place the whalers were, as early as 6 p.m. on the evening of the 9th, disturbed by booming noises coming through the earth. They were accustomed to hear the booming of the sea outside Tory Channel, but they were clear that these noises were not of that description. According to their account, these noises did not continue through the night. They afterwards heard the noises like the firing of guns, such as were heard at Nelson, Kaikoura, and even Christchurch and Auckland, at a distance of not less than 200 or 300 miles from the focus at the time, which agrees with what he would have to mention as the first stage of the eruption. A very distinct statement of the event was given to the speaker on the 13th by the Native Interpreter, Mr. Edwards, who resides on Pukeroa Hill, at Ohinemutu, and was fully confirmed by the account given on the same date by Mr. Roche, the Railway Engineer, who was encamped at the edge of the bush above Rotorua, and by the account of Mr. Macdonald, given on the 16th, who witnessed the whole eruption from the Kaingaroa Plains.

At 10 minutes past 2 a.m. the eruption began by the blowing off of the cap of Wahanga. The top seemed to go up as a great mass in fragments, and must have been illuminated, otherwise the spectators could not have seen what they did see. Then followed an up-throw of stones, accompanied by noises, and, about five minutes later, the top blew off Ruawahia, immediately followed by an out-throw of a vast column of steam, charged with stones and dust. Then came an outburst, obliquely, from the south end of Tarawera Mountain proper, right over Rotomahana. Noises and eruptions continued steadily for about two hours, when a most terrific earthquake was experienced. Some pretty severe ones had been previously felt at Wairoa, but, even at as short a distance as Rotorua, no damage was done by earthquakes. But at 4 a.m., or shortly before, there was a vastly heavier shock, the sensation of which was described as just as if you had been running fast and come against a fence. At the same moment a terrific sound rent the air, but it was not of the same clear report-like character as those accompanying the first eruptions, and suddenly an immense cloud, composed of steam and dust, was thrown up, from which lightning issued in all directions. This gigantic cloud sprang up, and then was seized by a kind of gigantic pantings or throbbings, each one accompanied by a fresh access to the volume of steam. The steam formed a flat-topped cloud, which drove right in the direction of Rotorua; and the people of that place who saw it advancing on them, and throwing out lightnings that seemed to touch the water's edge, thought their destruction inevitable. Just at that time a violent hurricane from the S.W. caught the cloud on its edge, and seemed to make it rear up on end, and arrested its progress. That time agrees with the fall of mud at Wairoa; and no doubt the condensation of the steam, and consequent collapse of the edge, led to the deposit of mud in a moist condition, but as far as known quite cold, upon the unfortunate inhabitants of Wairoa and the surrounding country. After this deposit of mud, a cloud of higher stratum appeared to reach all over the country. The heavier and more damaging kind of dust was driven towards the N.E., the edge being condensed so as to throw down the dust in the form of mud, from Wairoa to Te Puke, in a narrow strip. Away to the east the country was covered in dust, causing darkness from Gisborne to Tauranga until 11 a.m. Above that there was a higher cloud, unaffected by the wind, that appears to have spread out to a distance of 120 miles, depositing a light thin grey dust known as the Tauranga dust. Other kinds of dust were deposited at Opotiki, Hicks Bay, and the East Cape, the latter containing organic matter; and a grey dust also fell inland from Poverty Bay. A very distinct form of the ejected material is the black vesicular mud-stones resembling scoria, thrown out by Mount Hazard, and the great sandy deposit that completely covered the country in the neighbourhood of the focus of eruption.

He then described how, on Sunday, the third day after the eruption, he got to Rotorua, and, immediately on emerging from the bush from Tauranga, came in full view of the eruptions. He was able to count seven distinct points of eruption, while every now and then from three more marked points great outbursts of a reddish-brown character took place. During two clear nights he carefully watched these eruptions from Rotorua with a powerful glass, and never saw any evidence of a reflected glare, or sign of cracks or fissures in the mountain through which molten lava could be seen. The detritus had almost completely smothered the outline of the range, and had nearly filled up the valley between Ruawahia and Wahanga. He obtained a subsequent observation of the range from the opposite side from the Kaingaroa Plains on the seventh day after the eruption. On the top of Ruawahia the cone had greatly increased, with the addition of an outer ring. The most curious thing was that right along the back of the mountain could be seen with the glass a large crack or fissure, running obliquely to a great height on the southern end of the mountain. All along this line little wreaths of steam were escaping. In front of that crack could be seen an enormous terrace of a clear white colour, all the rest being of a mouse-grey colour, except at the extreme top which was brown. No doubt the terrace consisted of pumice sand, that was thrown up and fell perfectly dry and hot.



Another view of Tarawera was obtained from Te Hape-o-Toroa, a hill close to Rotomahana; and here a fissure was seen, as in the above woodcut, to the south end of Tarawera Mountain, running in a S.W. direction. The eastern side of the fissure was tolerably straight, but the view was much obscured by steam. It has the appearance as if part of the mountain, 2,000 feet by 500 by 200 feet, had been blown out. There is quite sound ground between the south end of the fissure and Okaro Lake. The direction of the fissure passes to the west of that lake; and Mr. Park, who examined that part of the field most closely, estimated that not more than three chains of ground separates the original edge of the lake from the point to which the fissure has reached. The fissure is not of the nature of a fault by a downthrow, but is really a row of pit-like craters, having two sides pretty much on a level, the material that occupied the intervening space having been simply blown out. The whole country in the vicinity is covered with the dazzling white sand, which creaks like starch under the foot. It was still quite hot on the fourth or fifth day, and where it has covered old forest trees they were smoking and burning. The valleys were all partially filled up, and the hill-tops covered, as if with terrific snow-drifts. This white sand must have been matter thrown out of the rent that intersected Rotomahana.

At one point the fissure was building a cone of stones thrown out by a volcano. Several craters were throwing stones 800 to 1,000 feet high. One crater, Mount Hazard, was doublebarrelled, having two orifices which alternately spouted out showers of hot water and dark-coloured stones to a height of 700 to 800 feet. These showers sometimes were oblique, and, clashing together, the stones fell on the outside slope of the crater, so that they are building up a miniature cone. This fissure, with its vents, will become an important feature in the district. Of course we have lost the lake and the terraces; and all that was gained was this hideous fissure and the active cones on Tarawera, which, he believed, will soon become dormant, and probably the only marked new feature resulting from the outbreak will be Mount Hazard, and the fissure, that will fill with water and become a lake.

He again repeated that, so far as he was able to see, up to the time when he left, there was no development of lava; and, therefore, if that were the essential feature of a volcanic eruption, there had been no proper eruption, merely a much more gigantic development than usual of great hydro-thermal forces, the conversion of heat and water into steam, and the dispersal, by its agency, through the atmosphere of an immense volume of rock fragments derived from superficial strata.

The study of this wonderful phenomenon fully explained how the rock terraces of the Waikato, which extend into its lateral valleys, have been smothered by pumice and re-excavated. This was formerly difficult to understand; but the whole mystery disappears in the light thrown on the subject by this eruption. The valleys were excavated by running water; but, instead of being filled and protected by great shingle flats, as in the Southern Alps, there had been in former times sudden eruptions of pumice sand, which had filled the valleys, and then the water had, with extraordinary rapidity, re-excavated the terraces down to the original bed-rock. The same applied to the valleys towards the East Coast; so that the cutting of the pumice terraces had nothing to do with the original cutting-out of the rock terraces themselves.

The conclusion to be arrived at was that this eruption was on a very gigantic scale, but was yet a very simple one as far as we know. He had a clear view from every point accessible. The party passed so close to White Island that we were able to see it quite active; in a like manner, Rotorua and other hot springs all showed extra activity, but there is nothing more in this than is usual after a great change in the weather or in barometric pressure. At Tokano there was no change whatever. It is mentioned as if new that there is a lake on Ruapehu, but if they looked at the model of that mountain in the Museum that was made years ago they would observe the very lake. This lake was first described by Messrs. Maxwell and Beetham, and steam is often seen rising from it, as if from a warm pool in cold weather. The fact of its being a lake surrounded by permanent snow and ice-cliffs, proves that it must be affected by some local hot spring; but Mr. Park, who observed it in January last from the top of Ruapehu, reports that it was then frozen over.

On the 15th of June Ngauruhoe showed no unusual activity, but appeared to be giving out rather less steam than usual. As for an underground connection between the different sources of volcanic energy, the eruption completely disproves it: because had there been any such connection with the outburst of steam from Rotomahana, what would have been the effect on Whakarewarewa? It would have drained the springs there. As it was, there were no signs of any effect on springs a short distance off. On the whole, he saw no ground for anticipating that we should have any renewal of the volcanic energy. It must have been a very long time since the last outbreak, for it is very plain that the terraces would have been destroyed by it. Now, it has been shown that such terraces in America, but of very much smaller dimensions, must have taken at least 1,000 years to form; and it may have taken perhaps ten times as long for the White Terrace. What the exact circumstance may be that has broken in on this period of rest, has still to be suggested.

Art. LXIII.—*Economic Antarctic Exploration.*

By C. Traill (Communicated by T. Kirk, F.L.S.).

Nearly half a century has elapsed since the Antarctic Expedition, under Sir James Ross, left the shores of England in Her Majesty's ships "Erebus" and "Terror," and the account of the expedition, written by Sir James, is now so seldom met with that to most of my readers it is probably unknown. In putting down some thoughts suggested by reading Ross's volumes I shall not scruple, therefore, to make free use of notes and extracts taken at the time.

My chief objects in writing are: (1) to consider whether we in New Zealand might not attempt something in the way of Antarctic exploration, combined with whaling; and (2) to provoke others, with fuller information and more access to men and books, to take the matter up and clear the way by showing what the difficulties are that have to be faced, how they may best be overcome, and what advantages we may fairly expect to accrue. I hope, also, by dwelling on some interesting features of the South Polar regions, without, however, pretending to write for scientific men, to draw more attention to Ross's work, as the book seems less known in New Zealand than it ought to be. In his volumes are to be found all that we yet know about the remarkable land discovered by him to the southward, and named after our reigning sovereign, a land supposed to be a continent, probably larger than Australia, and not very much further away; near enough probably to have a considerable influence on our climate and harvests, in at least the more southern parts of New Zealand. From Stewart Island to Cape Howe, in Australia, the distance is, in round numbers, something less than 1,000 miles, and to the North Cape of Victoria Land a trifle under 1,400 miles, or about the same as the distance by sea from Oamaru to Melbourne. In judging, however, of the effect of Victoria Land on our climate, we must consider not merely the intervening distance and the intensity of cold on its lofty ice-covered mountain ranges, but also, besides other matters, the effect of the numerous icebergs to which it gives birth, and which, with the ocean of fragments known as the "pack," approach so much nearer to us. I believe it was by indications of the thermometer alone that Captain Cook came to the conclusion that there must be a large extent of land to the southward. The first of two chief reasons given by Lyell for the excess of cold in the higher southern, beyond that found in similar northern, latitudes, is the extent and height of Victoria Land. To a considerable extent this will probably apply to these latitudes.

Though it seems commonly assumed that we have an Antarctic continent, it may be that we shall never know whether the name is correctly applied. Land and ice together may be found possessing continental dimensions; and yet, with regard to much of it, it may be impossible to determine whether it is land or an ice-laden sea, or a group of islands connected by ice.

Ross's voyage was doubtless expensive, far beyond anything we could afford. Indeed, it would be a mistake to compare any exploring work we could do with his three years' voyage, the great scientific object of which was not exploration, but emphatically that of terrestrial magnetism. This involved an extensive series of observations, which necessitated his visiting many parts of the world. Thus it came to pass that though the expedition left England in September, 1839, it was not until fifteen months later that, being in New Zealand waters, he steered a direct course to the southward on the meridian of Campbell Island. He had no steam-power, and even in those days his ships were considered slow sailers; and yet within four weeks he had restored to England the honour of the discovery of the southernmost known land, with its magnificent ranges of mountains, their lofty peaks covered with eternal snow, and their valleys filled with glaciers projecting for miles into the sea and terminating in lofty perpendicular cliffs. Another fortnight sufficed to show the continuity of this land from about 70° to 79° of south latitude, and for the discovery there of a grand active volcano, which was named by Ross "Mount Erebus," while its sister mountain, an extinct volcano of somewhat inferior height, was named, after the second ship of the expedition, "Mount Terror." Mount Erebus, which seems far more energetic in its action than our Tongariro, rises directly from the sea in the form of a regular cone, towering far up into the sky to about the same height as Mount Cook. Red glowing fires were visible at the summit, from whence issued a column of dense smoke, which rose at times to the height of 2,000 feet.

The appearance of this magnificent burning mountain, with its most interesting surroundings, never before and never since seen by mortal eye, must have been a grandly impressive spectacle to all on board of the two vessels, and they would gladly have wintered within sight of it if they had found a suitable place to secure the ships. Had they accomplished this, Sir James Ross might have had the honour of planting the flag of his country on both the north and south magnetic poles, their estimated distance from the latter being only about 160 miles. From Cape Crozier, at the foot of Mount Terror, the vertical icy cliffs of the great barrier stretched away to eastward as far as the eye could reach, while its smooth surface, only once seen from the mast-head over a lower part of the cliff, appeared like an immense plain of frosted silver. This vast unique ice-plain, or *mer de glace*, is perhaps the most interesting of Ross's discoveries to the southward. It may, with its surroundings, be the best illustration extant of conditions that prevailed during the well-established glacial period of the Northern Hemisphere, also of the desolation that may be expected to reign in the distant future over all the now pleasant habitable parts of the earth, supposing that after the conflagration foretold in Scripture the planet is allowed, so to speak, to die a natural death. We know little about it—yet enough, however, to whet the curiosity of scientific men, and make them eager to learn more. Ross estimated its thickness at 1,000 feet, and traced the northern edge, a straight perpendicular wall varying in height from about 100 feet to 200 feet, to a distance of 450 miles to the eastward.

Many questions with regard to it suggest themselves readily to the mind—as, What is its extent? Are its dimensions altering? Is it in motion? If in motion, at what rate does it move, and in what direction? Does it rest chiefly on land or on water? Is it fed chiefly by glaciers, or by the snow that falls on its surface? In what manner does it waste away? I do not find such questions discussed by Ross, and the answers to some can only be guessed at in our present state of knowledge. As to the waste, most persons on first turning their thoughts to the subject are apt to think that in a climate of such extreme rigour there can be no waste by thawing, and that such an ice-plain, or a circumpolar continent, must increase in height by the amount of the yearly snowfall. Let us see what this would lead to! Supposing that no more genial climate has existed there for the short geological period of a quarter of a million years, and that the snowfall increased the height of the ice by only 2 feet yearly, which would be equivalent to less than 23·0 inches of rainfall, a simple calculation will show that by this time the ice would form a stupendous mountain, in comparison with which the huge bulk of the mighty Himalayas would be a trifle—in fact, the ice-mountain would be eighteen times their height. Clearly, then, granting that our theoretic ice-mountain could not sustain its own weight, there must be yearly waste roughly commensurate with yearly nourishment. I think there can be little doubt that the ice-sheet is prevented from increasing in size and advancing towards us chiefly by the northern edge breaking off and floating away in the shape of icebergs, and by the thawing of the undersurface, due to some heat derived from the contiguous land or water, aided by the effects of pressure and friction, and yet that these combined causes would be comparatively powerless to hold it in check without the assistance of oceanic currents.

With regard to the feeding, Ross remarks: "Whether Parry Mountains again take an easterly trending and form the base to which this extraordinary mass of ice is attached must be left for future navigators to determine." Special interest attaches to Parry Mountains from their being the southernmost land yet discovered. Over the edge of the westerly portion of the barrier their lofty summits could be seen stretching far away to the southward. Although at right angles to the barrier edge, I do not see why they may not form the "base," without the supposition of an "easterly trending" being necessary. The ice, after descending from their slopes, though pushed off chiefly to the eastward, must surely be sufficiently plastic to spread northwards as well—the greater the resistance to its easterly advance, the more must it be pushed to the northward. Whether the chief nourishment is by glaciers from the Parry Mountains, (supposing that the ice-sheet is connected with no others,) or from the snowfall on its own surface, may depend chiefly on the comparative areas of that surface and of the eastern slopes of the range. I am inclined to think that the glaciers play a subordinate though important part.

That motion should be imparted to such a vast mass by ice descending from the mountains may seem hard to credit, especially if we suppose the sheet to rest chiefly on land, and consider the enormous friction where in contact with the rocks below; but perhaps nothing could so efficiently act the part of a lubricant in lessening the friction as interposed water derived from the thawing of the undersurface of the sheet. Whether supported chiefly by water or by land, (and I think the former supposition much the more probable,) we can hardly refuse to believe that glaciers *do* impart motion, for if they had not the power of making room for themselves on their descent, by squeezing and pushing forward the mass of ice, their channels would become blocked, every hollow would in time be filled, and Parry Mountains, instead of appearing as a noble mountain range, beautiful to the eye, would assume the uninteresting aspect of a huge mound. Probably the ice-plain has attained its maximum thickness under existing climatic conditions, and perhaps an increased snowfall would only cause greater lateral extension.

Those who maintain that there has been a glacial period in the Southern Hemisphere, may picture to themselves the great ice-sheet spreading to these shores, or rather to these latitudes; for if ever there was such a period it must surely have been while yet the shores of New Zealand lay beyond the Campbell and Auckland Islands, else how could those solitary islands be now clothed with a rich and varied flora?

Ross afterwards made the barrier in longitude 160° 27′ W., and latitude 78° 11′ S. He found that its perpendicular cliffs had dwindled down to less than half their height at the foot of Mount Terror, or to about 100 feet. They were seen to diminish gradually to about 80 feet at some 10 miles further to the eastward, but beyond that distance they again rose higher. This fact of their rising again seems to me significant, pointing to a connection with other land to the eastward, or to the north of east, in which direction the face began to trend.

The seas in this high latitude appear to swarm with animal life: whales, seals, and huge penguins are seen in all directions. On Possession Island the penguins actually disputed the rights of the invaders, biting at the legs of the sailors. Innumerable multitudes of those birds covered the ground, and crowded the ledges of the rocks, tier above tier, to the very highest points of the island. Some of the great penguins stood more than half the height of a man, and one was shot that weighed 78lbs. By letting themselves down on their bellies they were able to scuttle along, outstripping a man on the snow.

We can guess by the great beds of guano that generations untold have held undisturbed possession there. Now, however, a fearful danger threatens to thin their ranks in perhaps the near future, for when steam whalers invade their seas, and a ship runs short of coal for the return trip, a few tons of their oily carcases would prove invaluable as fuel. Though the birds themselves may have no commercial value, the large deposit of guano may prove to be of superior quality. Certain bones of other large birds from our southern islands have been exported in considerable quantities, for the purpose, I am told, of making pipe-stems, but for such a questionable benefit to humanity it seems a shame to kill numbers of unoffending birds.

I do not understand why Ross did not always try to avoid the pack, seeing that going through it involved such loss of time, and so much danger even to his vessels. Their situation at times amongst the rock-like masses of ice, dashing with fearful violence against each other and against the straining ships, was enough to fill the boldest heart with dismay. To ordinary unfortified ships it would have been destruction swift and sudden. For mere exploration or whaling it would surely be always wiser and better to endeavour to skirt the pack, as Ross did on his return journeys. On his second season he went through 1,000 miles of pack, which occupied 56 days, so that when he got through the season was almost over, and after making about 7° more of southing, he deemed it imprudent to remain longer. By then selecting a different route for his return, he got out without having to go through any of the pack, the time occupied in regaining the Antarctic circle from the point of greatest southing being only ten days. One obvious advantage in avoiding the pack when going south would be that, having found the clearest road out, the time required for returning by the same route could be calculated, and so also the time during which it would be safe to remain.

It seems a great pity that when it becomes necessary to go through the pack steam-power could not then be used, in order to shorten, as far as possible, a time of tedious delay and extra risk. It seems so important a matter that I would throw out a crude suggestion, without, however, feeling much confidence in its value. It is that an arrangement might be made so that, on entering the pack and hoisting up the screw-propeller, the steam might still have a certain propelling value, if used on the rocket principle. Two jets of steam, one on each side of the vessel, ought to be well under command, so that either jet could be stopped or reversed at a moment's notice, and in this way they could also be used for steering, in the event of the rudder being carried away—a most serious accident, not uncommon in the pack.

Doubtless, Ross had good reasons for going through the pack, perhaps in connection with the magnetic observations. It is impossible to read the narrative of his voyage without feeling that he must have been eminently fitted for such a command. With his large experience of ice in the Arctic seas—acquired while serving under such experienced commanders as his uncle, Admiral Sir John Ross, and Sir Edward Parry—and his high scientific attainments, he seems to have been also a thorough gentleman, an intrepid sailor, and a conscientious God-fearing man. It is easy to see that he could have accomplished ever so much more in the same time, besides running far less risk, if he had had the great advantage of steam-power. Even if he had had smart weatherly vessels, instead of his dull-sailing ones, it would have made a great difference. The expression "wore ships" is of constant occurrence; often he is unable to maintain his ground and is driven to leeward, perhaps with situations of peril. Again and again, when close-hauled, instead of keeping a straight course and passing quickly to windward of a berg, prudence compels him to bear away and lose much ground and valuable time by having to pass it in the "doldrums," and amongst the loose ice to leeward. It was no small matter to have Dr. (now Sir Joseph) Hooker attached to the expedition; his accounts of the botany of various islands visited are extremely interesting.

In view of the present depression, I can see no way in which we could prudently attempt exploration, except by combining it with steam-whaling. Scotch steam-whalers have won a good name for themselves; but the fishery at home is at present in a bad way, and very few whales have been captured of late. This, then, ought to be a favourable time to arrange to have one or two good moderate-sized steam-whalers brought out. Two would be better than one; for, with the feeling of emulation and mutual support, much better results might be expected from them when amongst ice, either in whaling or exploring work, than from one unsupported vessel. Still, much has been and may be done by one good vessel; and it is worthy of note that the most appalling danger that befell Ross's two ships arose from the fact of there being two in company, as it was occasioned by one of them running into the other. If two captains could be found who by push and industry have got to be owners of the ships they command, they would be the best men to arrange with, our object being to get hold of men who will come to stay. As inducements for them to come out with their ships, it might be necessary to charter them to bring goods and passengers; or it might suffice to offer full freights at current rates. In neither case does it necessarily follow that there would be any expense to the colony before their arrival here. After that they might be paid entirely by results; a moderate bounty, say, for three years, on all bone and oil, could be given at very little real cost to the colony, because the bone and oil bring so much money to the place. Indeed, if their whaling is successful here, they will benefit the place in various ways from the very first. The great point, however, should be to get them to cast in their lot with us as colonists, in the hope that having them here to set an example, and show our people how money is to be made, their ships may form the nucleus of a steam whaling fleet belonging to the colony. To stimulate the captains and crews in the work of exploration, so much might be given for each degree of latitude that they penetrate to the southward on any meridian beyond the furthest point reached by previous explorers. If it is contemplated to send out a staff of scientific men, such reward would have to be proportionately increased; and it would, of course, be proper to arrange for this from the first, stipulating perhaps that they must, if so required by our Government, consent to allow exploration to take precedence of whaling during three summer months, in any or all of the years during which the bonus is given. Without such stipulation they might object to do exploring work, because if they find that whales are plentiful near our shores it may seem to them that whaling pure and simple would pay better. Whaling need not be quite discontinued during exploration; it might be highly expedient to catch a whale or two in order to eke out coals, for which purpose any of the bones may be used, as they contain a large quantity of inferior oil. Indeed, the capture of a few whales and seals, while causing but little delay, would interest all on board, while the zoologist of the party might then reap his richest harvest. I have a suspicion that the "small fin-backed whale" mentioned by Ross may prove to be the interesting *Neobalæna marginata.*

The expenses of a cruise to the southward might be further reduced by landing a party of sea-elephant hunters on Macquarie Island, and picking them up with their spoils on the return trip. But unless we are prepared to expend large sums on exploration, and have perhaps naval men and naval discipline, I am strongly of opinion that payment by results, which is the very system to which whalemen are accustomed, would prove to be the most satisfactory plan to all concerned, giving less risk of failure, and of the time of the scientific gentlemen being wasted. Thus, if the chief object during one season is to reach the magnetic pole, let a handsome sum be offered as the reward of success—such sum to be divided in the usual way, so that every sailor on board has a stake in the issue. If they were to get only within a certain distance, but near enough to obtain valuable results, a smaller sum might still be allowed. If they were to succeed in circumnavigating Victoria Land, or in proving its connection with other lands discovered by D'Urville, Ross, Wilkes, and Biscoe, or in finding inhabited land in the Antarctic regions (an interesting possibility), surely no one would grudge them a substantial reward. If they were to find out some practicable way of reaching the surface of the great ice-plain with men and stores, that would open the door to what may turn out to be the most successful method of Antarctic exploration, namely, by means of sledges and dogs. If a list of such definite important objects were to be carefully drawn up, with the assistance perhaps of the President and Council of the Royal Society, or of the Geographical Society, and a certain fair reward offered for the attainment of each; then, if we have to ask for assistance, it would surely be afforded much more readily if we can show that we have paved or are paving the way, by bringing steam-whalers out here to within a week's steaming of Victoria Land, and that no payment would be made without some corresponding result.

As to the probability of owners of steam-whalers being willing to come to us with their ships, it seems to me that while it would be well worth our while to offer very liberal inducements, if necessary, yet that their prospects here would be so much brighter than at Home, that at the present time very very little encouragement would be needed to induce enterprising men (and we want no other sort) to come and give the place a trial, simply in the hope of permanently bettering their condition. I cannot conceive any better way of getting the steam-whaling industry to take root here than to induce trained men to come and settle amongst us, bringing their whole capital, practical experience, and ships ready equipped for work. Their success here might probably lead others of the same calling to come to us, also with their ships, unless the northern fishery greatly improves.

I do not *know* that any of the steam whale-ships are owned altogether by their captains; but I believe it is common for the captain to own a considerable share of his vessel. In a matter of such importance, it might be well in such a case for our Government to buy up, in the first instance, part or all of the remaining shares, with the view of after-disposal to some commercial firm in the colony. The vessels that sail from Peterhead average, I believe, at least 500 tons. A vessel that size would probably lower six boats and carry a complement of about fifty men, all told. The value of a good vessel of this class is considerable, but I have been unable to procure exact information on this point. I think the price of "black" oil is about £20 per ton; but the accounts I have received differ. In the way of granting bounties, England has spent millions of money on her whale fisheries; but I gather from Mr. McCulloch's "Commercial Dictionary" that she never took a wiser step for their encouragement than when she was at the pains to induce fishers from Holland to come and settle amongst her people, bringing with them their capital, industry, and skill. "In consequence of this signal encouragement," he writes, "the whale fishery of England was prosecuted with greater success than at any previous period."

It seems a reproach to us that, while American whalers have year after year carried away so much wealth from our very doors, we have done so little yet in the way of whaling, although our situation is so superior to theirs. I have conversed with a very intelligent sailor who has served on board a steam-whaler in the northern seas; and he is convinced that, if a pushing man were to bring a steam-whaler to these waters, he could have no surer road to a fortune. Not only has the northern fishery been unsuccessful of late, but in consequence of that, and of new uses being found for baleen, the value of that article has risen to the extraordinary price of £1,500 per ton. The baleen from our southern "right whale," commonly known as the black whale, is not so valuable as that from the northern animal; but the difference in value is not great, and, as far as I can learn, it is not owing to the quality being inferior, but only to the average length being less. It has been said that we have two right whales, but I have not heard whalers speak of more than one; and I think Dr. Hector has come to the conclusion that we have but one, the *Eubalæna australis.* The animal closely resembles the right whale of the North; its capture is more easy than that of the sperm whale, and there seems no reason to suppose that men accustomed to the northern fishery, coming with their ordinary equipments, would find the southern fish less easy of capture than the northern one. Indeed, they would probably be more thoroughly in their element in dealing with our black whale than some southern whalers are who have given their attention almost exclusively to the sperm whale. Mention is often made by Ross, when in the seas to the southward of New Zealand, of numerous whales and seals being in sight. On the way south from Campbell Island, in latitude 63° S., he says, "A great many whales were seen in the afternoon." At 7.20 p.m. the first icebergs were seen; and, next day, he says, "A great many whales were seen, chiefly of the common black kind, greatly resembling but said to be distinct from the Greenland whale. Sperm as well as hunchbacked whales were also observed. Of the common black species we might have killed any number we pleased; they appeared chiefly to be of unusually large size, and would doubtless yield a great quantity of oil, and were so tame that our ships sailing close past did not seem to disturb them."

Again, when much further to the eastward, in about lat. 63° S., he says: "We observed a very great number of the largest-sized black whales, so tame that they allowed the ships sometimes almost to touch them before they would get out of the way; so that any number of ships might procure a cargo of oil in a short time." It is to be observed that in both these cases the whales were seen directly on making the ice, and in the same latitude. On Ross's other trip ice was met with sooner, in lat. 58° 30′ S.; but from there to lat. 63° 47′ mention is several times made of numerous whales being seen. Since that time the sperm whale has been chiefly sought after; but now that the value of sperm has fallen, while that of baleen has greatly increased, the black whale will doubtless be more in request. The average yield of oil from our black whale is about 7 tons, and of baleen about 7 cwt., so that the value of the baleen from each whale would be about £500 sterling.

The advantages of steam-power for either whaling or exploring are so many that it would be tedious to enumerate them; but many of them are obvious. Good smart men will naturally ship in a steam-whaler in preference to another, because there is such constant life and stir; while in the ordinary South Sea whaler there is so much idle time that men are apt to fall into lazy habits. I may mention here one consideration in favour of our undertaking exploration in only some such economical way as that I am advocating. Were an expensive expedition to start now they would go out in utter ignorance of the present state of the ice. Now, we know that the position of the Antarctic pack varies in different years to a surprising extent. As an instance of this, Ross penetrated the pack for about 800 miles in about the 156th meridian of West longitude, and then found himself only about half a degree beyond Cook, who had found open water there. From this it seems not improbable that a succession of severe seasons may bring about conditions so unfavourable to exploration that any attempt would be likely to end in failure, if not in disaster; while several mild seasons in succession might open a road and make success comparatively easy. Steam-whalers belonging to the Colony might work the grounds near home during the colder months; but it would be short-sighted policy to work these grounds all the year round if the black whale abounds in higher latitudes.

If found necessary, some special encouragement might be held out to induce the men to push to the southward during the summer months in quest of the black whale, and from their reports on the state of the ice some judgment might be formed as to whether the time were favourable for exploration and for a scientific staff to go out. A yearly reconnaissance of the ice to the southward might prove very valuable to the farmers of Southland, encouraging them to lay down a good breadth of land in wheat when the ice was at a distance, and warning them to be content with chiefly the hardier sorts of grain when the ice had made any considerable approach to us.

Any scientific staff ought to be accompanied, if possible, by a really good photographer, for good photographs from the weird Antarctic regions would possess an interest for the civilized world. After some experience gained of the ice to the southward, an excursion trip might be attractive to many, and, if advertised beforehand in Europe and America, it seems not unlikely that scientific men there would eagerly embrace such an opportunity of studying glacial phenomena.

If such a field as we possess to the southward for the display of spirited maritime enterprise had lain as near to Great Britain, we may feel assured that hardy mariners of England and sturdy Dutch navigators would have pushed their way to it hundreds of years ago, even in their small, badly-provisioned ships, destitute of steam-power and of many modern appliances. Verily, it would seem that, though their ships were more frail than ours, their hearts at least were not less stout. Daring spirits, however, are still to be found, many of whom now look with longing eyes towards those mysterious unknown regions, and daring deeds will doubtless yet be chronicled by future historians in connection with Antarctic discovery; but unless we bestir ourselves, and that quickly, it is to be feared that our descendants in New Zealand will not find it recorded that their ancestors took any part in the work; but, on the contrary, that though nearest of civilized peoples to the unexplored ice-continent, and seeming to aim at being the "Great Britain of the South," they yet remained apathetically in the background and allowed others from a distance to come and do the work, and reap the honour that might have been theirs.

Putting together the facts here stated, I am led to the conclusion that the very first step towards economic Antarctic exploration is, on independent grounds, a highly important step, which it is very desirable to take; that the present time for doing so is opportune; and that, while the expense may prove to be quite trifling, we may yet expect it to lead to the establishment of a hardy and lucrative industry, the importance of which one can scarcely over-estimate. Any additional industry is important, and is a safeguard against times of depression in the future; but the importance of this particular industry being successfully established seems really paramount: for, besides being a source of wealth to the Colony, and besides making the great work of Antarctic exploration a matter within our reach, what better nursery could we have for a race of hardy seamen, on whom our children's children may yet have to rely to fight their battles by sea?

Thus I have sketched the only way, as far as I can see, by which we might manage Antarctic exploration ourselves. If, however, it is decided to send out a thoroughly equipped expedition on the grand scale, for scientific purposes only, then in order to have the best possible guarantee that the work will be done wisely and well, I trust that the Mother Country may be induced to undertake the whole management, selecting trained Arctic explorers, and accepting of assistance from the various Australasian Colonies in the shape of money, and by our provisioning the ships. England might, however, give a more willing and hearty assent if we had even one steam-whaler here, a fit vessel to despatch in quest of the others in case of any untoward event preventing their return.

Art. LXIV.—*The Track of a Word.*

By E. Tregear, F.R.G.S.

[*Read before the Wellington Philosophical Society, 4th August*, 1886.]

In seeking to attract attention to the immense geographical district over which a word may be in use, and to the very great periods of time during which a word must necessarily have existed, I would confine myself mainly to a record of the facts concerning it collected by modern science, and leave for discussion the points arising from such record. The word I propose to examine is the Maori noun *mata*, which means "the eye," or "face." This word has been often commented upon as one which maintained itself most purely and with little phonetic variation among the dialects spoken in Polynesia; but I believe that the full significance of its very extraordinary diffusion over a large area of the world's surface has not been sufficiently observed or commented on. We will now, with the aid of a map, pass along a track where this word, sometimes in a form exceedingly pure, sometimes corrupted almost beyond recognition, may be found in the spoken languages of mankind at the present moment.

Leaving New Zealand and moving to the northward, we arrive at the Fijian Group, the natives of which, although not Polynesians, retain in their language many Polynesian words, and these in great purity. Here we find it *mata*, as in Maori; thence journeying eastward to Samoa, it is *mata*: at Rarotonga and Mangaia (Cook's and Hervey Islands), it is *mata*: at Tahiti (Society Islands), *mata*: at Nukuhiva (Marquesas Islands), *mata*: at Easter Island, *mata*; at Hawaii (Sandwich Islands), *maka*. This course has passed through the principal Polynesian islands, and before proceeding further I must digress for a brief space to notice the dialectical change producing the variant *k* of the Hawaiian. The change from *t* to *k* seems at first sight to be peculiar, and to those who have not made the transference of sounds a specialty of study appears almost impossible. But it is by no means confined to the Polynesian; in many languages far more advanced this letter-change occurs: in the Latin, *Basculi* and *Bastuli*, *Vectones* and *Vettones*; in Danish, *mukke*, for English "to mutter," and *laktuk* (Latin *lactuca*), for English "lettuce;" in Greek we find the Doric makes *ὄκᾰ* for *ὅτε*, *τηνος* for *κεινος*; the modern French of low-class Canadians gives *mékier* for *métier*, *moikié* for *moitié*, according to Professor Max Müller,* on whose choice of this word *mata* as a text I shall have much to say at a future time; but here it is only necessary

* Müller, "Science of Language," 2nd series, p. 168.

to remark that in Polynesian the *t* to *k* transfer is exceedingly well marked, and that it is, even now, changing and spoiling the Samoan vernacular speech. The real *k* of the western dialects is, in Hawaiian, Tahitian, and Samoan, either lost altogether, or replaced by a kind of soft catch of the breath; the *k* which appears in the Hawaiian being the Maori and Tongan *t*. Thus, the Hawaiian *kai* is the Maori *tai*, the sea; the Maori *kai*, food, being represented by the Hawaiian *ai*. The Hawaiian *kii*, a carved image, is the Maori *tiki*, the medial *k* being lost, the *t* replaced by *k*.

Having thus shown that the change of *mata* to *maka* is the regular transfer of sound which should be looked for, I will now resume—the digression having been necessary, as we shall find that the *t* to *k* sound is not confined to the language of the Sandwich Islands. Returning to Fiji, we pass westward, first to Rotumah, where "the eye" is *matho;* then to the New Hebrides, where, among a Papuan population, many colonies of the fairer-skinned race have been planted. Here we find at Malicolo, *maitang:* at Tikopia, *mata*. At Santa Cruz, *maku* is the face; at San Christoval, *ma* is face; at Vaturana, *mata;* at New Georgia, *mata*. In New Ireland, the eye is *matak:* at Port Praslin, *mata;* in New Guinea (Triton Bay), *matatongo;* (Onim) *matapatin*. We find at Gilolo (Galela), *mata*. Four dialects of the Celebes give the eye as *mata:* Borneo (medial, near Labuan), *mata*. Ceram's seven dialects yield *matamo*, *mata*, *matacolo*, *mata*, *mataniua*, *matara*, and *matan*. Timor gives *mata:* Savu (S.W. of Timor) is *mata;* Java = *moto:* Sumatra, *mata*, although in South Sumatra *matty*. The Malay proper is *mata:* the Dyak is *mata*. Let us now take a long flight to the westward, to the island of Madagascar. Concerning the Malagasy I shall say little, as it is a well-known fact (whatever may be the origin) that the language possesses very many words akin to the Malay, and which have no representatives on the African coast near at hand. Of these words, one is *maso*, the eye; the root, *mat*, having apparently passed through the change (so common in all languages) from hard *k* to soft *c* or *s*, thus: *mat*, *mak*, *mac*, *maç*, *mas* (= maso). We will now return to the vicinity of New Caledonia, and pass to the Marianne Islands, where at Guam we get *mata:* at Chamori, *mata:* at Ulea, *matai:* at Satawal, *metal*. In the Pelew Islands we get the corrupt form *muddath;* but in the Tagal of the Philippines *matá*. In Formosa, *macha:* in the Loo-Choo Islands, *mi*; and again in Japan, *mi*. We shall probably trace, as we go on, how this curious variant *mi* has arisen. The Ainios, or aborigines of Japan, have no representative word; neither have the Coreans, or the Kamschatkans, nor any tribes north of this point.

The Chinese (Canton) have the word as *mok*, so also the Tonquin gives *mok*, and Cochin-China *mok;* but Cambogia has *mat*, Pegu = *mot*, the Ka dialect *mot*. The word in the Burmese proper is *myitsi*: and in Aracan *myitsi*: but the Palaong (S.E. of Bhamo) use *metsi*. Between the Burmese proper and the Siamese are the Karens, two of whose dialects (Sgau and Pwo) give *me*; a third closely allied is the Thoung-lhú = *may*. Taking Muneepoor as a centre, we have the Koreng, *mik*: Songpu, *mhik*; Luhuppa, *mik*: North Tankhul, *amicha*: Khoibu, *mit*: Maring, *mit*: Kapwi, *mik*: Maram, *mik*. The Siamese has no cognate word, but it is a very remarkable thing that one of the Siamese (or Thay) tribes which fought its way into Assam, and settled there, has the form pure as the Polynesian, viz., *matta*. We now pass into Assam through the varieties of Jili; Singpho, *mi*: Kakhyen, *mi*: Deoria Chutia, *mukuti*. In Assam, to the East, are the Mishmi tribes, in one dialect of whose speech (the Mijhu) we find *mik*: in Central Assam, the Mikir = *mek*. Of the Naga forms, (among five dialects showing no affinity,) the Mithan yields *mik*: Tablung, *mik*. Entering Nepaul, one division, the Kirata tribes, (Kirata proper,) gives *mak*: the Limbu, *mik*; the Lepcha spoken in Sikim yields *amik*. Among those peoples called the Broken Tribes are Vaya, *mek*: Chepang, *mik*: Dhimal, *mi*: Bodo, *mogon*: Garo, *mikran*. The Magars, who inhabit the lower levels of the Himalayan slopes, use *mi* (in Murmi); so also the Gurung on the higher slopes have *mi*. The Bramhú, a dialect of a degraded people, gives *mik*; the Nepaul proper in its purest form being *mikha*. The Pahri, one of the Broken Tribes, has *mighi*: but others of these tribes, the Darahi and Kuswar, while using *ankhi* for "eye," (of Sanscrit derivation,) call the head *mud*. In Bengal, at Aracan, the dialect used by Moslems, (called Ruinga,) uses *mata* for head; the Hindu dialect, (called Rossawn,) uses *mustok*. In Central India, the Sontal call the eye *met*, while the word for head with the Pakhya is *manto*, and the Tharu is *mudi*. I am aware of the affinity between the last few words for "head" and the Sanscrit word for "face," etc., but shall not in this paper touch the subject of the Aryan languages.

We now pass across the Indian frontier into Thibet—the land of the Bhot, or Bhotiya. To the south, near Nepaul, we find that the Serpa word is *mik*, and in other dialects *mi*. The rude tribes (called barbarians by Chinese) in the south-east of Thibet use, in the Changlo, *ming*: in the Gyarung, *tai-mek*. In Rampur (Milchan) we find *mik*: while a provincial dialect (Theburskud) has *mé*: and the Sumchu is *mi*. In the eastern Bhot of the Takyal it is *mido*: and in the proper Thibetan dialect, as at Ladak, it is written *mig*, and pronounced *mik*. If we pass from the Indian frontier, across Afghanistan, to Persia, we find that in Persian *mata* is the face, and that in Arabic *mata* is also the face. This, in the widespread speech of the Arab, carries us to the Mediterranean Sea and the Indian

Ocean. I will not pursue the word further to the westward, or open up the great question as to its appearance in the European languages.

We have thus followed *mata*, the "eye," or "face," in its various changes, through almost every possible corruption to which a word is liable, (always excepting the peculiar Semitic formation about radix,) and have seen that this word can have entered into, or departed from, the Asiatic mainland by three gateways—viz., 1st, by China and Japan; 2nd, by the Malay Peninsula; 3rd, by the Arabian route, past Madagascar. Some of the languages I have referred to are mere barbarous dialects, of which I have been able to gather about fifty words of each for purposes of comparison; but these share with others, (Burmese dialects, for example, of which I have been able to compare 500 principal words with Polynesian,) in that they have no other apparent resemblance *except in this most persistent word.*

I must not omit to notice one other point before concluding —viz., that the zigzag course we have followed by no means defines the vast area covered even by the modern use of this word. Leaving out the Australians, the Papuans, and most Melanesians to the south; to the north excluding the Tungus languages, the Mongols, Samoyeds, the Turkish forms of North-west Asia, Finns, Laps, etc.; and also the Dravidian tribes of Southern India: then, (with these exceptions,) from Central Asia to the south of New Zealand; from near the shore of Africa to islands near the coast of America, this word has vitality. We trace it in spite of every disguise it assumes, aided by one slight change after another, but with the track still remaining visible. To use an oft-quoted word-example, no one in his senses would compare the French *jour* (a day), with the Latin *dies* (a day), unless he could track (either historically or geographically) its changes through *dies*, *diurno*, *giorno*, *jour*. So no one would compare the Thibetan *mi* with the Polynesian *mata*, if it was not that we could trace it step by step at the present hour through *mat*, *mak*, *mik*, *mi*. But, (an important "but,") every now and then we have been refreshed on our search by the pure word starting up anew, (as in Northern India, *matta*,) and at the very extremity of our journey by the reversion to the pure *mata* of Persia and Arabia.

The questions to be considered as resulting from this inquiry are these:—

1. Did the Polynesians bring this word from the mainland, either by China, Malacca, or the Arabian Gulf? Or,

2. Did they give the word to the mainland through either of these paths? Or,

3. Is this word a living sole-survivor (an "apteryx of language"), lingering in districts all over the south of the great Asiatic continent?

4. If the last be the case, why, against all rules known at present to philologists, should this vital word be shared by the inflected languages of Persia and Arabia, the agglutinative speech of Thibet and Malaysia, and the monosyllabic tongues of China and its islands?

Art. LXV.—*Polynesian Folk-lore.*

"Hina's Voyage to the Sacred Isle."

By E. Tregear, F.R.G.S.

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In venturing to commence a paper on the subject of Polynesian Folk-lore from the comparative mythologist's point of view, I do so with great diffidence, as the field is so enormous as to extend itself beyond any mental vision. But in this vast area are mines so rich that some reward is sure to fall to the lot of the diligent worker, however clumsy he may be; and if he is not gifted with the ability to discover truth, he may assist in its elucidation by others. Those who have made it their pleasure and business to collect all the procurable myths and folk-tales of these islands, in a generation from which the knowledge is fast passing away, and dying with its elder men, have done an incalculable service to Science: for the student of a century hence, however earnestly he may seek to gather such traditions, will search in vain for stories, lost, (as the Maori proverb says) "like the losing of the moa;" and, moreover, could such tales be collected, they would be tainted with the suspicion of European influence. Enough has already been done to give us much instructive material to work upon; and I think that the direction to be taken first is to widen the field of Maori legend by lifting it above locality, and by showing that most of the New Zealand stories are not *of* New Zealand, the Tongan not of Tonga, the Samoan not of Samoa, etc., etc. For this purpose I will first take a fairly representative tradition, that of the "Voyage of Hina to the Sacred Island,"* leaving out those portions of the story which do not perceptibly bear in any way on the main body of the legend.

"Maui had a young sister named Hinauri, who was exceedingly beautiful; she married Irawaru. One day Maui and his brother-in-law went down to the sea to fish. Maui caught not a single fish with his hook, which had no barb to it, but as long as they went on fishing Maui observed that Irawaru continued

* "Polynesian Mythology," Grey.

catching plenty of fish. So he thought to himself, 'Well, how is this? How does that fellow catch so many whilst I cannot catch one?' Just as he thought this, Irawaru had another bite, and up he pulls his line in haste, but it had got entangled with that of Maui, and Maui thinking he felt a fish pulling at his own line, drew it in quite delighted; but when he had hauled up a good deal of it, there were himself and his brother-in-law pulling in their lines in different directions, one drawing the line towards the bow of the canoe, the other towards the stern. Maui, who was already provoked at his own ill-luck, and the good luck of his brother-in-law, now called out quite angrily, 'Come, let go my line, the fish is on my hook.' But Irawaru answered, 'No, it is not, it is on mine.' Maui again called out very angrily, 'Come, let go, I tell you it is on mine.' Irawaru then slacked out his line, and let Maui pull in the fish; and as soon as he had hauled it into the canoe, Maui found that Irawaru was right, and that the fish was on his hook; when Irawaru saw this too, he called out, 'Come now, let go my line and hook.' Maui answered him, 'Cannot you wait a minute, until I get the hook out of the fish.'

"As soon as he got the hook out of the fish's mouth, he looked at it, and saw that it was barbed; Maui, who was already exceedingly wrath with his brother-in-law, on observing this, thought he had no chance with his barbless hook of catching as many fish as his brother-in-law, so he said, 'Don't you think we had better go on shore now?' Irawaru answered, 'Very well, let us return to the land again.'

"So they paddled back towards the land, and when they reached it, and were going to haul the canoe on the beach, Maui said to his brother-in-law, 'Do you get under the outrigger of the canoe, and lift it up with your back.' So he got under it, and as soon as he had done so Maui jumped on it, and pressed the whole weight of the canoe down upon him, and almost killed Irawaru. When he was on the point of death, Maui trampled on his body, and lengthened his backbone, and by his enchantments drew it out into the form of a tail, and he transformed Irawaru into a dog. As soon as he had done this, Maui went back to his place of abode, just as if nothing unusual had taken place; and his young sister, who was watching for the return of her husband, as soon as she saw Maui coming, ran to him and asked him, saying, 'Maui, where is your brother-in-law?' Maui answered, 'I left him at the canoe.' But his young sister said, 'Why did not you both come home together?' and Maui answered, 'He desired me to tell you that he wanted you to go down to the beach to help him carry up the fish: you had better go, therefore; and if you do not see him, just call out; and if he does not answer you, why then call out in this way: Mo-i, mo-i, mo-i.' Upon learning this, Hinauri hurried down to the beach as fast as she could, and not seeing her husband, she went about calling out his name, but no answer was made to her; she then called out as Maui had told her, 'Mo-i, mo-i, mo-i.' Then Irawaru, who was running about in the bushes near there in the form of a dog, at once recognised the voice of Hinauri, and answered, 'Ao! ao! ao! ao-ao-o!' howling like a dog, and he followed her back to the village, frisking along and wagging his tail with pleasure at seeing her; and from him sprang all dogs, so that he is regarded as their progenitor, and all New Zealanders still call their dogs to them by the words, 'Moi, moi, moi.'

"Hinauri, when she saw that her husband had been changed into a dog, was quite distracted with grief, and wept bitterly the whole way as she went back to the village; and as soon as ever she got into her house she caught up an enchanted girdle which she had, and ran back to the sea with it, determined to destroy herself by throwing herself into the ocean, so that the dragons and monsters of the deep might devour her. When she reached the sea-shore, she sat down upon the rocks at the water's very edge; and as she sat there she first lamented aloud her cruel fate, and repeated an incantation, and then threw herself into the sea, and the tide swept her off from the shore. . . . For many months she floated through the sea, and was at last thrown up by the surf on the beach at a place named Wairarawa. She was there found, lying as if dead, upon the sandy shore, by two brothers named Ihuatamai and Ihuwareware. Her body was in many parts overgrown with seaweed and barnacles, from the length of time she had been in the water, but they could still see some traces of her beauty, and pitying the young girl, they lifted her up in their arms and carried her home to their house, and laid her down carefully by the side of a fire, and scraped off very gently the seaweed and barnacles from her body, and thus by degrees restored her. When she had quite recovered, Ihuatamai and Ihuwareware looked upon her with pleasure, and took her as a wife between them both. They then asked her to tell them who she was, and what was her name. This she did not disclose to them, but she changed her name and called herself Ihungarupaea, or the 'Stranded-log-of-timber.' After she had lived with these two brothers for a long time, Ihuwareware went to pay a visit to his superior chief, Tinirau, and to relate the adventures which had happened; and when Tinirau heard all that had taken place, he went to bring away the young stranger as a wife for himself, and she was given up to him; but, before she was so given to him, she had conceived a child by Ihuatamai, and when she went to live with Tinirau it was near the time when the child should be born.

"Tinirau took her home with him to his residence on an island called Motutapu: he had two other wives living there;

they were daughters of Mangamanga-i-Atua, and their names were Harataunga and Horotata. Now, when these two women saw the young stranger coming along in their husband's company, as if she was his wife, they could not endure it, and they abused Hinauri on account of her conduct with their husband; at last they proceeded so far as to attempt to strike her and to kill her, and they cursed her bitterly. When they treated her in this manner the heart of Hinauri became gloomy with grief and mortification, so she began to utter incantations against them, and repeated one so powerful that hardly had she finished it when the two women fell flat on the ground, with the soles of their feet projecting upwards, and lay quite dead upon the earth, and her husband was thus left free for her alone. All this time Hinauri was lost to her friends and home, and her younger brother, Mauimua, afterwards called Rupe, could do nothing but think of her; and excessive love for his sister, and sorrow at her departure so harassed him, that he said he could no longer remain at rest but that he must go and seek his sister.

"So he departed upon this undertaking, and visited every place he could think of without missing one of them, yet he could nowhere find his sister; at last Rupe thought he would ascend to the heavens to consult his great ancestor Rehua, who dwelt there at a place called Te Putahi-nui-o-Rehua, and in fulfilment of this design he began his ascent to the heavenly regions. Rupe continued his ascent, seeking everywhere hastily for Rehua; at last he reached a place where people were dwelling, and, when he saw them, he spoke to them, saying 'Are the heavens above this inhabited?' and the people dwelling there answered him, 'They are inhabited.' And he asked them, 'Can I reach those heavens?' and they replied, 'You cannot reach them; the heavens above these are those the boundaries of which were fixed by Tane.' But Rupe forced a way up through those heavens, and got above them, and found an inhabited place; and he asked the inhabitants of it, saying, "Are the heavens above these inhabited?' and the people answered him, 'They are inhabited.' And he again asked, 'Do you think I can reach them?' and they replied, 'No, you will not be able to reach them; those heavens were fixed there by Tane.' Rupe, however, forced a way through those heavens too; and this he continued to do until he reached the tenth heaven, and there he found the abode of Rehua. When Rehua saw a stranger approaching, he went forward and gave him the usual welcome, lamenting over him: Rehua made his lamentation without knowing who the stranger was, but Rupe in his lament made use of prayers by which he enabled Rehua to guess who he was.

"When they had each ended his lamentation, Rehua called to his servants, 'Light a fire, and get everything ready for cooking food.' The slaves soon made the fire burn up brightly, and brought hollow calabashes, all ready to have food placed in them, and laid them down before Rehua. All this time Rupe was wondering whence the food was to come from with which the calabashes which the slaves had brought were to be filled; but presently he observed that Rehua was slowly loosening the thick bands which enveloped his locks around and upon the top of his head; and when his long locks all floated loosely, he shook the dense masses of his hair, and forth from them came flying flocks of the tui birds, which had been nestling there; and as they flew forth, the slaves caught and killed them, and filled the calabashes with them, and took them to the fire, and put them on to cook; and when they were done, they carried them and laid them before Rupe as a present, and then placed them beside him that he might eat, and Rehua requested him to eat food; but Rupe answered him, 'Nay, but I cannot eat this food; I saw these birds loosened and take wing from thy locks; who would dare to eat food that had rested in thy sacred head?'"* For the reasons he thus stated, Rupe feared that man of ancient days; and the calabashes still stood near him untouched. At last Rupe ventured to ask Rehua, saying: 'O! Rehua, has a confused murmur of voices from the world below reached you upon any subject regarding which I am interested?' And Rehua answered him: 'Yes; such a murmuring of distant voices has reached me from the Island of Motutapu, in the world below these.' When Rupe heard this, he immediately, by his enchantments, changed himself into a pigeon, and took flight downwards towards the Island of Motutapu. On, on he flew, until he reached the island, and the dwelling of Tinirau; and then he alighted right upon the window-sill of his house. Some of Tinirau's people saw him, and exclaimed: 'Ha! ha! there's a bird; there's a bird;' whilst some called out, 'Make haste, spear him; spear him.' And one threw a spear at him; but he turned it aside with his bill, and it passed on one side of him and struck the piece of wood on which he was sitting, and the spear was broken. Then they saw it was no use to try to spear the bird; so they made a noose, and endeavoured to slip it gently over his head; but he turned his head on one side, and they found that they could not

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* The meaning of the birds nestling in and flying from the hair of Rehua is apparently to be understood only by a word preserved in Hawaiian, but lost in Maori: *rehua* (*lehua*) being there the ancient name for a forest. We find in "The Chant of Kualii" (*Tu-ariki*) the following lines:—

> "The younger children of the rain,
> Are raining on the lehua (forest)."

And perhaps a sister allusion is made to the incident of the slaves catching birds in the hair of Rehua, in the lines:—

> "The child catching birds c—
> Reaching up the bird-catching pole on Lehua."

snare him. His young sister now suspected something; so she said to the people who were trying to kill or snare the bird: 'Leave the bird quiet for a minute until I look at it.' And when she had looked well at it she knew it was her brother; so she asked him, saying: 'What is the cause which has made you thus come here?' And the pigeon immediately began to open and shut its little bill, as if it was trying to speak. His young sister now called out to Tinirau: 'Oh, husband; here is your brother-in-law.' And her husband said in reply: 'What is his name?' and she answered, 'It is my brother Rupe.' It happened that upon this very day Hinauri's little child was born; then Rupe repeated this form of greeting to his sister, the name of which is 'Toetoetu':—

'Hinauri,
Hinauri is the sister,
And Rupe is her brother,
But how came he here?
Came he by travelling on the earth,
Or came he through the air?
Let your path be through the air.'

"As soon as Rupe had ceased his lamentation of welcome to his sister, she commenced hers, and answered him, saying:—

'Rupe is the brother,
And Hina is his young sister,
But how came he here?
Came he by travelling on the earth,
Or came he through the air?
Let your path be now upwards through the air
To Rehua.'

"Hardly had his young sister finished repeating this poem before Rupe had caught her up with her new-born baby: in a moment they were gone."

Thus far the New Zealand story. We will now turn to the sister legend, as told at Mangaia by the Rev. Mr. Gill.* The first reference we find is in the version related at that island concerning the myth of Maui catching the sun in ropes for the purpose of making him go slower, a story which is identical with the New Zealand tale. Here we find it mentioned that when Maui tried cocoanut fibre ropes for his snares they would not hold. He then cut off the hair of his lovely sister Ina-ika, and plaited it into a rope, which had the necessary strength. Here it will be noticed that Maui is called Hina's brother, as in the Maori story. The name "ika' (fish) is explained by her further adventures. The Mangaian tradition is as follows:—

"The only daughter of Vaitoorunga and Ngaetua is Ina, whose brothers were Tangi-kuku and Rupe. The parents of

* "Myths and Songs."

Ina were the wealthiest people in the land of Nukutere, boasting, as they did, of a rich breast ornament, abundance of finely braided hair, beautiful white shells worn on the arms, and, more precious than all these, a gorgeous head-dress, ornamented with scarlet and black feathers, with a frontlet of berries of the brightest red. Early one morning the parents for the first time left their home in the care of Ina, the mother charging her to put these treasures out to air; but, should the sun be clouded, be sure to take them back into the house. For Ngaetua knew well that in the bright beams of the sun the arch-thief Ngana would not dare to come; but, if exposed on a lowering cloudy day, the envious foe would not fail to try his luck. In a short time the sun shone brightly, not a cloud could anywhere be seen. The obedient Ina carefully spread out these treasures on a piece of the purest white native cloth. But the arch-foe Ngana was on the watch. Very cautiously did he approach through the neighbouring bushes, in order to get a sight of the much-coveted articles. He forthwith used an incantation, so that the sun became suddenly obscured. Ngana now fearlessly emerged from the thicket, and endeavoured to grab the long-wished-for ornaments. But Ina was too quick in her movements to permit this. Ngana now, with affected humility, begged permission to admire and try on the various ornaments for her to see how he would look in them. Ina was very loth, but, after great persuasion, consented that Ngana should put them on *inside* the house. To prevent the possibility of his taking away any of these treasures, she closed the doors. The crafty Ngana now arrayed himself in these gorgeous adornments, excepting the head-dress, which Ina still held in her hand. Ngana, by his soft words, at length induced her to give *that* up too. Thus completely arrayed he began to dance with delight, and contrived to make the entire circuit of the house, careering round and round in hope of seeing some loophole through which he might escape with his spoil. At last he espied a little hole at the gable-end a few inches wide, through which at a single bound he took his flight, and for ever disappeared with the treasures. Ina at first had been delighted with the dancing of her visitor, but was in utter despair as she witnessed his flight, and heard the parting words—

'Beware of listening to vain words,
O Ina, the fair and well-meaning.'

"Not long afterwards the parents of Ina came back in great haste, for they had seen the arch-thief passing swiftly and proudly through the skies, magnificently attired. A fear crept over them that all was not right with their own treasures. They asked the weeping girl the cause of her tears. She said, 'Your choicest possessions are gone.' 'But is there nothing left?' demanded the parents. 'Nothing whatever,' said the still weeping girl. The enraged mother now broke off a green cocoanut branch, and broke it to pieces on the back of the unfortunate girl. Again and again Ngaetua fetched new cocoanut branches and cruelly beat Ina. The father now took his turn in belabouring the girl, until a divine spirit (*manu*) entered and took possession of Ina, and in a strange voice ominously said—

'Most sacred is my person,
Untouched has been my person,
I will go to the Sacred Isle,
That Tinirau alone may strike it.'

"The astonished father desisted; her younger brother Rupe cried over his beloved sister. After a while Ina got up, as if merely to saunter about, but no sooner had she eluded the eyes of her parents than she ran as fast as her legs could carry her to the sandy beach. When nearly there, she fell in with her elder brother Tangikuku, who naturally asked her where she was going. She gave an evasive answer; but, fearing lest he should inform her parents of her flight, she snatched his bamboo fishing-rod, broke it to pieces with her foot, and selected one of the fragments as a knife. She now said to her brother, 'Put out your tongue.' In an instant she cut off its tip. Tangikuku vainly essayed to speak; so that Ina was certain that he could not reveal the secret of her sudden departure. She kissed her maimed brother, and pressed on to the shore, where she gazed long and wistfully towards the setting sun, where the Sacred Isle is. Looking about for some means of transit, she noticed at her feet a small fish named the *avini*. Knowing that all fishes were subjects to the royal Tinirau, she thus addressed the little *avini* that gazed at the disconsolate girl:—

'Ah, little fish, art thou a shore-loving avini?
Ah, little fish, art thou an ocean-loving avini?
Come, bear me on thy back
To my royal husband Tinirau,
With him to live and die.'

"The little fish intimated its consent by touching her feet. Ina mounted on its narrow back; but when only half-way to the edge of the reef, unable any longer to bear so unaccustomed a burden, it turned over, and Ina fell into the shallow water. Angry at this wetting, she repeatedly struck the *avini*: hence the beautiful stripes on the sides of that fish to this day, called 'Ina's tattooing.' The disappointed girl returned to the sandy beach to seek for some other means of transit to the Sacred Isle. A fish named the *paoro*, larger than the *avini*, approached Ina. The intended bride of the god Tinirau addressed this fish just as she had the little *avini*: and then mounted on its back, and started a second time on her voyage. But, like its predecessors, the *paoro* was unable long to endure the burden, and dropping Ina in shallow water sped on its way. Ina struck the *paoro* in her anger, producing for the first time those beautiful blue marks which have ever since been the glory of this fish. Ina next tried the *api*, which was originally white; but for upsetting Ina at the outer edge of the reef was rendered intensely black, to mark her disgust at the third wetting. She now tried the sole, and was successfully borne to the edge of the breakers, where Ina experienced a fourth mishap. Wild with rage, the girl stamped on the head of the unfortunate fish with such energy that the underneath eye was removed to the upper side. Hence it is that, unlike other fish, it is constrained now to swim flatwise, one side of the fish having no eye. At the margin of the ocean a shark came in sight. Addressing the shark in words very like those formerly used, to her great delight the huge fish came to her feet, and Ina mounted triumphantly on its broad back, carrying in her hand two cocoanuts to eat. When half-way on the dangerous voyage to the Sacred Isle, Ina felt very thirsty, and told the shark so. The obedient fish immediately erected its dorsal-fin (*rara-tua*), on which Ina pierced the eye of one of the nuts. After a time she again asked the shark for help. This time the shark lifted its head, and Ina forthwith cracked the hard shell on its forehead. The shark, smarting from the blow, dived into the depths of the ocean, leaving the girl to float as best she could. From that day there has been a marked protuberance on the forehead of all sharks, called 'Ina's bump.' The King of Sharks, named Tekea the Great, now made his appearance. Ina got on his wide back, and continued her voyage. She soon espied what seemed to be eight canoes in a line rapidly approaching her. When near, they proved to be eight sharks resolved to devour Ina. Ina, in agony, cried to her guardian shark, 'O Tekea; O Tekea!' 'What is it?' inquired the shark. 'See, the canoes!' said the girl. 'How many are they?' 'Eight,' replied Ina. Said her guardian shark, 'Say to them, Get away, or you will be torn to shreds by Tekea the Great.' As soon as Ina had uttered those words, the eight monstrous sharks made off. Delivered from this peril, Ina again went on her long voyage to the Sacred Isle. At length the brave girl reached the long sought for island, and Tekea the Great returned to his home in mid-ocean. Upon going ashore, and cautiously surveying her new home, she was astonished at the salt-water pools, full of all sorts of fish, everywhere to be seen. Entering the dwelling of Tinirau, (Innumerable), the lord of all fish, she found one noble fish-preserve inside. But strangely enough the owner was nowhere visible. In another part of the house she was pleased to find a great wooden drum, and sticks for beating it by the side. Wishing to test her skill, she gently beat the drum, and even to her astonishment the sweet notes filled the whole land, and even reached to Pa-enua-kore, (No-land-at-all,) where the god Tinirau was staying that day. The king of all fish returned to his islet-dwelling to discover who was beating his great drum. Ina saw him approaching, and in fear ran to hide herself behind a curtain. Tinirau entered, and found the drum and sticks all right, but for a time could not discover the fair drummer. He left the house, and was on his way back to 'No-land-at-all,' when the coy girl, unwilling to lose so noble a husband, again beat the wonderful drum. Tinirau came back and found the blushing girl, who became his cherished wife. Ina now discovered that it was the might of Tinirau that inspired her with a *manu*, or strange spirit, and then provided for her safety in voyaging to his home in the Sacred Isle. In the course of time Ina gave birth to the famous Koromauariki, commonly called Koro. Besides this boy, she had a girl named Ature. Her younger brother Rupe wished much to see his sister Ina, who had long ago disappeared. Rupe asked a pretty *karaurau* (a bird of the linnet species) kindly to convey him where Ina lived. The bird consented, and Rupe, entering the linnet, fled over the deep blue ocean in search of the Sacred Isle where his beloved sister had her home. It happened one morning that Ina noticed on a bush near her dwelling a pretty linnet, just such a one as she used to see in her old home. As she complacently gazed upon it, the bird changed into a human form. It was Rupe himself! Great was Ina's delight; but, after a brief stay, Rupe insisted on going back to tell his parents of the welfare of Ina. They were rejoiced to hear of their daughter, for whom they had long grieved. A feast was made, and the finest cloth prepared for Ina and her children. Mother and son now entered the obliging linnets, and, laden with all these good things, flew off over the ocean in search for Ina. Arrived safely at the Sacred Isle, mother and daughter embraced each other tenderly; the past was forgiven. Three whole days were spent in festivities on account of Koro and Ature, the children of Ina. The visitors returned to their home over the sea, and Ina was left happy with Tinirau, the king of all fish."

The coincidences in these two stories are very remarkable, and are as instructive to students of comparative Mythology as the differences in the two accounts are. First, most of the names agree. In the Cook and Hervey Islands the *h* is not pronounced. For this reason those islanders have been called "the cockneys of the Pacific;" Hina becomes Ina, by the regular phonetic loss. Tinirau is the name of the demi-god to whom she flies; Motu-tapu, "the Sacred Isle," is the name of the island where she finds refuge; and Rupe the name of the affectionate brother who flies to her in the form of a bird. These points are quite sufficient to establish a common origin for the two stories. The main differences are as follows:—Hina is, in the New Zealand story, the sister of Maui-mua and of Maui the Great, the last being known both as Maui-potiki (Maui, the baby) and

Maui-tikitiki-a-Taranga = Maui (born in) the top-knot of Taranga,* their mother being Taranga, and their father Makea-tu-tara. In the Mangaian tale, although elsewhere Ina is called Maui's sister, her parents are styled Vaitooringa and Ngaetua. In Mangaia, Ina has two brothers—Rupe and Tangi-kuku; both Rupe and Tangi-kuku are pigeon names; Tangi-kuku doubtless meaning "cooing like a dove," *kuku* and *kukupa* being the Maori words for pigeon. Rupe is not a modern Maori word for pigeon; but the form of a pigeon assumed by Rupe sufficiently shows that the pigeon was once known to them by that name, as it still exists in the Samoan *lupe*, Tahitian *rupe*, and Tongan *lupe*—all meaning "pigeon." The Maoris have lost the incident of "the master-thief;" they assign a different reason for Hina's flight; they make Hina a married woman, instead of a maiden, and have no story of her adventures on her way to Motu-tapu. The Mangaians apparently know nothing about Ina's connection with Irawaru, or of his being changed into a dog; nor about her finding other wives of Tinirau on her arrival in the Sacred Isle; nor of Rupe's visit to Rehua in heaven; and they seem to have missed the meaning of Rupe's name being "pigeon" by giving him the form of a linnet.†

There are references in other legends which partially clear up, and partially darken the story. From far-off Nukuhiva, in the Marquesas Islands, comes a tradition as to "The origin of fire"—one of the most widely-spread of the many legends concerning Maui. In this myth, the name of Maui's mother is given as Kui; and although this may not seem to be her proper name, (*kui* in Maori being a term of address to any old woman, and in Marquesan meaning "mother" generally,) yet that it was an especial name of Maui's mother is proved by a Mangaian story, that Kui gave to Tane her daughter Ina (Maui's sister), "Ina who rivals the dawn;" and again by another Mangaian myth, that "the eldest of Kui-the-blind's attractive daughters was named Ina; that Marama (the moon), who from afar had often admired her, became so enamoured of her charms that one night he descended from his place in the heavens to fetch her to be his wife." But this blind old woman very probably appears

* Maui is the Prometheus who gained fire for men, in all the Pacific legends except that of Samoa. Here the Maui name is unknown, their hero being Ti'i Ti'i, whose mother was Talanga. How completely the comparative method vindicates itself, when we find that Maui was called Tikitiki-a-Taranga, because he was born in Taranga's top-knot—a name incomprehensible in Samoa without our New Zealand story.

† It is perhaps worthy of notice that Hina's house (as described in the Mangaian story) is utterly unlike a Samoan house, which is a large circular structure, like a bee-hive raised upon posts, open all round; mats are let down round the outside or from internal partitions when privacy is required. This is somewhat of evidence that if (as some think) the Mangaians came from Samoa, this part of the story was new.

in another New Zealand tradition—that of Tawhaki. The glorious demi-god Tawhaki, before he ascended to heaven and became the god of thunder and lightning, (his mother was Whatitiri, the thunder, before him,) met with the following adventure:—"The fame of Tawhaki's courage in thus destroying the race of the Ponaturi, and a report also of his manly beauty, chanced to reach the ears of a young maiden of the heavenly race who live above in the skies; so one night she descended from the heavens to visit Tawhaki, and to judge for herself whether these reports were true. She found him lying sound asleep, and, after gazing on him for some time, she stole herself to his side and laid herself down by him. He, when disturbed by her, thought it was only some female of this lower world, and slept again; but before dawn the young girl stole away again from his side, and ascended once more to the heavens. In the early morning Tawhaki awoke, and felt all over his sleeping-place with both his hands, but in vain, he could nowhere find the young girl. From that time Tango-tango, the girl of the heavenly race, stole every night to the side of Tawhaki, and lo, in the morning she was gone, until she found that she had conceived a child, who was afterwards named Arahuta; then, full of love for Tawhaki, she disclosed herself fully to him and lived constantly in this world with him, deserting for his sake her friends above; and he discovered that she who had so loved him belonged to the race whose home is in the heavens." The legend then relates that the husband and wife quarrelled in a very foolish manner over the new baby. We resume:—"Then Tango-tango began to sob and cry bitterly, and at last rose up from her place with her child, and began to take flight towards the sky, but she paused for one minute with one foot resting upon the carved figure at the end of the ridge-pole of the house, above the door. Then Tawhaki rushed forward, and springing up, tried to catch hold of his young wife; but missing her, he entreatingly besought her, 'Mother of my child, oh return once more to me!' But she in reply called down to him, 'No, no, I shall now never return to you again.' Tawhaki once more called up to her, 'At least, then, leave me some remembrance of you.' Then his young wife called down to him, 'These are my parting words of remembrance to you: Take care that you lay not hold with your hands of the loose root of the creeper, which dropping from aloft, sways to and fro in the air; but rather lay fast hold on that which, hanging down from on high, has again struck its fibres into the earth.' Then she floated up into the air, and vanished from his sight. Tawhaki remained plunged in grief, for his heart was torn by regrets for his wife and his little girl. One moon had waned after her departure, when Tawhaki, unable longer to endure such sufferings, called out to his younger brother, to

Karihi, saying: 'Oh, brother, shall we go and search for my little girl?' And Karihi consented, saying, 'Yes, let us go.' . . . Tawhaki and Karihi then went upon the road, accompanied by only one slave. They at last reached the spot where the ends of the tendrils which hung down from heaven reached the earth, and they there found an old ancestress of theirs, who was quite blind, and whose name was Mata-kerepo (blind-eyes). She was appointed to take care of the tendrils, and she sat at the place where they touched the earth and held the end of one of them in her hands. . . . Tawhaki then touched both her eyes; and, lo! she was at once restored to sight, and saw quite plainly, and she knew her grandchildren and wept over them."* Keeping in mind this singular Maori story of the heavenly maiden, let us read a brief legend from Atiu: "It is said that Ina took to her celestial abode a mortal husband. After living happily together for many years she said to him, 'You are growing old and infirm. Death will soon claim you, for you are a native of earth. This fair home of mine must not be defiled with a corpse. We will therefore embrace and part. Return to earth, and there end your days.' At this moment Ina caused a beautiful rainbow to span the heavens, by which the disconsolate aged husband descended to earth to die." The mention of this rainbow connects itself with another myth which relates that the god Tangaloa (Tangaroa) fell in love with Ina, when she was bathing in a stream called Kapu-ue-rangi; hence one name of Ina is "Ina-ani-vai" (Ina-solicited-at-the-fountain). He unfastened his girdle, which mortals call the rainbow, and descended by this dazzling path to earth. Ina gave way to him, and had two children, Tarauri and Turi; both were fair like their parents (Tangaloa has golden hair). In Tahiti, Hina was supposed to have been the first creation of the great Taaroa (Tangaroa), and it was with her help that he made the heavens, earth, and sea. His two sons by her are called Oro-tetefa and Uru-tetefa. From the wife of the eldest of these sons arose the famous Areoi Society, the priest-freemasons of the Eastern Pacific. This Oro, afterwards a great god, was probably the Koro mentioned in Mangaian legend as Hina's son; the Tahitians regularly losing the *k* in their dialect. The islanders of Niue have an "underworld," to which the spirits of the dead depart; it is called Maui: but their heaven is the bright "land of Sina," in the skies, where night comes not, but day is everlasting. The Manahikians, in telling the story of "fishing up the land," say that Sina, who was the sister of Maui Mua, Maui Loto, and Maui Muli (Maui, first, middle, and last), helped to fasten the great fish-hook: a tradition also believed in Hawaii (Sandwich Islands), where it

* "Polynesian Mythology," Grey.

was Hina's own bird, the "Alae," with which the hook was baited:—

"The great fish-hook of Maui,
Manaia-te-Rangi. * * *
The bait was the Alae of Hina,
Let down upon Hawaiki,
The sacred tangle, the painful death,
Seizing upon the foundations of the earth,
Floating it up to the surface of the sea."

There are many fragments of the tradition to be found in Samoan song and legend. In the genealogy of the primitive gods are several Sinas, the first of whom, "Sina the tropic-bird," is the wife of Pili, the son of Tangaloa. In one of their love songs it is related that—

"Sina longed to get Maluafiti,
He was her heart's desire, and long she had waited for him.
Maluafiti frowned and would return,
And off he went with his sisters.
Sina cried and screamed, and determined to follow swimming.
The sisters pleaded to save and bring her;
Maluafiti relented not, and she died on the ocean."

But if this Sina was Sina the Swimmer, the Samoans know another bright Sina, "the woman in the moon." "Sina (the white) was busy one evening with mallet in hand beating out on a board some of the bark of the paper mulberry, with which to make native cloth. It was during a time of famine. The moon was just rising, and reminded her of a great bread-fruit; looking up to it she said, 'Why cannot you come down and let my child have a bit of you?' The moon was indignant at the thought of being eaten, came down forthwith and took her up, child, board, mallet and all. At the full of the moon, young Samoa still looks up and traces the features of Sina." Hina also finds her way into one of the ancient Deluge legends: as the daughter of Tangaloa she is sent down by her father in the form of a bird, *turi* (the snipe),* but after flying about for a long time, can find no resting-place—nothing but ocean; so she returns to heaven. Again sent down by Tangaloa, "she observed spray, then lumpy places, then water breaking, then land above the surface, and then a dry place where she could rest. She went back and told her father. He again sent her down; she reported extending surface of land, and then he sent her down with some earth and a creeping plant. The plant grew, and she continued to come down and visit it," etc. In Hawaii, she seems also to be connected with the Deluge, as Hina-lele, generally called simply Hina; she is the goddess of fishes, and thus compares with the western Hina-ika, the wife of Tinirau, the fish-deity. There are genealogical evidences in Hawaiian legend as to the coincidence between the two Hinas,

* Turi is her son, in a legend above cited.

and reference is made to the story of Tawhaki, mentioning his brother Karihi, his father Hema, and his mother Hina :—

"The rainbow is the path of Tawhaki.
Tawhaki arose, Tawhaki bestirred himself,
Tawhaki passed on, on the floating cloud of Tane.
Perplexed were the eyes of Karihi.
Tawhaki passed on, on the glancing light.
The glancing light on men and canoes.
Above was Hanaiakamalama;
That is the road to seek the father of Tawhaki."

In a note commenting on this legend, Judge Fornander says: "Hanaiakamalama was the name of Hema's mother Hina. She is said to have been disgusted with her children Puna and Hema, and to have gone up to the moon to live." This seems to show that, however distorted the legend had grown, Tawhaki's "heavenly maiden" was the Hina of the moon; the Hawaiian "Hanaiakamalama," reading in Maori as "Hanaia-te-marama," or "Hana-i-a-te-marama," doubtless originally signifying "Brightness of the moon," or "Let the moon shine." Hina's voyage is mentioned in a prayer to Lono (Rongo) :—

"My god has assumed the shape of a shark
In the month of Hinaialeele,
May I be saved through my fullness of prayer!
Saved through my health-offering!
Saved through my devotion!
By you, O God!"

The conclusion which seems inevitable in considering this legend, and the broken-up remnants of it existing all over the Pacific, is, that it probably was the property of all the tribes before the separation. It may have travelled from one land to another, from one island to another, but it bears internal evidence of very high antiquity, and of primitive origin. The connection between Maui and Hina, through the old blind Kui and the heavenly race, seems at first sight to be very slight. I believe we must go not only outside New Zealand, but outside Polynesia, for an explanation, which will probably be found in its study as a lunar myth.

Professor Max Müller has already noted the story of Ina, as agreeing with the Greek legend of Tithonos and Eos, and quotes it as a singular coincidence; but I trust to be able to show in a series of papers that there are too many hundreds of such similarities in these folk-lore tales for them to be put aside with any such poor word as "coincidence." I believe that in science there is no more "coincidence" than there is "chance," or "luck;" that every idea, like every word, has its proper parentage: though, alas! all the searchings of the wise will long beat in vain in the effort of discovery against that dark blank wall which time and ignorance has built between us and the past. A lesser, but more exasperating, barrier is that of "localization." Every story is localized; and it seems impossible to make men, who have thoroughly imbibed the idea of a tradition being a local one, ever get away from the notion that the incidents happened *there*, particularly *there*. In Polynesia, constantly we hear: "It was on *that* hill my ancester fought the monster;" "It was *this* island which was hauled up from the bottom of the sea by the fish-hook of Tangaloa or of Maui." A good example is given at the end of the Mangaian myth: "Mangaia now for the first time emerged to the light of day, and *became the centre of the universe*. Its central hill was accordingly designated Rangimotia ("the centre of the heavens"). The inhabitants of Mangaia were veritable *men* and *women*, as contrasted with the natives of other outlying islands, who were only evil spirits in the guise of humanity."

This is by no means confined to the Polynesians, it meets investigators everywhere. To take two examples at random: Mr. Kennedy* says that nearly every lake and hill in Ireland has its legend of the encounter of hero and monster; and Mr. Burnell† writes: "The localization of the events of the Mahabharata is endless; every few miles, in Southern India, one can find the place where some battle or other event occurred; and so it is also in Java. Such legends, therefore, are absolutely worthless, for they prove no more than that the Mahabharata and Ramayana are or were favourite stories over a large part of the East." Of course, Mr. Burnell means worthless for fixing locality. Doubtless, dragons no more inhabited the hills of Ireland than they did the New Zealand plain of Kaingaroa; nor could Arjuna or Rama have fought the same battles in Java and in India. But the stories are useful, as showing a common fount of knowledge. Sir George Grey, in his "Polynesian Mythology,"‡ has compared two Maori legends with similar European tales: first, that of the dog of Whakaturia crying out from the belly of his eater, with the tradition of St. Patrick and the stolen sheep; and the other, one of our New Zealand dragon stories, with the dragon poem of Spenser. There can be no collusion here, and no interchange of myths, as between nations whose borders touch each other; the English poet and the Maori "*ariki*" were more favourably situated than any other persons in the world could be, if we wish to guard against interchange of ideas by personal communication; yet, word for word, line for line, the description of the animal pourtrayed by the one is a transcript of the mythical monster of the other; thus showing how deeply, not only the general idea, but the very details of the ancient marvel had sunk into the spirit of the primitive mind, and evolved similar products after centuries of separation.

In the tiny specimen of Polynesian folk-lore submitted in

* "Fictions of the Irish Celts."

† "South Indian Palæography."

‡ Appendix, New Edition.

this paper, mention has been repeatedly made of incidents supposed to be Aryan, if not exclusively European. Most of us have read the old fairy stories about "swan maidens," of whom Grimm* says: "Theirs is the power to fly or swim; they love to linger on the sea-shore. . . . When they bathe in the cooling flood, they lay down on the bank the swan-ring, the swan-shift. . . . The myth of Volundr we meet with again, in an Old-High-German poem, which puts doves in the place of swans: three doves fly to a fountain, but when they touch ground they turn into maidens." So Maui stole his mother's feather-dress, and turned himself into a dove or pigeon; and Rupe performs the same feat. Again, the tendrils of the vine hanging from the heavens, and up which Tawhaki climbed, swung down for us also in our childhood's story of Jack and the Bean-stalk. But it is to two of the loveliest legends in classical literature that I wish to compare our shorter myths recited above. The heavenly maiden, coming secretly down to repose by the side of her mortal husband, is Selene, the Moon, stealing to the slumbers of Endymion: she—

> "Kisses the closed eyes
> Of him, who slumbering lies."

That the Moon, in the Mangaian myth, should not be a "maiden of heavenly race" but a male deity, is in accordance with a curious "twist" peculiar to Mangaian legends, many of the celebrated Polynesian personages there changing sex. The second story is that of the immortal wife seeing the mortal husband getting grey and old. Those who have read Tennyson's beautiful poem on the old Greek mythus will remember:—

> "How can my nature longer mix with thine?
> Coldly thy rosy shadows bathe me, cold
> Are all thy lights, and cold my wrinkled feet
> On all thy glimmering thresholds, when the steam
> Floats up from those dim fields about the homes
> Of happy men that have the power to die,
> And grassy barrows of the happier dead.
> Release me, and restore me to the ground;
> Thou seest all things, thou wilt see my grave;
> Thou wilt renew thy beauty morn by morn;
> I, earth in earth, forget these empty courts,
> And thee returning on thy silver wheels."

The Polynesian goddess was more kind, in giving the rainbow bridge down which the aged feet might pass back to the world; but this bridge of the rainbow is cherished in Scandinavian mythology as the *Bifrost*, the rainbow bridge along which the souls of the heroes pass to the breast of Odin.

Hina, or Sina, (the Natives of the extreme North of New Zealand pronounce this word as if written by an Englishman, "Sheenah,") with the meaning of white or silvery, is found in most Polynesian dialects,† and is a part of the moon's name

* "Teutonic Mythology."

† And probably in our own Teutonic speech as "sheen," or "shine."

in many of them. The Marquesan *mahina*, Tongan *mahina*, Mangaian *maina*, Samoan *masina*, and Hawaiian *mahina* all mean the moon: and, although in some of these languages (Maori and Tahitian, for example,) this word is replaced by *marama*, yet the Sanscrit words *mah*, the moon, (√ *ma*, to measure,) and *rama*, light, white; also, the connection of this word with Rama-Chandra (Moon-Rama), point clearly to a time when "*Ma*" was the Polynesian (as the Aryan) word for moon, in *ma-rama* and *ma-sina*, both phrases signifying "shining," "bright," moon, *i.e.*, moonlight. And in those Polynesian dialects where *hina* does not mean "white" when standing alone, it means "white hair," (in Maori and Hawaiian), which is explained by the Indian myth that Krishna was the *black* hair, and Rama the white hair, plucked from the head of Vishnu (as twins of Darkness and Light).

Somewhere in Europe or in Asia the name of Hina, or Sina, must have been cherished as a lunar name, since the sect of the Gnostics called the moon "Sin" (Sina) in their mystical language. In the great Mesopotamian valley the word lingered for ages. Sin, the moon-god, was worshipped by the Assyrians and Babylonians, and probably before the dispossession by those nations of the earlier Accadian people. On one of the Babylonian cylinders the king Nabonidus writes of "Sin, the illuminator of heaven and earth, the strengthener of all;" and in another place we find*: "As the emblem of the Sun-god was the solar orb, the emblem of Sin was the crescent moon." "Sin was the patron-god of the City of Ur." But this "Ur of the Chaldees" was named thus because they worshipped there the "bright illuminator;" and the root *ur*, to shine, is the common property of the world's languages. "*Ur* signifies light or fire, and is to be found in every dialect of the Celtic."† So in the Hebrew *or*, to shine, and the Latin *uro*, to burn; but in none purer than the Maori *ura*, to glow. It is not an Aryan word only, but an Asiatic word, common to all races springing from the *vagina gentium*. In the opening verses of the Sanscrit "Hitopadesa," where Siva is invoked under the name of "Dhurjati," he is described as *yad-murdhni sasinas kala*, (literally, "on whose head the moon's sixteenth part,") meaning crescent-crested. The word *sasinas* may be akin to the Polynesian Sina, although *sasin*, moon, is generally derived from *sasa*, a hare, as though the moon was called "the hare-marked." Etymologists often alter their opinions as time goes on.

The connection or confusion between the lunar Hina, and Hina the fish-goddess, lies probably in the fact of Hina the swimmer being "Ina the bright, fair one," and "Ina who rivals

* "Assyria, its Princes, Priests, and People."—Sayce.

† "Gaelic Etymology."—Mackay.

the dawn." Ina being spoken of in one legend as having been given by Kui to Tane may perhaps be referred to the following cause:—Although the great deity Tane was, in Western Polynesia, the father of gods and men, the representative of the male generative power in the universe: and although *tane* is almost everywhere the common word for "male," or "husband," yet in Eastern Polynesia he was regarded as the "light principle," and stands for "Light" in the ancient Hawaiian Trinity of "Kane, Ku, and Lono," ("Tane, Tu, and Rongo"). Thus runs the sacred chant:—

> "Tane, Lord of Night, Lord the Father,
> Tu-te-pako, in the hot heavens,
> Great Rongo with the flashing eyes;
> Lightning-like lights has the Lord
> Established in truth, O Tane, Master-worker,
> The Lord Creator of mankind."

Thus, that Hina, the bright fair one, should become either the bride of Tane, the Light, or of Ma-Rama (moonlight), seems mythologically inevitable, and the entanglement between this Hina and our "silver-footed goddess of the sea" is probably explained.

Art. LXVI.—*Notes on Antigone*, 2–6.

By Francis Haslam, M.A.,
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[*Read before the Philosophical Institute of Canterbury, 5th August*, 1886.]

Antigone.

(1.) *Ὦ κοινὸν αὐτάδελφον Ἰσμήνης κάρα*
ἆρ οἶσθ' ὅ τι Ζεὺς τῶν ἀπ' Οἰδίπου κακῶν
ὁποῖον οὐχὶ νῷν ἔτι ζώσαιν τελεῖ
οὐδὲν γὰρ οὔτ' ἀλγεινὸν οὔτ' ἄτης ἄτερ
οὔτ' αἰσχρὸν οὔτ' ἄτιμον ἐσθ' ὁποῖον οὐ
τῶν σῶν τε κἀμῶν οὐκ ὄπωπ' ἐγὼ κακῶν.

Lines 2–3: *ὅ τι – ὁποῖον*. If there were *ὅ τι* without *ὁποῖον*, or *ὁποῖον* without *ὅ τι*, the passage would be quite easy. Several solutions have been proposed of the difficulty,—

α. That it is simply a double interrogation, *i.e.*, "What evil of what sort?" *cf.* line 1341, *οὐδ' ἔχω ὅπα πρὸς πότερον ἴδω.*

β. That we should read *ὅτι*, and that there is a mixture of two constructions, such as—

1. *οἶσθ' ὅτι Ζεὺς* { *πᾶν* / *ποῖον οὐ* } *κακὸν τελεῖ*
2. *οἶσθα Ζεὺς ὁποῖον οὐ κακὸν τελεῖ*

Or, γ. That the oblique form *ὁποῖον* comes quite naturally after the verb *οἶσθα*, the *ὅτι* being redundant, *cf.* O.T., 1401,—

ἆρα μου μέμνησθ' ὅτι
οἷ' ἔργα δράσας | *ὑμῖν εἶτα δεῦρ' ἰὼν*
ὁποῖ' ἔπρασσον αὖθις

It has occurred to me that it might perhaps be translated as it stands with *ὅ τι* in two other ways, each of which involves an ellipse of *τελεῖ*—

1. Do you know what evil inherited from Œdipus Zeus will bring to pass, and what he will not bring to pass, in the lifetime of us twain? *ἆρ οἶσθα ὅ τι Ζεὺς* (*τελεῖ*) *τῶν ἀπ' Οἰδίπου κακῶν, ὁποῖον ὀυχι—τελεῖ*, *i.e.*: Do you know the exact sum of our sorrows? a style of expression that is not at all unusual in Greek.
2. Do you know what evil inherited from Œdipus Zeus will bring to pass that he will not bring to pass in our lifetime? (In this case it might be better to take *τελεῖ* as present rather than future.)

The latter interpretation seems, perhaps, to suit the context best, since, from the repetition below of the same phrase, *ὁποῖον οὐ* with *τῶν σῶν τε κἀμων κακῶν*, the pith of Antigone's complaint seems to be that she and her sister had an *unfairly* large share of this evil inheritance.

Lines 4–5. *ἀλγεινὸν, αἰσχρὸν, ἄτιμον* are all words which certainly do not *exclude*, if they do not actually *include*, the conception of *ἄτη*; whereas with them we find coupled the phrase *ἄτης ἄτερ*, which expressly *excludes ἄτη*; and yet all have but one verbal phrase *οὐκ ὄπωπα*, so that the passage seems to mean "there is nothing baneful and nothing bane*less*," etc., "that I have not seen." No satisfactory reading has been suggested that I know of instead of *ἄτης ἄτερ*. As all the MSS. have this reading, it is worth while to try and make something out of it. The following interpretations have been suggested:—

(1.) By Seidler, who takes *ἄτης ἄτερ* to signify "without blame" or "guilt"—*i.e.*, *undeserved;* and the following *οὔτε—ὄυτε* to signify *ἤ—ἤ*, *cf.* line 1157.

If *ἄτη* can be taken in this sense, it seems simple enough; and *γὰρ* would then be taken as explaining the phrase *Των ἀπ' Οἰδίπου κακῶν*, while *ὀυκ* simply duplicates the former negative *ὀυ*.

(2.) By Hermann, who suggests taking *ἐσθ' ὁπῦιον ὀυ* with *ἄτης ἄτερ*, "For neither what is painful nor what is not free from bane (*i.e.*, what is mixed with bane), be it base or dishonourable, have I failed to see."

αἰσχρὸν and *ἄτιμον* are thus taken parenthetically, as subdivisions of *ἄτη*.

The construction becomes clearer if we neglect the parenthesis, and read: *ουδὲν γαρ, ουτ᾽ ἀλγεινόν, ουτ ἄτης ἄτερ ἐσθ ὁπõιον ὀυ, οὐκ ὄπωπα*, "For nothing, neither what is painful nor free from bane what is not, have I failed to see"—*i.e.*, I have seen all kinds of misfortune. The well-known use of *ουδεις ὄστις ὀυ* might be adduced as a parallel for this construction, and is so brought forward in Dr. Jelf's Greek Grammar.

All reverence is due to the mighty name of Hermann. There were giants in scholarship in those days; and, if we ever do see farther than they do, it may be that we are after all dwarfs mounted on the shoulders of giants. With all respect then, be it said, that even when thus ingeniously elucidated, the fact remains that Sophocles has chosen a very awkward way of saying what he meant, by writing *ὄυτε ἄτης ἄτερ ἐσθ᾽ ὁπõιον ὀυ* where, according to the general usage of similar phrases, the *ὀυ* would be expected to negative *ὄπωπα* and not *ἄτης ἄτερ*; and this when there seems nothing to be gained by it, and in the beginning of a play, too, where such a difficult collocation of words might be more than usually displeasing.

Is it impossible for *ἄτης ἄτερ* to mean, "besides the curse that rests upon us," (in addition to it,) like the Latin "ut omittam," referring to *τῶν ἀπ᾽ Οἰδίπου κακῶν*. Lines 2–6 might then be translated:—

> "Do you know what evil that we inherit from Œdipus, aye and what evil *we do not inherit*, Zeus will fulfil in the lifetime of us twain; for there is nothing, neither what is painful, nor—to say naught of the curse that rests upon us—is there aught of private disgrace or public infamy, that I have not seen in the number of thy woes and mine?"

The word *οὐχι* is thus taken to negative *τῶν ἀπ᾽ Οἰδίπου κακῶν*; and the sense is, "Do you know what misery Zeus is going to spare us, for I know of none—whether inherited from Œdipus as a curse, or not—that we have not suffered?" I may remark that *ουχι* in the "Iliad" (*οὐκί*) is, I think, invariably used as above—*i.e.*, as the last word in the negative clause of an alternative; *e.g.*, *ὅς τ᾽ ἄιτιος, ὅς τε καὶ οὐκί*, and still oftener *ἠὲ καὶ οὐκί*, at the end of a line. It is also used in the same way in two out of three places where I have noted it in Æschylus. I have not been able to compare other passages in Sophocles or Euripides.

I have not been able to find a similar use of *ἄτερ*, but there is a similar use of the word *χῶρις* in Hdt., i., 93, also "Medea," 297, and Æsch., Sep. c. Th., 25, *πυρὸς δίχα*, where *δίχα* seems to bear the same meaning, according to Hermann himself.

ART. LXVII.—*A Note on Latin Place-names.*

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[*Read before the Otago Institute, 12th October,* 1886.]

IN Livy, xxi., 19, we read, "tum maxime Sagunto excisa;" further on, in xxi., 21, we read, "Sagunto capto." The first expression is explained *per synesin* of "urbe" with *Saguntum*, and the participle is taken in agreement with it. Livy occasionally introduces *urbem*, *vicum*, in apposition to the names of towns, in "*um*." Hence has arisen a certain perplexity as to the gender of Latin place-names; add to which the influence of Greek place-names, and we have the erroneous statement of our Latin Grammars on this point seemingly justified. But Livy, in using such a sentence as the following (among a host of such instances), ii., 63: "Fusi, in primo proelio hostes, et in *urbem* Antium, ut tum res erant *opulentissimam* acti," is telling us that the enemy fled to Antium—a town of very great wealth, as the times were then—and uses the plainest way of saying what he has to tell us.

In our Latin Grammars, (two books of this year, 1886, are enough to cite,) the statement runs substantially thus: "Names of countries, *cities*, islands, and trees are feminine." In another Grammar the statement is somewhat guarded: "Most names of cities are feminine." Here is a qualification of the previous statement; and it is to be hoped that in time the statement will be further attenuated, so as to represent the facts.

What are the facts? In my copy of Madvig's Grammar (third edition, an old book), p. 28, the author says very little about the subject; but adds, "of the words in *us* the names of towns are feminine. *These names are all Greek.*" The italics are mine; and the statement is worth noting, because it indicates the natural order of things: that, in the case of one highly-inflected language passing on names into another highly-inflected language the names bear their gender with them. All these Latinized spellings of Greek place-names only go to show that in Greek the names of towns in *os* are feminine.

But in his "Notes on Latin Word-systems," published in 1844, this great scholar (who has died since this note was compiled,) goes further: "Not a single name of a place in Latin, irrespective of the nature of its termination, is of the feminine gender." Notwithstanding which dogma of the master, compilers of Latin Grammars for English boys have gone on reiterating the same misleading "rule" with a sort of hide-bound obstinacy.

We find place-names declined according to the scheme of the first, second, and third declensions. I am not acquainted with any belonging to the fourth and fifth declensions, and am inclined to think that as geographical names usually belong to rough speech, these somewhat obscure varieties of declension do not contain any place-names.

Taking suffixes in order, we begin with

i.—*a*, *æ*.

Pola	Cremona	Roma	Ilerda
Aquileia	Brixia	Sinuessa	Corduba
Vicetia	Florentia	Gaieta	Dertosa
Ravenna	Pisa	Aquilonia	Cæsaraugusta
Bononia	Cortona	Tarracina	Sămărobriva
Mutina	Sena	Ostia	
Placentia	Ancona	Ardea	
Faesulæ	Fidenæ	Minturnæ	Cannæ
		Allifæ	

All feminine, as the terminations require.

ii.—*ii* or *i*.

Corioli	Gabii	Puteoli	Volsinii
Falerii	Veii	Volci	

And, by analogy, Pompeii, together with numerous tribal names, of which, in the case of towns, the suffix *ii* is a survival. These are masculine words.

iii.—*um*.

Patavium	Clusium	Ferentinum	Antium
Tarvisium	Ariminum	Aquinum	Herculanum
Altinum	Pisaurum	Arpinum	Surrentum
Mediolanum	Assisium	Tusculum	Salernum
Bergomum	Spoletium	Pæstum	Saguntum
Ticinum	Asculum	Venafrum	Casilinum
Comum	Lanuvium	Bovianum	
Arretium	Nomentum	Teanum	

—with many others. These are all neuter.

iv.—*a* (of the plural).

Susa	Leuctra	Megara	Tigranocerta
Arbela	Bactra	Artaxata	

—Greek names, but neuter, as their suffix requires.

v.—*us*.

There are no Latin place-names with this suffix, which is native, however, to Greek, and brings with it its gender; even in the case of variants,—as *e.g.*, *Canopus*, *Isthmus*, *Orchomenus*, *Pontus*,—names masculine in Greek are masculine in Latin.

vi.—*o* (gen. *-onis*).

Croto	Hippo	Olisipo	Vesontio
Telo (Martius)	Frusino	Pompaelo	Tarrăco
Narbo	Sulmo	Mago	

—all masculine, as the suffix requires.

vii.—*e*.

Tergeste	Caere	Bibracte	Soracte
Praeneste	Reate	Nepete	

—all neuter, as the suffix requires. (But Arelate, a Greek word of 1st declension, is feminine.)

viii.—*ur*.

Tibur Anxur

—neuter, as the suffix requires. (Anxur, the mountain, is masculine by analogy with the usual gender of the names of mountains.)

ix.—*Various suffixes*.

Gadîr	Tuder	Asty	Hispal
Ierusalem	Illiturgi	Pessinous (*-nus*)	Tunes

—neuter or masculine. (The indeclinable words are neuter.)

In all the cases quoted above we note that the suffix determines the gender of the place-name; the "rule" is not even traceable. There is, *e.g.*, a well-known suffix *-onis*, and another *-inis*. The former is masculine, the latter feminine: hence Narbo -onis is masculine (Narbo Martius), and Carthago -inis is feminine (Carthago Nova).

If we follow Latin further afield, the question is further elucidated. In Gaul, the Romans meet with a place-suffix *dun* (enclosure, wick, or burg). To bring this suffix within the scope of their system they add a neuter suffix, *um*, and the place-names become neuter: hence we have—

Noviodunum	Verodunum	Camalodunum (Britain)
Lugdunum	Eburodunum	Sorbiodunum (Britain)
Segodunum	Uxellodunum	

And even such hybrids as Augustodunum and Cæsarodunum. All these words are neuter.

But the suffix *um*, or *ium*, is freely used to reduce to the Latin scheme a very large number of words found among subject tribes :—

Londinium	Corinium	Glevum	Lindum
Eburacum	Mancunium	Verulamium	Regulbium

(All in Britain)

Turicum Avaricum Aginnum

—besides words like Trajectum, Durotrajectum, and many others, all neuter, as the suffix requires.

What becomes of the "rule"? As Zumpt seems to have felt, it is so overwhelmed with exceptions that *mole ruit earum.* Having examined three hundred and fifty place-names, found chiefly in the western section of the Orbis Romanus, I am not able to discern any "rule" applicable to the names of towns. But the influence of the "rule" is very great. Even Lewis and Short, s. v., are misled by it. In order to justify Liv., xxi., 19, cited above, they allege that Liv. used *Saguntus.* But *Saguntum* is in good prose the only form used, *cf.* Mayor on Juv., xv., 114. Poets and writers like Mela and Florus use *Saguntus.* Juv., *loc. cit.*, uses *Zazynthus*, a thinly-veiled form of *Zacynthus.*

Art. LXVIII.—*Transcendental Geometry: Remarks suggested by Mr. Frankland's Paper, "The Non-Euclidian Geometry Vindicated."**

By George Hogben, M.A.

[*Read before the Philosophical Institute of Canterbury, 7th October*, 1886.]

In the paper referred to, Mr F. W. Frankland implies that the views he advocates are generally accepted by living mathematicians—*e.g.*, on page 59, paragraph 4: "He [Professor Clifford] says, in common with most living mathematicians who have studied this question, that space *may* be finite"; and again, on page 60, paragraph 6: "To the expression 'geometers of the Euclidian school' I take exception, believing that none such are left, in the sense in which Mr. Skey uses the word. The triumph of the non-Euclidian geometry, or, I will say, the 'general' geometry, has been complete. I can safely appeal, on this point, to any distinguished member of any Mathematical Society in Europe or America."

Now, I am quite aware that, if this were an accurate description of the state of mind of most living mathematicians and distinguished members of Mathematical Societies, it would be an extremely rash proceeding on my part to enter into the controversy. One could only gaze in wonder at those superior beings who roamed at large in space of the (n+ 1)th degree, while we poor mortals had to be content with three dimensions.

I cannot think that Mr. Frankland is justified in demanding a greater admission than this: that there are (or have been,) distinguished mathematicians holding those views, and that Mathematical Societies have, as in duty bound, allowed the discussion of them in their meetings and in their journals.

* "Trans. N.Z. Inst," vol. xviii., p. 58

I shall not enter into all the questions raised between Mr. Frankland and his critic, Mr. Skey, but content myself with noticing the three most important propositions laid down in the two papers contributed by the former. These are :—

(1.) That the axioms of geometry may be only approximately true:
(2.) That the actual properties of space may be somewhat different from those which we are in the habit of ascribing to it :
(3.) That the extent of space may be a finite number of cubic miles.

If these propositions are sound, the transcendental geometers may be right ; if not, the position of the Euclidian geometers, who maintain that space has three dimensions, and three only, remains unassailed.

The subject, of course, has often been discussed, and the argument on the orthodox side is well represented by Stallo, ("Concepts of Modern Physics,") and Lotze ("Metaphysic"). While acknowledging my obligations to these great writers, each of whom, however, gives only part of the argument, I shall endeavour to state the case in a somewhat different form :—

(1.) "The axioms of geometry may be only approximately true"; or, again, as Mr. Frankland says in another place, "geometry is a physical and experimental science."

This idea of geometry, though countenanced by John Stuart Mill, is founded upon a serious misconception as to what the subjects are of which geometry treats. The line of reasoning pursued is shortly as follows :—'Geometry treats, among other things, of straight lines ; but straight lines cannot be conceived apart from objects, and nowhere are we acquainted with lines that are more than approximately straight. Therefore geometry is only an approximate science.' The argument, as Stallo and others have shown, contains its own answer. How do you know that any given line must be only approximately straight, except by reference to some standard ? The very phrase "only approximately straight" implies the existence of such a standard in the mind of the person who makes it. When Mr. Frankland speaks of a line on his supposed manifold as having such feeble curvature as hardly to be distinguishable from a Euclidian straight line, he is really implying this standard. In a similar manner it could be shown that we must admit the concepts of a line, a surface, a plane surface, a right angle, a solid, and so on.

In fact, geometry is the science of such standards as this, or rather of such concepts as this. It has been, I think, rightly defined as the science of the concepts of the limits of the modes of extension. It starts with a limited number of concepts, and upon them builds up, by a process of deduction, all its propositions. In the physical sciences, on the other hand, whatever concepts we start with, we find that our results have continually to be qualified by bringing in new concepts—so that even in our theories a continual process of approximation is going on.

(2.) We now come to the speculation that the actual properties of space may be different from those generally ascribed to it. This really comes to the same thing as saying that there may be points in space whose position we cannot consider by reference to our Euclidian system of geometry of three dimensions. If we show that by our geometry of three dimensions we could consider the position of all possible points in space, then its methods would suffice for the investigation of any possible form of surface or solid; the so-called geodesics, parallel straight lines which meet, and uniplanar non-parallel straight lines which do not meet—all of which are drawn on this wonderful surface to which Mr. Frankland refers—could be brought to reason by considering the corresponding lines on a similar surface of manageable extent. For it must be possible, on the assumption that three-dimension geometry is sufficient, to obtain a surface of small extent similar to any finite surface whatever.

By many of the transcendental geometers this objection is met by the answer, (which is, I believe, the only possible one,) that there may be four or more dimensions in space, not three only, as is usually imagined. Now, as Lotze points out, if there be a fourth dimension in the strict sense of the term, it must be of the same kind as the other three—length, breadth, and thickness: otherwise, our use of the word "dimension" is a misnomer; so also is our use of the word "space." Time, density, thermal capacity, etc., are all excluded from being regarded as corresponding in any real sense to dimensions of space.

We have three concepts of the methods of extension in space, the three dimensions already referred to: the question is, whether space can be such that we cannot completely examine by reference to our three concepts the form and position of a space which is finite.

Let the position of any point of which we are cognizant in three-dimension space be referred to three co-ordinate axes, OX, OY, OZ, which are mutually at right angles. All points in our space can be so referred, and every point with any finite and real co-ordinates whatever can have its position assigned to it. Let the fourth dimension be referred to an axis OV: OV must bear the same relation to OX and OY as OZ does, that is, it must be at right angles to each of them. (This follows from the fact that the fourth dimension must be of the same kind as the other three.)

An imaginary being might have the same OX and OY, but might have OV instead of OZ for his third axis.

In choosing our arbitrary axes, let us suppose we begin by fixing the position of $O X$. In any given plane through $O X$ there is only one axis, $O Y$, at right angles to $O X$. By making the plane revolve about $O X$, we shall make it coincide in succession with all the planes that can be drawn through $O X$, and $O Y$ will coincide in succession with all the straight lines that can be drawn perpendicular to $O X$. Let one of these be chosen for the axis $O Y$; let it be $O Y_1$. But $O Z$ is also at right angles to $O X$; therefore it is one of the possible $O Y$'s; so is $O V$. But there is only one series of possible $O Y$'s; therefore $O Z$ and $O V$ must both be in the same series. Now, the particular $O Y$ which is taken as $O Z$, must be at right angles to $O Y_1$; so must the particular $O Y$ taken as $O V$. But in the series of $O Y$'s there is only one straight line which is perpendicular to $O Y_1$. Therefore $O Z$ must be that line; so also must $O V$. Hence $O Z$ and $O V$ must be identical: the imaginary being's space is identical with ours, and he would be cognizant of no points, or of no properties of space, of which we were not also cognizant.

I am aware that this argument is only the reproduction in mathematical form of the argument from common sense; but the only ground, I think, on which it can be overthrown is, that the fourth dimension is not comparable with the other three—length, breadth, and height, to which we refer our notions of the extension of bodies; that is, it is not a dimension of space at all, in our sense of the term. Not being a dimension of space, it cannot aid us in finding any points in space other than those known to us by our three dimensions.

It has been said, I think, by the authors of "The Unseen Universe," that though space may be of three dimensions with us, yet at some great distance it may have a higher number of dimensions. But space, as space, must be homogenous; to assert anything else is, as Stallo has shown, to confound space with the matter or with the structures which are in it. To explain the use of the word "structure" here, I proceed to distinguish between two of the meanings attached to the word "space." So far, there has been no danger of ambiguity. But we cannot go further without distinguishing between what is sometimes called structure-space, and absolute space.

Consider the piece of chalk I hold in my hand: it occupies space; outside it there is space not occupied by the chalk. The space occupied by the chalk, the form of which we identify with the form of the piece of chalk, is what is called structure-space. Other bodies besides the piece of chalk in question are said to occupy space. It is possible, indeed, that no space is empty; but the very fact of our being able to think of it as empty or not empty shows that we have formed a concept of space apart from the structures which are in it. This is absolute space, or the universe of space. Absolute space, in short, is the sum of all structure-spaces and all potential structure-spaces.

In order to be finite, it must, as the new school admit, return into itself, as the circumference of a circle or the surface of a sphere or spheroid returns into itself. Now, since by our three-dimension geometry (the sufficiency of which has, I trust, been made clear) we can always obtain a figure of small extent similar to any corresponding figure of finite extent; we could, if space were finite, obtain a similar small structure-space which likewise returns into itself. But we cannot—the phrase is meaningless; therefore the universe of space cannot be finite.

The only possible meaning that could logically be given to the statement that the Universe is finite, is that the structure-space occupied by all the bodies subject to the physical conditions known to us is a finite number of cubic miles.* But outside this structure-space, again, there must be space, just as there is space outside my piece of chalk.

It is possible that I may be accused of neglecting the argument upon which Mr. Frankland relies—that, namely, which is based upon the assumption that all the axioms of Euclid are true, except the twelfth; and that the twelfth is not true. That axiom is easily shown to be identical with the modern substitute†; the advantage of the latter being, to my mind, the fact that it is at once seen to flow directly from the concept of parallel straight lines; whereas Euclid's 12th needs the 28th proposition before its force can be properly appreciated. I do not know whether it would not be just as easy to approach the subject by assuming as the axiom the second part of Euclid I., 29:—"If a straight line fall upon two parallel straight lines, it shall make the exterior angle equal to the interior and opposite angle on the same side." This is an immediate consequence, hardly more than a re-statement, of the concept of parallel straight lines (which may be roughly described as straight lines drawn in the same direction).

What Mr. Frankland seems to lose sight of is this: That the notion of parallel straight lines is as truly a concept as is that of a straight line; that the definitions are not and cannot be equivalents for the concepts; they are merely indexes to the nature of the several concepts; and, in like manner, the axioms are indexes of certain concepts so closely related to those pointed to in the definitions as to need no detailed proof.

The inclusion of the twelfth axiom does not make geometry an experimental science. The very question brought as an

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* In this, of course, there must be included not merely the space these bodies occupy in a literal sense, but the whole space within the range of which all phenomena connected with them take place.

† Through the same point there cannot be two straight lines, each of which is parallel to a third straight line.

illustration by Mr. Frankland and others will serve to show this. That illustration is as follows:—Vertical lines on the earth's surface were once thought to be parallel; they are now almost universally considered to be inclined to one another. This is a purely physical question, not in *pari materiâ* with the present. Geometry, as a science of concepts, gives standards to which we may refer physical facts; among its standards are the plane and the sphere; formerly, it was thought that the surface of the earth was nearly a plane; it is now known that it more nearly approaches the sphere, and still more nearly the spheroid. But no standard, no concept of geometry, has been altered by this correction of our physical ideas.

One word more. If the concepts of Euclidian geometry were useless as standards to which to refer actual physical facts, Euclidian geometry would have to go; or if any other geometry gave equally valuable standards, it would have to be admitted by the side of the Euclidian. Otherwise, it must be rejected, however pretty it may be as a playground of the imagination.

ART. LXIX.—*On "The Whence of the Maori."*

By W. H. BLYTH.

[*Read before the Auckland Institute, 14th November*, 1886.]

IT is with considerable diffidence I venture to bring the following results of an inquiry into the interesting subject of "The Whence of the Maori" before the Institute. In the first place, because several scientific men, far more capable of dealing with the question than I, have discussed it; and their researches have been embodied from time to time in the "Transactions" of the Institute: a fact that in itself endorses their value. In the second place, not being *an expert* in Maori lore, I shall doubtless merit, by my temerity, the critical displeasure of such authorities as Mr. Colenso, who, more than once, has shown in the pages of the "Transactions" some impatience at what he terms the "never-resting spirit of conjecture" in matters Maori. Yet, why this impatience? Why should conjecture rest? Conjecture, if it lead to nothing, cures itself. Conjecture is a symptom that the imagination is not stagnant; and the imagination, when scientifically controlled, is the great desideratum that has led to the most brilliant discoveries. It may be that the imagination of the specialist will be found just too much loaded with technicalities to render that kind of service on this question; though equally valuable and not less necessary work will undoubtedly fall to his share in giving the public, or at least the student, the treasures of his knowledge in the shape of facts and criticism.

Mr. Turnbull Thomson's philological papers, read before some of the affiliated Societies of the Institute, on "The Whence of the Maori," tracing their aboriginal home to Peninsular India, or "Bharata," first drew my attention seriously to the subject, as I had some acquaintance, as a student, with the religious systems and mythologies of the Hindus: and my comparative study of Maori traditions with these has now led to a discovery of so many analogies and coincidences, that I have been impelled to bring the results of this inquiry before you—for discussion at least. Mr. Thomson's conclusions, as results of philological inquiry, are completely borne out by the supplementary evidence to be adduced from Maori tradition and mythology. My investigations, if correct, establish the following :—

(1.) That the Maoris, as a race, are of an An-Aryan, or Turanian origin: members of a family of people that once held possession of Peninsular India, or Bharata:

(2.) That with these is amalgamated an Aryan element, more immediately represented by their priests and chiefs:

(3.) That the cause that provoked their emigration was the overthrow, generally, of their race by the invading Aryans; large portions of the country having been absorbed among the territories of the superior race.

For information on the Maori part of the subject I am indebted to some of the papers of Mr. Colenso, and of others, published in the "Transactions;" but more particularly to a work, "Te Ika a Maui," by the late Rev. Richard Taylor. I purpose, in this paper, to confine myself more immediately to the Turanian element of the question, leaving the Aryan element to be more fully dealt with on some future occasion.

The chiefs and priests, and perhaps some of the tribes who retain a more Caucasian cast of features, seem to have Aryan blood in their veins. The Aryans who broke into India called themselves Aryas. The chiefs and *tohungas* among the Maoris call themselves, as distinguished from the lower ranks, *arikis*—a name which is perhaps equivalent to "Children of the Aryas." Both words mean "nobles" or "lords;" the derivation of the name, from a Sanskrit word that refers to the plough, I will notice in my next paper.

The following cosmological poem of the Maoris appears of an order far higher than might have been expected from a people of their position in the ethnological scale; it has all the metaphysical ring of the Hindu mind. Mr. Taylor calls it "The Hymn of Creation," and he says of it: "There is a degree of thought perceptible in it which marks a far more advanced state than their present." This can be easily understood if the Hindu connection be proved :—

First Period—Epoch of Thought.

"From the conception the increase,
From the increase the thought,
From the thought the remembrance,
From the remembrance the consciousness,
From the consciousness the desire."

Second Period—That of Night.

"The word became fruitful;
It dwelt with the feeble glimmering;
It brought forth night: * * * "

During these periods there was no light—"there were no eyes to the world."

Third Period—That of Light.

"From the nothing the begetting,
From the nothing the increase,
From the nothing the abundance,
The power of increasing,
The living breath;
It dwelt with the empty space, and produced the atmosphere which is above us,
The atmosphere which floats above the earth;
The great firmament above us, dwelt with the early dawn,
And the Moon sprang forth;
The atmosphere above us dwelt with the heat
And thence proceeded the Sun;
They were thrown up above, as the chief eyes of heaven:
Then the heavens became light,
The early dawn, the early day,
The mid-day. The blaze of the day from the sky."

Fourth period, land was produced. Fifth period produced the gods. Sixth period, men were produced.

For comparison, I have selected a hymn from Max Müller's "Chips from a German Workshop" to go with it :—

Hindu Hymn.

"Nor Aught nor Nought existed; yon bright sky
Was not, nor heaven's broad woof outstretched above.
What covered all? What sheltered? What concealed?
Was it the water's fathomless abyss?
There was not death—yet there was nought immortal;
There was no confine betwixt day and night;
The only One breathed breathless by itself,
Other than It there nothing since has been.
Darkness there was, and all at first was veiled
In gloom profound—an ocean without light—
The germ that still lay covered in the husk
Burst forth, One Nature, from the fervent heat,

Then first came love upon it, the new Spring
Of mind—yea, poets in their hearts discerned,
Pondering, this bond between created things
And uncreated. Comes this spark from earth
Piercing and all-pervading, or from heaven?
Then seeds were sown, and mighty powers arose—
Nature below, and power and will above—
Who knows the secret? Who proclaimed it here—
Whence, whence this manifold creation sprang?
The gods themselves came later into being—
Who knows from whence this great creation sprang?
He from whom all this great creation came,
Whether his will created or was mute,
The Most High Seer that is in highest heaven,
He knows it—or perchance even he knows not."

The points of contact will become plain on a slight study; but not only is the matter generally of the subjects similar, but even the manner of the hymns has been retained, in some of h emore ancient compositions of the Maoris. In some of these older poems a refrain is persisted in, which recalls forcibly the same feature in some Vedic hymns—something like the responses of a litany. Mr. Colenso gives us an invocation of Pani, which it will be well to compare with a hymn or so from the Veda, as translated by Max Müller. This invocation of Pani* was used at the planting of the *kumara* crop:—

"Oh, Pani! Oh! come hither now; welcome hither!
Fill up my basket, (with seed kumara roots) placed carefully in, one by one;
Pile up loosely my seed-basket to overflowing:
Give hither, and that abundantly!

Open and expanded awaiting (is) my seed basket;
Give hither, and that abundantly!

By the prepared little hillocks in the cultivation is my seed-basket placed;
Give hither, and that abundantly!

According to the spell of Space (is) my seed-basket awaiting;
Give hither, and that abundantly!

By the sides of the borders of the plots (in the) cultivation is my seed-basket placed;
Give hither, and that abundantly!

By (*or* according to) the proper form of power and influence (*or* potential power) is my seed-basket placed;
Give hither, and that abundantly!"

The following extract (Rig Veda, x. 121) is from the translation by Max Müller:—

"1. In the beginning there arose the golden child—He was the one born Lord of all that is. He established the earth, and this sky.
Who is the God to whom we shall offer the sacrifice?

"2. He who gives life, He who gives strength: whose command all the bright gods revere; whose shadow is immortality, whose shadow is death:
Who is the God to whom we shall offer our sacrifice?

* "Trans. N.Z. Inst.," vol. xiv., p. 44.

"3. He who through His power is the one King of the breathing and awakening world; He who governs all, man and beast:
Who is the God to whom we shall offer our sacrifice?

"4. He whose greatness these snowy mountains, whose greatness the sea proclaims, with the distant river—He whose these regions are, as it were, His two arms:
Who is the God to whom we shall offer our sacrifice?"

I add a second specimen from the Rev. R. Taylor's work, "Te Ika a Maui,"—"The Spell of Tawaki, on his ascending to Heaven":—

"Ascend, Tawaki, to the first heaven:
Let the fair sky consent!
Ascend, Tawaki, to the second heaven:
Let the fair sky consent!
Ascend, Tawaki, to the third heaven:
Let the fair sky consent!
Ascend, Tawaki, to the fourth heaven:
Let the fair sky consent!
* * * *
Ascend, Tawhaki, to the tenth heaven:
Let the fair sky consent!
Cling, cling, like the lizard, to the ceiling;
Stick, stick close to the side of heaven."

As I have duplicated the quotation from the Maori, I will balance it by a second from the "Chips."—"Hymn to Varuna" (Rig Veda, vii., 89):—

"1. Let me not yet, O Varuna, enter into the house of clay:
Have mercy, Almighty, have mercy!

"2. If I go along trembling, like a cloud driven by the wind:
Have mercy, Almighty, have mercy!

"3. Through want of strength, thou strong and bright God, have I done wrong:
Have mercy, Almighty, have mercy!

"4. Thirst came upon the worshipper, though he stood in the midst of the waters:
Have mercy, Almighty, have mercy!

"5. Whenever we men, O! Varuna, commit an offence before the heavenly host, whenever we break the law through thoughtlessness:
Punish us not, O! God, for that offence.

These analogies, taken with the fact that the Maoris have preserved the very names the Hindus gave such hymns and invocations—viz., *gathas*, and *mantras*: *gatha*, a song, becoming *waiata* in Maori; and *mantra*, a spell, becoming *maatara*, seem to me to point to more than a mere coincidence.

I now come to the more direct evidence. Mr. Turnbull Thomson, in his paper on "Barat, or Barata Fossil Words,"* says:—

"Barat is the Malay traditional and poetical name for Hindustan, and to this day they speak of the *angin Barat*—that is, the

* "Trans. N.Z. Inst.," vol. xi., p. 157.

westerly, or wind of Barat—as they do of the *angin Jawa*, that is, the southerly, or wind of Java. Barata, or Bharata, is the ancient term for their country by the natives of Hindustan. In the language of Madagascar, allowing for phonology, precisely the same word is used for the north—viz., *avaratra*, whose winds wafted commerce from the parent country—viz., South India." Mr. Thomson had already shown that from Barata there must have been an eastern migration to the Malay Peninsula, and a western one to Madagascar. Mr. Colenso, in his notes to a paper read by him before the Hawke's Bay Institute on "A Charm or Invocation used at the Planting of the *Kumara* Roots," (quoted above) comments thus on the following couplet from his translation :—

> "And it was divulged abroad by thee
> At Wairoti (and) at Wairota."

He says: "Wairoti and Wairota are the names of two places out of New Zealand (real or mythical) not unfrequently referred to, in this way, in their old poetry and myths, and often in conjunction with Hawaiki." Now I cannot doubt that, allowing for phonology, *Wairota* is equivalent to *Barata;* whilst *Wairoti* is probably *Wairota-iti*, or "Little Wairota:" the new land (that proved only a halting-place) named after the old home. The fact of the names being found in what Mr. Colenso has pronounced one of the most ancient of Maori poems, "The Invocation of Pani," which we have seen in structure resembles some of the Vedic hymns; and the names being connected with Hawaiki, their more immediate though still ancient island home, all strengthen the inference that *Wairota* is identical with *Barata*.

That this tradition of Barata is not confined to New Zealand is evidenced in the following extract from a review in the "New Zealand Magazine," on Dr. F. Müller's work on the Malay race (from the ethnological and linguistic parts of the "Voyage of the *Novara*") :—

"We believe that in the Samoa and Tonga Islands we have to seek for the original seat of the Polynesians. . . . The native tradition, however, leads us still farther back. Similarly, as in the eastern insular groups, the name Savaiki describes a land which may be considered as the Eden of the Polynesians, which it surrounds with the poetry of careless childhood. Tradition in Samoa and Tonga preserves the memory of a large island, which is placed in the west, and is regarded as the abode of the departed, and as the point of departure of mankind. The name of this island in Samoan is *Pulotu*, or *Purotu*; in Tongan, *Bulotu*. It is most probable that in this expression the name of the Island of Buro is to be recognised." It is added, in a note: "The *tu* in Pulotu is probably connected with the word *tabu* (as Tonga-tabu=sacred Tonga), and the expression means nothing more than sacred Buro."

Now, I think the inference is plain, from the light that the Maori version throws on the Samoan and Tongan tradition, that *Wairota* or *Purotu* refers to the *original* home of the race, that is *Barata;* while *Wairoti*, or Little Barata, refers to the Island of *Buro*, the new home named after the old. The explanation by the reviewer, of the terminal syllable *tu*, as a contraction or detrital fragment of *tapu*, is ingenious, but hardly convincing; as it is neither backed by analogy, nor is any reason given why Samoans or Tongans should make *tapu* into *tu;* nor is it shown that they do so: the instance of Tongatabu is rather fatal to the view. Moreover, the Maori tradition removes Purotu a stage farther than the Island of Buro; which, according to Maori view, ought to be Puro*ti*, and not Puro*tu;* so then the *tapu* connection vanishes, for it can hardly be contended that the terminal *ti* is a contraction of *tapu*, unless indeed it can be shown that *tapu* is sometimes *tapi.*

We then see the evidence points to Havaiki or Savaiki, that is Samoa; Wairoti, the Island of Buro, that is Little Barata; and Wairota or Purotu, that is Barata, as the three former homes of the Maori.

All doubt that the view taken here is the correct one will be set at rest by the following quotation from Mr. Taylor's work*:—

"At Parapara, a small village on the road from Kaitaia to Doubtless Bay, there resided (1840) an intelligent old chief named Hahakai, a *tohunga* deeply versed in the traditions of the country. . . . He repeated a list of twenty-six generations from their first coming to this island. The old priest in his first half-dozen names," says Mr. Taylor, "seems to have gotten among the gods." These first names are: Tiki, Maui, Po, Maweti, Atua, Maea. The last is a Hindu goddess, Maya (or illusion), the physical universe (a mother-goddess). "He stated that their ancestors originally came from three islands, *Hawaiki*, *Matatera*, and *Wairota;* all which lay to the East."

I think Mr. Taylor has made some slips here. The old priest must have said "all which lay to the *West*." This is to be seen by taking them in order: *Hawaiki* is the land from which they came more immediately to New Zealand. To the *West* of Hawaiki must have lain their more ancient home, for it is called *Mata-tera*. This is only an erroneous form of the words *Mate-te-ra*, the dying (or dying place) of the Sun, that is the West; and would answer to *Wairoti*, or Little Wairota, or the Island of *Buro*. Then *Wairota* would represent the land still farther west from which they set out, that is Peninsular India, or

* "Te Ika a Maui," p. 193.

Bharata, which would doubtless be considered an island by its inhabitants. Its northern boundary being the Vindhya Mountains, they might suppose what lay beyond it was probably the sea, just as the sea bounded their country on its other sides. This old *tohunga* described the men in the neighbourhood riding on beasts, and having axes with holes in them, through which the handles were thrust, etc.

But it is from Maori mythology that the strongest evidence is to be obtained: for, not only are the names of the most ancient Turanian gods of India retained, and this in but partial disguise, but the old Phallo-pantheistic faith, that preceded both Buddhism and Brahmanism in India, is also enmeshed with their cosmological and other legends. I shall deal with the latter feature first.

In India the Deity was symbolised, even in the earliest days, as a serpent. The snake formed one of the most important figures of Phallo-pantheism—the first philosophical faith of India; since either as a perpendicular, or ringed, it so facilely expressed the male and female principles in Nature; these being also expressed by other figures, suggestive of a like meaning. The snake, the truncated tree, or monolith, alluded to the generative faculty evidenced in Nature, through the instrumentality of the generative organs. Separate from his intention to create, the Deity was conceived as bi-sexed, or hermaphrodite; but in periods of creative or recreative energy, the phallic snake was represented as putting its tail into its mouth, thus picturing the *lingham* and *yoni*, (the *phallos* and *umbelichos* of the Greek pantheists,) the instruments of generation: that is to say, there arose a sexual differentiation in Nature. The Hindus thus looked upon the vital phenomena in creation as a begetting, even from its divine origination. As may be imagined, so sensuous a symbolism could not fail (being but understood in its exoteric bearing by the people at large,) to lead to licentiousness; but, in its esoteric and philosophic bearing, this view simply symbolised the marriage of all natural things; a state that Manichæism alone has ever reprobated: Since—

"Nothing in this world is single;
All things, by a law divine, in each other's being mingle."

Whenever, then, we find traces of this ancient snake and tree-worship, we may be certain the old Hindu philosophy underlies it, whether in Britain, or Central America even.

Now, that there should be no direct reference to the serpent portion of the cult among the Maoris is easily accounted for, as there were no snakes in New Zealand to help to keep up the recollection of the old symbol. Yet, if the antiquity of the rock-paintings found in the South Island be established, the serpent is certainly figured there, in a rude way, among other exotic representations: and perhaps, after all, Mr. McKenzie Cameron's conjecture, that the Nga Puhi tribes of New Zealand represent the *Naga Puhi*, or Snake Tribe (or, I should suggest, the snake-worshipping tribes,) of India, may be true. The objection raised by Mr. Stack, (and probably Maori scholars will all think with him,) that the Maori etymology, and, moreover, the fact that in Maori the adjective or qualifying term never precedes the substantive, both forbid the possibility of such a construction; yet it may be possible that the *Nga*, or *Ngati*, which enters into combination with almost every tribal name in New Zealand, represents a titular particle of unknown etymology —a patronymic, perhaps, rather than the plural definite article, in such cases; but, of course, this is a point for linguists to settle. I simply hazard the suggestion, without any knowledge on this head, and I cannot pretend to anything of the kind. I will add, however, that in Mr. Taylor's book (chapter v.) a number of "'*reptile* gods' are mentioned as ranged under Maru." From their names, I should judge them to be Turanian deities connected with snake-worship; but of this, more anon. There is just one other passage which seems to bear on the snake connection: it is in the cosmogonic hymn already quoted. Mr. Taylor says "in the sixth period, after the creation of the gods in the previous period, the earliest men were formed. That these were of reptilian character seems to be implied in the following descriptive names:—Ngae, Ngaenui, Ngaeroa, Ngaepea, Ngaetuturi, Ngaepepeke.

Supposing *Ngae* to represent the Hindu *Naga*, "the snake," these names become: Snake, Big Snake, Long Snake, Snake-like, the Couching (recumbent, or bent) Snake, the Leaping (or erect) Snake. Ngae is one of the names of Kae, in the legend of Tinirau and his whale; and I am satisfied that in *his* case the significance of the name connects him with the Turanian Snake Tribe, or snake-worshippers. I think on the whole, the evidence, from other legends as well, strengthens the inference that the *Naga* worship was not unknown to the ancient New Zealanders. The *Ngaenui*, etc., etc., either describe the phallic-snake, or, if descriptive of a tribe of men, its worshippers. It will be seen later on that the same adjectives, *tuturi*, *pepeke*, are applied to another form of the phallic symbol.

The *Naga*, or phallic-snake, worshipped by the early Turanians in India as a symbol of the Deity, must not be confounded with the cloud-serpent of the Aryan solar mythology, the emblem of darkness—and so evil, and death. The phallic-snake represented the good principle of light, and life, and healing: it was the brazen serpent of Moses; the "*agatho daimon*" (Ἀγαθοδαίμων) of the Greeks; the Kneph, or Knuphis, of the Egyptians; and, as I have shown elsewhere, the object of the adoration of the *Nephelim* of Genesis, a word translated "giants" in the Authorised Version, but untranslated in the Revised Old Testament. In the forms Naga, Ngae, Kneph, and Nephelim, I believe we have similarly-originated words, alluding to the phallic-snake of the Phallo-pantheistic faith of the people of Turanian India, or *Bharata*, the *Wairota* of Maori tradition.

But if the *Naga* evidence be deemed rather circumstantial than direct, not the slightest doubt can attach to the evidence for the other symbol of the Phallic cult of India—viz., the truncated tree, monolith, or obelisk.

Mr. Taylor says there were two grand orders of gods: the first and most famous were the gods of the night, as night preceded the light, and then followed the gods of the light. Of these the chiefs were Hine-nui-te-po, (" great mother night,") the grand-parent of the rest. Of the latter, Rangi and Papa (or (Heaven and Earth,) were the parents. This conception of heaven and earth being the parents of life belongs both to Aryan and Turanian systems in India. In fact, it simply personifies the union of spirit and matter—the representatives of the male and female principles, the parent snakes from which springs the germ. The Greeks also married Auranos to Gaia in the same way. Mr. Arthur Lillie, in his work on "Buddha and Buddhism," quotes from the Veda the following passages:—

> "May the soft wind waft us a pleasant healing;
> May mother Earth and father Heaven convey it to us. * *
> We invoke the lord of living beings!"

And adds, "This lord of living beings is the sun;" or, as he in other places of his book terms him, "the solar god-man, the Divine germ, or anthropomorphic Deity, the logos, or demiurge." The Maoris represented him in the person of Tiki, a name perhaps contracted from *potiki* = a child. But, to return to the quotations from Mr. Taylor: "The sky with its solid pavement lying upon the earth rendered it fruitless; a few insignificant plants, shrubs, and creeping plants only had room to grow on its surface." (I would suggest, in parenthesis, that these plants were probably looked on as either hermaphrodite or sexless.) "The offspring of Rangi and Papa were: first the *kumara*, next the fern-root." (I shall show later that the kumara and fern-root represent the phallic emblems in the vegetable economy of Nature.) "The first living being produced was Tane, from whom proceeded trees and birds." What he was they do not seem clearly to know: a god, a man, or a tree. He is also called Tane Mahuta. Mr. Taylor gives a full account of the separation of the heaven from the earth, and its propping by Tane, too lengthy for quotation in full. I select the following passages, however:—

"Alas for Rangi! Alas for Papa! Alas for the power of Tane Mahuta! For him was reserved the propping up. Down went his head below; up went his heels above. Up entirely went Rangi; down entirely went Papa. . . . Tane Mahuta is represented as a tree with its head downward and roots upward, and thus trees were supposed formerly to grow. . . . Tane had six names, each being emblematical of his power:—

"Tane Tuturi=Tane the bending. [If my theory is correct, it would mean recumbent or bent.]
Tane Pepeke=Tane the bowing.
Tane Uetika=Tane straight as a tree.
Tane Ueka=Tane strong as a tree.
Tane-te-Waiora=Tane the person who opened the fountain of living water.
Tane-nui-a-Rangi=The great Tane of heaven."

In addition to these he is called Tane Mahuta. The last great work which is attributed to him is the opening of the fountain of living water to perpetuate the existence of the sun and moon. The latter, when it wanes, is thought to go to it, and bathing therein to receive a renewed existence. Hence the saying: "Man dies and is no more seen; but the moon dies, and plunging into the living water, springs forth again into life." Mr. Taylor adds in a note: "The same tradition of the heaven being joined to the earth is found in Tahiti, and that they were only separated by the *tera* (*Draconitum polyphyllum*, an insignificant plant,) till their god *Ruu* (the Maori *Ru*) lifted it up—Na Ruu-i-to-te-rai = Ru did elevate (or raise) the heavens."

Now, we must put aside the exoteric features; they are mere adjuncts to disguise the true significance: such as the Maori belief that Tane *really* lifted the heavens from off the earth, or that he was the father of trees and birds; these are mere exoteric features that make the legend. The esoteric features disclosed by a comparative study of the fossil names embedded with Indian mythology, point to an elaborate philosophy as underlying the story. Tane means the *male*, in Maori, and here stands for the distinguishing organ of the sex, or the *phallos*, (and thus the truncated tree, *ashera*, or monolith, as expressed in symbol,) that makes *generation* and *regeneration* possible, by its fecundation of the fountains of being or life. The attributive terms, *tuturi*, *pepeke*, etc., applied to Tane, form, really, an extremely sensuous but realistic picture of the different functional states of the *phallos*.

I need hardly urge that this naked exposition of a certain phase in the anatomy of the human mind is not advanced in any spirit of irreverence or wantonness. But, in order to arrive at truth, and to form a correct estimate of the different progressive stages in the physiology of belief, philosophy cannot afford to hesitate, or look coy, in its examination, however shocking to ordinary view the subject be. That the generative organs should ever have been deemed objects worthy of adoration, and symbols of Deity, seems so marvellous a thing to Europeans that a study of the peculiar phase of mind which led to such a cult has always been approached with a prejudice that has, in very many cases, amounted to a loathing. While, on the one hand, the matter has been viewed as a symptom of the terrible depravity and degeneracy of the originally pure human mind; on the other hand, by others, it has been viewed as marking an infant and sensuous stage of human speech, and human thought. That there is anything occult or esoteric underlying such beliefs as tree-propped heavens, or creation of life on the falling of stones that turn into men, or of serpents talking to women, and suggesting the tasting of the fruit of the tree of knowledge of good and evil, seems completely ignored. That there may have been a stage in the development of the human intellect when people viewed their surroundings as endued with a life and intelligence similar somewhat to their own, may be true, or may not be true; but certainly this explanation is not true, as applied to the tales that have had their origin among the philosophical Hindus, as most of the tales of the East have had. There is nothing infantile about the story of Tane Mahuta, of the Hindu-taught Maori; in the story of Deucalion raising up men by casting stones behind him, of the Hindu-taught Greek; (for the name of the Phœnician Cadmus, and the Cretan Minos, prove their teachers to have been Hindus; Cadmus is one of the Gautamas of India, and Minos is a Manu). Nor is there anything infantile, or even mythical, in the story in Genesis of the temptation and the fall of Adam (whose name is also, as I have proved elsewhere, only a mutilated form of the Benne Guadam, or Benne Kedem, or sons of the East, who migrated from India to Western Asia).

In the first case, as has been shown, it is the Phallic tree, or prop; in the second it is still the *phallos*, or meteoric stone, in a figure, by its fall impregnating the womb of earth; symbolising the union of spirit and matter. In the third case, we have a concentrated and exoteric account of the Phallo-pantheistic philosophy, viewed from a Buddhistic standpoint, wherein birth into a material existence, (or "falling into generation," as it was termed,) is viewed as a calamity, hence a fall. The occult symbols of the first philosophical faith of India are employed in the story—viz., the Phallic-serpent, and the Phallic tree of knowledge of good and evil—the truncated tree, or *phallos*. The Hebrew philosophy very justly starts with this damnatory view of human life that was promulgated in the early philosophies of India: and proceeds to show what more hopeful views were engrafted on the tree of knowledge and mortality, so as to render it eventually a tree of life and immortality; this being rendered possible by the incarnation of Deity, from time to time, to impart those spiritual lessons that serve to develope man's soul, so as to in time wean it from its material clog or body, and invest it in its spiritual body, or garment of light, which alone can inhabit eternity. All religious teachers of note, such as Adam, Enoch, Noah, and Moses, were deemed to have been partial incarnations of the Divine Spirit, having partaken in no small measure, though not perfectly, of the Divine nature. Thus Adam is, by Matthew the Evangelist, called "the Son of God." Adam was the first of the Gautamas, the first *spiritual father* of mankind—not the first physical—and published the gospel of condemnation, or Proto-Buddhism, in the land of Nod, or India, that Phallo-pantheistic creed that Sakhya Muni, at a much later period, elaborated and reformed. All Eastern writings are more or less of this esoteric nature. Josephus says as much. "Moses," he says, "wrote some things in a decent allegory." The very directness in the sensuous bearing of the Maori story, proves that the true exposition is to be found by treating it esoterically. That it is impossible to be mistaken in the exposition here advanced, a short study of the fossil names in the tradition will render evident.

Siva, the great Hindu god of Turanian type, is the deity whose peculiar functions are those of *generation* and *regeneration.* He is also called *Rudra.* It will readily be seen that *this* name of his is the original of the Maori *Ru*, and the Tahitian *Ruu.* In his *generative* faculty, he is represented under the symbol of the *lingham*, or phallos; he is then named *Maha-deo*, or *Maha-deva*, equivalent to "Magnus-deus:" we have the one form preserved in the *Mahuta* of the Maori story, and the latter part of the second form—viz., *deva*, in the *tera* of the Tahitians. The Greeks called the phallic-tower of the Phœnicians *mudros;* and the Celts of Ireland, who were doubtless connected with Phœnician colonists, called their round towers *mudhr.** It seems to me impossible to resist such evidence as this, which tallies in every feature, the Maori with its original Hindu. I would repeat that from the fact that such words as *tuturi* and *pepeke* are applied to Tane, one form of Phallic symbolism, as also to Ngae, (the hypothetical snake symbol,) the inference is *strengthened* that this phallic view of Ngae is probably correct, and Tane Tuturi = Ngae Tuturi, and Tane Pepeke = Ngae Pepeke; that is, they represent two forms of the same symbol of "tree and serpent-worship." It has been suggested to me that the Maori word *ngarara*, which the Natives apply to any reptilian or worm-like creature, may have been similarly understood,

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* *See* Jennings' "Rosicrucians."

originally, as applicable to animals that recalled the *Naga* of India.*

I come now to a group of unmistakably Turanian and Hindu deities; but, before I mention them, or their originals, certain points of complication in both the Maori and Hindu traditions must be explained.

There has been some misplacement of sex in the Maori story, arising probably from the somewhat undefined nature as to sex of the Hindu deities. The female deities are really conceived as rather the energies of their consorts, (the *vacti*, as it was called, of the male deities,) than as having any individuality of their own.

Then, again, there has been a misplacement among the characters themselves; but in this the Maori story seems studiously to have been modelled on the Hindu that preceded it, which in the shape that it has reached us has been considerably modified. The time when the later Hindu accounts were framed was evidently a period of transition. The contests of Aryans and Turanians had resulted in the subjugation of the inferior race. In the interests of peace and conciliation it became the policy of the Aryan priesthood to try and smooth away religious differences as far as possible, by remodelling the Turanian deities somewhat, so as the more easily to adapt them to a companionship with Aryan deities in the Hindu pantheon. Accordingly, Rudra, the Phallic deity, was identified with Siva, the third member of the Brahminic Trinity: his consort Durga, or Kali, also called Uma, took the place of Aditi (space), or Dewaki, the original or celestial mother goddess, Uma being the terrestrial mother-goddess, that is, mother earth: and Krishna, the solar god-man or offspring, was identified with Vishnu, the second member of the Aryan Trinity, as one of his incarnations. The original mythology was distorted to suit an Aryan order of things. Rudra, Uma or Kali, with Krishna, really represent the original Turanian Trinity (personifying, as they do, the male and female principles, with their offspring,) of the old Phallo-pantheistic faith.

That Kali and Krishna are Turanian deities, is plain by the signification of their names, both names meaning "black." "Whenever there is a relaxation of duty, O son of Bharata," says Krishna, in the Bhagavat Gitâ, "I then reproduce myself, for the protection of the good and the destruction of the evil." The state of anarchy that accompanied the Aryan invasions might well provoke such an incarnation; and Hindu ingenuity has been taxed to the extreme, to invent several intricate distortions and substitutions, to prove that Krishna,

* *Ngarara* may, however, be *Nga* = the, and *rara* = ribs; as applied to animals who appear to progress by means of, or on, their ribs, in which case, of course, *Nga* is the plural form of the definite article.

though a dusky deity, is yet of an Aryan connection. He is no longer a son of Kali, the terrestrial mother goddess of Turanian connection, but he is born of Dewaki, earlier known as Aditi (space), the celestial mother goddess of the Aryans; and hence he figures as an Aryan god with a dusky face but Aryan sympathies; an incarnation, with his white twin-brother Balarama, of a black and a white hair from the head of Vishnu. Kali or Uma plays her part, but in quite a modified and subordinate character, becoming incarnate at the same time with Krishna in order to be substituted for him, and so suffer a temporal death in his stead, at the hands of the reigning king, his grandfather, who dreaded his advent: being dashed to death in mistake for the infant Krishna, she regained her position as a deity. This substitution of Kali for Krishna shows the close relation that originally existed between her and Krishna; for, being in the original cult mother and son, this very intimate relation had not altogether to be ignored, and was compassed in this roundabout way.

But not only is the descent of Krishna thus distorted: his future career is modified in the same interest. He is, as already said, Aryan in sympathy, and is represented fighting on the side of the Pandavas, or white race, as against the Kurus, or black race, in the poem of the Mahabarat, an epic commemorating the struggle of two rival families of the great house of Bharat (that, is really, of Aryans and Turanians) for the possession of Peninsular India, or the land of Bharat.

This group of Turanian gods find their counterparts in Maori mythology, with some modifications as indicated. Kali, or *Uma*, appears as *Hema*, or *Houmea*: *Krishna* as *Karihi;* and *Dewaki*, the mother of Krishna, is transformed to *Tawaki*, a son of *Hema* (corresponding to *Uma*, or Kali). According to one story of *Hema*, or *Houmea*, her husband's name is *Uta*, which seems a contraction of *Mahuta*, a phallic name, as I have shown, and equivalent to the Hindu *Maha-deo*, a name of Siva, or *Rudra*, the husband of *Uma*, or Kali. Now, these *fossil-names* occurring in the same Maori story, or groups of stories, the persons they represent being all of one family, and answering to a like series of related names of the Turanian deities of India, all point to India as the source whence they were derived. The bearings of the legends, or the stories related of these heroes and heroines, are completely to be interpreted by the stories related of their Hindu counterparts. The attributes of *Hema*, or *Houmea*, are those of *Uma*, or Kali: *Hema*, like *Uma* in some legends, has personal beauty; in others she is a glutton and thief: just as *Uma*, being the goddess of death and the grave, is propitiated with bloody rites, and is pictured as bloodthirsty in the extreme; for, being "mother earth," she is at once the womb that bears and the grave that again consumes the fruit of the womb; and she is, moreover, the patron-goddess of gambling, and of the murdering robber, the *Thug*. Kali, in her more beautiful bearing, represents Aphrodite, or Nature in its poetic garb. *Tawaki* is the Aryanised Krishna; his story is that of Krishna: he is the loved of women, and dies the death of the solar god-man on the confines of the West, slain at the hands of the powers of darkness, the children of the cloud-serpent of Aryan myth. After a time of sleep, he rises to a new life and immortality, and ascends to heaven, pouring down vengeance on the powers that had formerly injured him.

The prejudice that had impelled the Hindu Aryas to remodel the story of Krishna to favour Aryan proclivities, and to make Krishna (really the offspring of the Turanian Kali) a son of the Aryan goddess Dewaki, seems to have wrought still more powerfully with the Maori *arikis*, for they belittle Krishna entirely, and transfer his exploits to an unmistakably Aryan hero, with a name modelled on that of the Aryan Dewaki—viz., *Tawaki*, who opens the way to heaven, whereas Krishna (that is, *Karihi* of the Maori,) not only fails to gain apotheosis, but is condemned to condign punishment for his envy of *Tawaki*. These deductions will be fully borne out by the following extracts from Mr. Taylor's work; the whole account is too lengthy:—

"Originally men were not aware that Tawaki was a god, until one day he ascended a lofty hill, and some one who was cutting brushwood saw him throw aside his vile garments and clothe himself with the lightning. They then knew he was a god. When Waitiri, or Watitiri, (his grandmother,) descended from heaven, the fame of Kaitangata and his bravery reached her. She slew her favourite slave Anonokia, and took out his lungs as an offering for Kaitangata, which, when she came, she presented to him. Kaitangata feared her. . . . They became man and wife; their firstborn was Punga, afterwards Karihi; and the youngest Hema. Their children were not particularly clean. Kaitangata turned up his nose and said, 'Hu! the filthy children!' Waitiri was offended. . . . Afterwards she returned to heaven; her parting words were: 'When Punga has children, do not let them follow me.' She called to Karihi, 'When you have grown up, do not suffer your children to go and seek me. When my Waka Makanga (my shame) has a child, he may come to me.' . . . When Kaitangata returned from the sea, he asked his children, 'Where is your mother?' They said, 'She has gone to heaven, to her dwelling-place.' Kaitangata inquired, 'What did she say to you?' 'She said that Punga, the anchor of your canoe, was to be my name; that for this here (pointing to his brother) the name was to be Karihi, the sinker of your net; that for our sister, the Waka Makanga ("the shame") of our mother, for your turning up your nose at our filth.' They went and showed the *papae* to their father.

(The *paepae* is the jetty or board from which she ascended.) The offspring of Punga and Karihi were the lizard-shark and dog-fish. The child of Hema was Tawaki. The elder brethren took Muri-waka-roto and Kohuhango as their wives. These women were not satisfied with their husbands; they preferred Tawaki. The elder relatives hated him. They said, 'Let us go to Wai-ranga-tuhi,' where he had gone to wash. Tawaki prayed—

> "Let the morning spring forth; give me my comb, my beautiful comb,
> That I may arise and go to the water of Rangatuhi, Rangatuhi."

"They found their brother there and slew him; after he was dead they returned home. Muri-waka-roto demanded, 'Where is your younger brother?' *Mango* (the shark) said, 'At the water, combing his hair.' She waited a long time and then went and called Tawaki—e—. The *pukeko* (a bird) answered '*ke*.' She went again and called to Tawaki. The *moho* (another bird) answered '*hu*.' She returned home and said, 'You have killed your brother.' They confessed they had done so. They inquired if he did not answer her call; she replied the *pukeko* and the *moho* were the only things that heard her. 'No, Tawaki is gone to *karakia*, and to mix his blood with water-blood, with star-blood, with the blood of what? With the blood of the moon, with the blood of the sun, and the blood of Rangi-Mahuki (fair-sky): this is the flowing of Tawaki's blood, truly the causing his blood to grow that he might be restored to life.' (The union of these kinds of blood formed life, and thus resuscitated Tawaki.) Tawaki is alive again. He slept soundly on the sea-shore after his resurrection from below, from the Reinga, he sleeps soundly by the sea-side; a great wave appeared, rolling in from afar; that wave came to kill Tawaki, but his ancestor, the *kaiaia* (the sparrow-hawk) appeared, and cried '*ke-ke-ke-ke*.' Tawaki arose; he started up from his sleep, he seized a stick, (and casting it,) defied the wave; it glanced on one side of the billow which was drifting towards him from afar. Enough! Tawhaki left the shore and went inland. His uncle, Karihi, overtook him; they wept together.

"Afterwards they arrived at the outside (or verge) of heaven, and at the fence which divided it from the earth." Then follows Karihi's attempt, and Tawaki's successful feat, of climbing up into heaven. Tawaki's inimical spell sent Karihi sliding to earth again; whilst the spell on his own account [quoted in the first part of this paper] took him fairly to heaven." Mr. Taylor adds, in a note: "It is said Tawaki ascended to heaven by a spider's thread." "Tawaki succeeded, he reached the sky; he cut off the road by which he ascended. His uncle called to him to turn back, and help him to get up. But he answered from above, 'No! you all aided in my murder.' Tawaki then visited his grandmother, and restored by his spells her eyesight. Then

Tawaki went and saw the *toka tamiware* which stood there. He asked the old woman, 'What is this?' Waitiri replied, 'Do not touch them with your hands; they are your ancestors.' Then Tawaki stumbled against it; the stone fell down by the sea. Tawaki went crying, 'You also shall cry, who slew me.' From that stone that fell commenced the revenge which Tawaki took against his brethren. He drove the shark and the dog-fish from the land, and compelled them henceforth to live in the sea."

From her name, Tawaki's grandmother Waitiri, or Whatitiri, which means "the thunder," is probably to be connected with the cloud; and so is probably to be regarded as of the black, or Turanian order; Kaitangata and Anonokia are probably to be classed with the Aryan order, for reasons I hope to fully set forth in a paper on the Aryan element in Maori legend. This is why, probably, Kaitangata treats his dusky children with indignity: "Hu! the filthy children!" In the Maori story, a new name is introduced, *Punga*. It will be remembered that, in the Hindu version, Krishna has a twin-brother, his white counterpart. In the Maori story, *Punga* seems a counterpart of *Karihi*. I am inclined to think that Mr. Taylor has made some mistake in his explanation of the name *Punga*. *Punga*, in the north, is an eel-pot, and *karihi* would be its sinker; and they are thus, as it were, really one. The *exoteric* rendering given would then be, "You, Punga, are your father's 'eel-pot,' and you, Karihi; you are its 'sinker;' and your sister, Whakama-Ranga, is 'my shame.'" I cannot help thinking we have here an exoteric allusion to the phallic idea, worked in with the legend. The eel, (which I have reason to believe took the place of the phallic serpent in Maori mythology, as I hope to prove in my next paper,) the pot, and its sinkers, would represent the *penis*, *scrotum*, and *testes* of the phallic male emblem; while the female emblem would be represented by Whakama-Ranga, in covert reference to the significance of Uma, the original of Hema, which, I believe, is etymologically connected with the Sanskrit *rambha*, meaning the womb. I have to hazard this last statement, as I have no means at present of verifying it: I have had to trust to memory in this matter, and may be I am not quite correct in this derivation; but my impression is that it is correct. Thus, we find, not only the names of the Turanian deities preserved, but the principal features of the Phallic faith enmeshed cleverly with the regular lines of the story.

That Punga and Karihi are said to beget lizards, and sharks, and dog-fish, rather confirms the view of their Turanian and reptilian nature (or, rather, the reptilian characteristics of the cult in which they figured). And that they are roughly dealt with at the hands of the *arikis*, or Aryo-Maori priests, is as might have been expected; for by this time the malific idea of the Aryan cloud-serpent, or dragon, had been engrafted on that of the Phallic life-serpent, thus obscuring its true significance: hence, Tawaki, who had been recognized as a god from his girding himself with the lightning, is represented as carrying on a vengeful war against these dark, cloudy, or watery powers who had once overcome him, and hurling the "*toka tamiware*," (his ancestors, as his grandmother, Whatitiri, the thunder, had termed it,) which probably meant a thunderbolt, against them, and forcing them from the original serpentine life on land to the dragon-like life in the sea.

I now come to Tiki and Pani. Tiki is, according to the northern Maoris, the husband of Pani. Huruki is also said to be her husband; but this name may be more fully Huru-tiki, alluding to the top-knot, which, as Mr. Taylor tells us, adorned a chief's head, and was called "*he tiki;*" and therefore Huruki and Tiki may be the same being. Mr. Colenso also gives the name Maui-whare-kino,* as that of her husband; and adds, "this is not the hero who bound the sun and moon." Yet, from the name, he evidently belongs to the class of solar gods, and this seems to be the case with Tiki, (as will be shown presently,) so probably they are one. "Of Tiki," Mr. Taylor says, "little is preserved: his great work was that of making man, which he is said to have done after his own image. One account states that he took red clay and kneaded it with his own blood, and so formed the eyes and limbs, and then gave the image breath. Another, that man was formed of clay, and the red-ochreous water of swamps; and that Tiki bestowed both his own form and name upon him, calling him *Tiki-ahua*, or Tiki's likeness. The most prized ornament is an uncouth image of man, formed of green-stone, and worn round the neck as an "Heitiki" image, or remembrance of Tiki. The new-born infant is called '*he potiki*,' or a gift of Tiki from the Po or Hades; and he adds in a note, 'The word *Tiki*, in Nukuhiva, or *Tii*, in Hawaiian, means an image, according to Rev. Mr. Buddle.' "

From this it is plain that Tiki answers to what Mr. Lillie (as already quoted) terms "the solar god-man, or anthropomorphic Deity, answering to the Logos, or Demiurge, of the Platonists and Gnostics, forming one of several series of Phallo-pantheistic triads or trinities." Tiki, therefore, corresponds to Krishna and others. We select the following triads from Mr. Lillie's work on Buddhism for comparison. He says, "I have tried to draw a table of this triad idea in the old creeds:—

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* Mau-whare-kino = "Maui of the dirty house," and may allude to a Turanian form of an Aryan-like sun-god, which (as the husband of Pani, the goddess of the earth and agriculture,) would be likely enough.

	"Father.	Mother.	Solar Man-God.
"Rig Veda ...	Varuna ...	Aditi ...	Mitra.
Manu ...	Brahm ...	Maya ...	Brahma.
Buddhism ...	Buddha ...	Prajna ... / Dharma	Sangha.
Plato ...	Father ...	Mother, or / Nurse ...	λόγος.
Gnostics	Abraxas ...	Sophia ...	Gnosis or Christos.
Babylonia ...	Bel ...	Melissa ...	Tammuz.
China ...	Yn ...	Yâng ...	Taiki.[1]"

To these I will add the following:—*

Bharata ...	Mahadeo[2] ...	Dewaki[3] or / Uma[4] ...	Krishna.[5]
Maori ...	Uta, or ... / Mahuta[2] ...	Hema[4] ...	Tawaki,[3] or Karihi.[5]
Maori ...	Rangi ...	Papa ...	Tiki.[1] (? Contracted form of *potiki*, the child or germ.)

It will be seen that the Chinese, who, it must be born in mind, got their religion from the Hindus, have preserved a name of a solar-god-man almost identical with Tiki—namely, Taiki. I might add that the Buddha Sakhya Muni, who is also a solar god-man, according to the Chinese, was the son of the Queen of Heaven, the "Lily Lady" (after the lotus) of Marichi = ray of light. This name Marichi (ray of light) seems to correspond to the *Marikoriko* (or twilight) of the Maoris, who is said to be the wife of Tiki. The daughter of Tiki and Marikoriko was called *Kauatata*, a name that approaches the Esther, or Hadassah, and El-issa, that is Venus, of Western Asia. The particle *ka*, being a root common to many Turanian tongues, meaning burnt or black, *Ka-uatata* might then possibly be "black Esther." The Egyptian root was *aka* or *āga*, to burn (consume by heat); Maori *ahi* = fire, and *kapura* = fire. The *k* sound in *K-ush* means black, and *ish* is man; Cushite means, therefore, black man. So in Hindu, *ka-ua* = the crow, that is the black bird—the original, I believe, of the *kaaia* (sparrow-hawk) that roused up Tawaki, and is called his ancestor, thus betraying his Turanian or dusky origin. So we have in Hindu Kali, and Krishna, both meaning black. But this is by no means the only correspondence between Maori tradition and Western Asiatic antiquities; for the latter have been intimately connected with those of India; but these analogies I have reserved for my next paper, as they connect more with the Aryan portion of the subject.

But if Marikoriko is Tiki's wife, so is (according to the Rarawa Maoris) Pani; perhaps, as Kali is the terrestrial repre-

* By referring to the reference figures in the above table the connection may be more readily traced.

sentative of the celestial Aditi (space), Pani is a terrestrial Marikoriko.* "'The god Pan,' says Mr. Kendall to Dr. Waugh, 'is universally acknowledged. The overflowing of the Nile, and the fertility of the country in consequence, are evidently alluded to in their traditions. . . . Query.—Are not the Malay and the whole of the South Sea Islanders Egyptians?' "To which," says Mr. Colenso, "we reply, When will the spirit of conjecture rest?" Whether Mr. Kendall alluded to *Pani* (in the capacity of *a female Pan*) when he said the god Pan was universally acknowledged in New Zealand, I cannot undertake to say: but Mr. Colenso has told us sufficient about Pani, in his interesting and valuable papers, that I think a lawyer might make out a very fair case for defendant, and prove from Mr. Colenso's own communications that there are several features in the tradition of Pani that connect her with *Isis;* and this is not to be wondered at, for she is the earth goddess, the *Ceres*, *Isis*, *Mahadeo* or Kali of the New Zealanders; that is, the mother from whose womb the fruits of the earth are derived—a goddess peculiarly the object of devotion to the Turanians, who were emphatically *the* agriculturists of the ancient world. The Polynesians resemble the Egyptians, just as far as the Egyptians can be shown to be one with the Turanian nations of India. Just as the soil of Egypt, which Isis personified, was fructified by the Nile, so we find from Mr. Colenso's account of Pani, that she, when producing the *kumara*, enters a river, and gathers the roots with her hands from her person, and fills her baskets for the ovens. This seems to me to allude to a time when the New Zealanders dwelt in a tropical country, when the cultivations were planted after the floods had watered the ground, or were irrigated. In India *pani* is water, but whether the Maori goddess derived her name from this, I shall not even conjecture, though the sea as well as the earth was deemed a womb of Nature. *Pani* may be equal to the Hindu *yoni*, the female generative organ.

"The *kumara*," says Mr. Stack, "and *aruhe* were the offspring of Huruki and Pani; *aruhe* (fern-root) was the *ariki* (lord), because it descended from the back of its parent; while the *kumara*, having come from the front, was inferior in rank.

"Descend from the back, the great root of Rongi,
Descend from behind, the fern-root;
Descend from the front, the kumara
By *Huruki* and *Pani:*
Then it was nourished in the mound,
The mound of *Whatapu*,
Great mound of *Papa*,
Great mound of *Tauranga;*
There was seen the contemptuous behaviour of Tu;
There they were hungered after," etc., etc.

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* Quoted by Mr. Colenso, "Trans. N.Z. Inst.," vol. xi., p. 77.

"The *kumara*," says Colenso,* "is *Rongomaraeroa* (fame-resounding-(in)-long-open courts); the *aruhe* is *Arikinoanoa;* they are both children of the Sky and Earth," (Rangi and Papa,) which comes to much the same thing as their being descended from Huruki (Tiki) and Pani. Mr. Colenso gives a translation of the story of the fighting of Tumatauenga with his elder brother Rongomaraeroa (the *kumara*), in which contest Tumatauenga kills and eats Rongomaraeroa. *Tumatauenga* is evidently the *Tu*, "whose contemptuous behaviour, and hungering after the *kumara*," are mentioned in the *waiata* just quoted from Mr. Stack. Mr. Colenso, in his notes on his paper, explains *Tumatauenga* ("Lord-with-the-fierce-(or-strongly-emotioned) countenance") as man, who arms himself with weapons, which Mr. Colenso interprets as the *koo*, the Maori spade, having "two mouths, four eyes, four ears, and four nostrils to its two noses." The name given to the battle was Moenga-toto ("sleeping in blood," or "bloody sleep"). He adds: "Tumatauenga's destroying the *kumara* may indicate—(1.) That man at first did not know how to cultivate and to preserve that valuable root. (2.) That fierce fighting man was an enemy to the quiet cultivator, and cared nothing for the arts of peace." A remnant of the *kumara* tribe took refuge in Pani; "her stomach (*puku*) was wholly the storehouse for the *kumara*, and the *kumara* plantation was also the stomach of Pani."

In Mr. Taylor's work, Tumatauenga seems to be another name for Tutenganahau, the third son of Rangi and Papa, and the grand author of evil. He is also (I presume for shortness,) designated *Tu*, the great god of war, in the North, answering to *Maru* in the South." Now, *Maru* seems to answer to *Māra*, or Death, the Sagittarius of the Hindu Zodiac. (Of *Tu* and his family I shall have more to say later, in my next paper). It will be seen from this that another construction than that given by Mr. Colenso is possible. Tumatauenga, ("lord of the fierce countenance,") who destroys the *kumara* field, reducing it to "a bloody sleep," may mean the pestilence of drought in a tropical country, drying up and reddening the *kumara* crops; and it is just as likely that the *koo* was modelled with a "Janus-like appearance," (as Mr. Colenso describes, and conjectures it was made so for some esoteric reason,) to meet a Hindu, rather than a Latin, idea, and originally represented the symbolic weapon of the destroyer; just as Yama, the ruler of the Hindu Hades, is represented as attended by his *four-eyed* hounds. The *koo* may have taken this shape to commemorate this very contest with the "lord of the fierce countenance;" or it may have been introduced into the story as merely an exoteric feature, when the true significance of the story was forgotten, or on purpose to

* "Trans. N.Z. Inst." vol. xiv., p. 35.

disguise it. The word *koo*, the Maori spade, is probably derived from the Hindu *khōdh*, (the rhyme with "loathe" gives the pronunciation,) which means *to dig*.

If Tumatauenga is man, he must have lost a good deal of the "fierceness of his countenance" before he had any *kumaras* to fight: and it is strange that the milder he has grown the bloodier has been the field of struggle, and the wider the devastation; for the more civilized man has become, the more fiercely and ravenously has his poor brother the *kumara* been attacked and devoured. It seems to me Mr. Colenso's interpretation halts; but Mr. Taylor's account of Tumatauenga, as the great author of evil, sets it running.

In Mr. Colenso's valuable notes on the "Invocation to Pani, on the planting of the *Kumara*," one or two other points are noticed that recall Hindu Turanian influence. Mr. Colenso says of the invocation itself: "It is just possible that the kernel of this charm, or invocation of Pani, may be amongst the very oldest known!" and again, "Of the various spells, etc., anciently used in planting the *kumara* that I have acquired from several *tohungas* during many years, there are no less than three which contain this direct invocation to Pani; and while the introductory words of those three forms vary a little, the kernel—the invocation itself—is almost literally the same in them all." He adds, in a later note on the invocation itself: "Note its great simplicity, its gradations, and its recurring refrain, repeated regularly six times." It will be plain that Mr. Colenso has not exaggerated either its importance or its interest. Its extreme importance will, I trust, be the more thoroughly appreciated, since a comparative study of it with Hindu antiquities has proved the claim to antiquity put forward for it by Mr. Colenso; and certainly its interest will not be lessened when "its poetical structure, and its regular fitting and progressive disposition, and its recurring refrain," point its kinship with the hymns of the Veda.

The muttering of the charms in the plantations to procure fertility, by the *tohungas*, reminds Mr. Colenso of similar practices among the Egyptians and Romans at the vernal festivals. But this was a Hindu feature as well as an Egyptian; and from the East it passed in much later times to the West. Mr. Colenso mentions another "strange plan" adopted by the Maoris of the interior to insure the fertility of the soil. The skulls and bones of Tia and his party, who had died at Titiraupenga, near Taupo, were "annually brought out and placed with much ceremony in the *kumara* plantations, by the margins of the plots, that the plants might become fertile and bear many tubers." This might be a traditional echo of the Meriah sacrifice, as is still practised by the Khonds, an aboriginal tribe of Turanian India. "The objects of their worship," says Canon Trevor, in a little book on

India and its missions, "include the moon, the deity of war, and the Hindu goddess Kali. The favourite divinity, however, is the Earth, in the cultivation of which this branch of the Dravidian family has attained to considerable proficiency. In order to induce their god to yield them an abundant harvest, a rite called *Meriah* is annually performed, which is no other than a human sacrifice. For this purpose children of both sexes are purchased or kidnapped from neighbouring tribes, a foreigner being deemed essential. The intended victims are carefully reared and guarded in villages appointed to this use. At the appointed season a feast is held, with drunken and licentious revellings, for two days, during which the victim is indulged with every sensual gratification. On the third he is brought out, and bound to a stake or tree ; and at an appointed signal the savage Khonds rush in with their knives, pick away slices from the yet living body, and hasten to bury them, warm and palpitating, in their fields."

Mr. Colenso designates the tradition of Tia "a portion of an *ancient* relation he had from the Maoris of the interior." The story runs significantly, somewhat: "Tia and his party did not return from Taupo (inland), whither they had gone, to Maketu (on the coast); they all died inland at Titiraupenga, where their bones," etc.

Perhaps they (if historical) fell victims to a Maori form of *Meriah;* or, maybe, Tia is only a form of Tiki, the husband of Pani, the goddess of the *kumara* plantations (or, rather, the personification of the plantations themselves) ; he would thus represent the solar-god, or male principle, fructifying the female principle: for it can be shown that Tiki is also Siva or Rudra, and Pani is only another name for Uma or Kali, thus manifesting a Phallic connection.

But the most interesting fact mentioned by Mr. Colenso in this connection, is the following: "In conclusion," adds Mr. Colenso, "another curious superstition relating to Pani, sometimes observed on the harvesting of the crop of *kumaras*, may also be mentioned. At such seasons, a peculiarly-shaped, abnormal, and rather large *kumara* root was met with, though by no means frequently, (sometimes not one such in the whole cultivation,) this was called 'Pani's canoe'=Pani's medium, between her and the priest. . . . It became the peculiar property of the priest, and was set aside to be cooked at a sacred fire as a kind of offering of first-fruits. . . . such a *kumara* was chiefly, if not only, to be found when the crop was a very prolific one; this fertility was also taken as another proof of Pani's gracious visit."

Why, here we have nothing less than the ship of Isis, the female symbol of phallism—the *yoni*, that is, or boat that carried the first-fruits of the womb of Isis, or Nature, at the harvest festivals of Egypt. "In its purely symbolical aspect," says a writer in "Harper's Monthly Magazine," "the ship is very conspicuous. It is the emblem of wealth, and the hieroglyph of plenty. The earth itself is an ark, containing within itself everything necessary for replenishing the world. And so, in the old mysteries of dead religions, the ship always had an honoured place, being carried in the processions of the priests, either in its own form—an actual ship model—or in some occult symbol of the symbol—a bowl or cup, or shell, or water-flower. So, in the worship of Isis, a ship, sometimes of colossal size, freighted with the first-fruits of the year, was carried by patient kine in a triumphal progress—'the voyage of Isis'—from shrine to shrine, in the early days of March." The occult symbols—the ship, bowl or cup, or shell, or water-flower (the lotus lily, that is), all mean the *yoni* or womb of Nature.

I may add, it attests the tenacity and value of tradition, that it is for this reason rather than for any other that sailors call a ship "she."* The *kumara*, then, or "canoe of Pani," undoubtedly alludes to the *yoni* of the Hindu Phallic cult. The word *yoni* itself is retained in Maori in *not exactly* the same sense, but in *an allied* one. The Tahitian for *kumara* is *umara;* and Mr. Colenso has shown that in South America the name is *umar:* perhaps this form, *umara*, was the original one, and connected this fruit of the earth with *Uma* or Kali, who, we shall presently see, represents Pani.

The *kumara*, then, represented the female symbol of the Phallic cult; the *aruhe*, or fern-root, which was said to descend from the back, as the *kumara* was said to descend from the front, represents the *phallus*, in the vegetable economy of nature, just as Tane does in the animal. The Mahomedans of India say they are descended from the *backbone* of their fathers.

In the "Spell of Paikea" the "skid of Houtaiki" is mentioned. Mr. Colenso explains in his notes that this alludes to the skids on which his canoe was drawn up on shore; "it also meant a barrier that might not be passed, known as '*te puru o Houtaiki.*'" "The name of Houtaiki often occurs in poetry in connection with that of Houmea," says Mr. Colenso, and he refers us to the story of Houmea, of which he gives a translation. There the name appears as Uta, and he is the husband of Houmea; that is, Ho-uta is the husband of Ho-umea, and they are the parents of Tu-tawhake, or Tawhaki. I have shown that Tawhake and his mother, Houmea or Hema, and his father, Uta or Mahuta—or, as it would seem, Houta as well—correspond. the first to Krishna, as represented by the name Dewaki; the second to Uma or Kali; and the third to Mahadeo or Siva—the Turanian Trinity—all members of the

* *See* "Rosicrucians."

same family, the counterparts in Maori tradition of the earlier Turanian Hindu triad. I have shown that *Kali*, or Uma, is the terrestrial mother-goddess, the Earth; and, as such, she must represent not only Houmea, or Hema, but Pani, the Maori earth-goddess. So the inference is clear that there is really no difference between Houmea and Pani. Now, the husband of Houmea is Houtaiki, and the husband of Pani is Tiki; and these names of the husbands approach so nearly to each other that they seem merely two forms of the one. So, then, the inference is *strengthened*, if it be premature to assume it *proved*. The form *Taiki*, of the Chinese triad, represents exactly the latter part of *Houtaiki* of the Maoris; but I have shown that, as the Maori *anthropomorphic deity*, or direct Creator of man, the Maori *Tiki* represents the *Taiki* of the Chinese—as he does also the other solar-god-men of the other triads of Eastern religions. So then, I think, all doubt must be removed from the inference that the Maori *Houtaiki*, the Chinese *Taiki*, and the Maori *Tiki* are names for the same solar deity—the husband of the terrestrial mother-goddess Houmea, or Pani. The skid of Houtaiki therefore refers, in an occult way, to the *phallos*; and, as barriers that might not be passed, they answer the same purpose as the phallic obelisks that marked the precincts of consecrated or other ground in the East.

There is a curious passage in a paper by Dr. Buller on a bird, the *Tieke* (*Creadion carunculatus*), or Saddle-back, which is well worth considering in its bearings on this connection of phallism. "The *tieke* is regarded," says Dr. Buller, "as a bird of omen by the Natives of the Bay of Plenty. It is also the mythical bird that is supposed to guard the ancient treasures of the Maoris. According to Maori tradition, among these hidden things is a stone *atua*. . . . The Natives state that this species usually places its nest in the hollow of a tree. . . . A pair is said to be still breeding in the hollow of the famous tree at Omaruteangi, known all over the country as 'Putatieke.'" It is added in a note: "Putatieke: a renowned *hinau* tree in the Urewera country. It is supposed to possess miraculous attributes. Sterile women visit it for the purpose of inducing conception. They clasp the tree in transport, and repeat certain incantations by way of invoking the *atua*."

The Egyptian and Greek women used to touch the *phallos* for a similar purpose; and I think there can be no doubt that a phallic meaning is hidden away in this traditional usage of the Maoris. The name *Tieke* is sufficiently near the name *Tiki* to suggest a connection; and the fact that, among the treasures guarded by the Tieke was a stone *atua*, probably a *heitiki* or image of Tiki, bears out the suggestion. As Tiki and Pani are shown to be identical in character or function to Uta and Hema, the Maori counterparts of Siva and Kali, the phallic deities of the Hindus, the drift of the practice of the Maori women becomes intelligible. *Putatieke* means the hole of the Tieke; and *tieke*, besides its signification as the name of a bird, is also applied by the Ngapuhi Maoris to the fruit of the *kiekie:* it is called *tieke:* as also, from its resemblance, by a more suggestive name, *ure*, which means the *phallos*. *Putatieke* may then, in an occult sense, refer to the phallic images, the *lingham* and *yoni*, of Hindu Turanian Phallo-pantheism. The "mythical bird" signification of the Tieke is equally Hindu; it is the "winged Garutmat" of the Veda and the winged disk of the Egyptians; the mystic bird that librates o'er the mundane egg, and fructifies it; the bird symbol of the union of spirit and matter, which therefore answers to the male and female serpent of Phallism.

Now, it appears to me that evidence could hardly be more significant and cumulative for the establishing of the truth of any proposition, than we have here in Maori tradition for the solution of the problem as to the "Whence of the Maori." The lords many and gods many of Turanian type, of both the Maori and Hindu Pantheon, resolve themselves into a triad, consisting of father, mother, and germ; they are found with similar names—names scarcely altered or disguised in the Maori from their originals in the Hindu. These gods and goddesses, or heroes and heroines, have similar functions, and have similar stories told of them. Then, again, seeing that Maori tradition carries the Maori race back to Wairota, which has been shown to be one with Bharata; seeing that philology confirms this tradition, it is hard to resist the conclusion of the identity of the races, or that their deities occupy identical niches in the one Pantheon.

The Maori features of this study carry some instructive lessons, which it were well for the student of Eastern thought not to overlook. One is, the *esoteric* and *symbolic* nature of Eastern legends. It is mere waste of time to credit a philosophical people like the Hindus, (and unsafe even of those with whom they have had at any time contact,) with notions that are popularly, though rather unwarrantably, ascribed to children—that inanimate things have, for them, a life similar to their own. Even children do not really believe anything of the kind; they simply amuse themselves with such a view for the time being, just as poets indulge themselves in imagery. This matter, with regard to children, can be tested by at any time taking up the *rôle* of the little poets. Do so, and they will very soon open their eyes in astonishment, and laugh at you for your credulity. A case in point, from several that I am personally cognisant of, will make this clear. A little fellow at Russell, about (or little more than) two years old, frightened by the noise of the steamer's fog-horn, clung to his mother. She, to reassure him, said, "Oh, it is only the steamer telling the people to come on board, quickly, quickly!" "Mamma, steamers can't talk," was his response; and I believe such cases might be multiplied indefinitely, as often as (with a little tact) we care to test the matter.

Professor Max Müller says something to the effect that with children the chair, or table, or pussy, shares with papa and mamma an equal share of life or intelligence, as the case may be: and on this view comparative mythologists have tabulated an infant age in man's beliefs, when talking wolves or snakes, and such like, were living realities, by which we may gauge the intelligence of the people who told tales about them. Nothing can be more unsafe than this, at all events when applied to tales or traditions that have had their origin in the East.

There is certainly no greater myth than crediting the Hindus with belief in the actual, rather than the symbolical, nature of their myths, as is the fashion among Europeans generally. Their mythology, and therefore that of all Western Asiatics, is symbolical. St. Paul well indicates this principle that underlies all Eastern writings, etc.: "The invisible things of Him (God) since the creation are clearly seen, being perceived through the things that are made, even his everlasting power and divinity;" that is, visible things were, in the East, used to express the nature of invisible things; the visible formed the *symbol* of the invisible. Man has made the mistake, on the one hand, to deem the symbol adequate to this expression; and, on the other hand, the uninitiated (the greater number) have had no just conception of the symbol, a fact which has merged it into the idol: and, moreover, anthropomorphism, which was intended in the East to be modified and corrected by being taken in the symbolic sense, and not to be taken in the actual or obvious sense, by furnishing the Deity with unworthy attributes, led to the corruption of morals and the degeneration of thought. The sooner the symbolic principle is recognised, the sooner will the East yield up its secrets, and its symbols be interpreted: the literal or exoteric signification is a delusion and a snare, as our examination of the Maori legend of Tane testifies. Exoterically, Tane is a tree that pushed up the sky, and propped it; and, in the belief of the uninitiated, he is not only a tree that walks and talks and works, but he begets children, which are other trees, and birds of course, seeing these, lodge in the branches; but esoterically, as we have seen, the legend was built on a philosophical basis, and its authors had a keen insight into the nature and end of things. This is testified to in the analysis of the story, wherein Tane is resolved into the *phallos:* and this construction is still further borne out by a fact not mentioned in our examination, that one of the wives of Tane is *Para-ure*, the name of a substance which doubtless Mr. Huxley would pronounce protoplasm, and could prove it so on chemical analysis;

a substance which over and above its chemical and material constituents, contains what physiologists term spermatozoa, that represents a *living* and fecundating principle.

Another point of importance is the nature of fossil names and words. Native etymology is helpful, just so far as the words are not fossil; but in the case of fossil words the original form of the word has been mimicked in sound, as nearly as possible, by similarly sounding Maori words; the etymology of which native words may, or may not, express the significance of the original. For instance, *Mahuta*, a name of Tane, is such a fossil name; its Maori etymology may, or may not, express the meaning of its original, *Maha-deo*, the great god; but its association with the other names, *Karihi* or Krishna, *Tawhaki* or Dewaki, *Hema* or Uma, betrays its origin. The native etymology cannot upset the inference that is to be drawn from this coincidence. In the case of *Karihi*, which means a kernel, or a sinker of a net, or eel-pot, we find the etymology has only a lateral reference to the original subject, having a phallic significance; but it is not the equivalent of the Hindu name Krishna, which means "the black god." This idea of blackness, however, may have been originally expressed in the Maori tradition by the introduction of the name of a brother, or counterpart, of Karihi, that is *Punga*, that being the form of name in the tale as it *now* stands, (but which may have been originally *Pango*, or *Mangu*, which both mean "black" in Maori; *Pango* may have been a translation into Maori of the Hindu name Krishna, on the framing of the present tale). However, by the slight alteration of the name *Pango*=black, into *Punga*=an eel-pot, and the retention of Krishna in the Maori form, *Karihi*, "the sinker of the eel-pot," the phallic idea was capable of being in an occult way expressed: and as it was no part of the Aryo-Maori priests' interest to emphasize an *an-aryan feature, as blackness of colour*, the change was the more easily effected; and the original *Pango*=black of the Maori, and the signification of the Krishna of the Hindu, which answered to it, was effectually veiled, only to be understood by the initiate; until the meaning itself became lost, only to be recovered on a comparative study. Similarly, *Mangu*= the black man, another form of *Pango*, may have suggested the shark idea; for by a very slight alteration *Mangu* becomes *Mango*, "the shark." A second purpose would be served by the change: the original reptilian, or rather, reptile-worshipping, nature of the cult could, in an occult way, be hinted at: and the effacement of Punga and Karihi, the Turanian brothers, as rivals of the more Aryan Tawhaki, be the more effectually compassed.

The deduction is plain, unless indeed the arguments, analogies, and coincidences brought forward prove altogether erroneous, that in the elucidation of the problem as to the "Whence of the Maori," the comparative method is the only adequate means of arriving at a solution. The efforts of Maori scholars, however ingenious, will prove as futile as those of old classical scholars, who strove to elucidate the etymology of the Anglo-Saxon elements in English from a comparison with Greek and Latin. The study of Sanskrit gave the right key to the unlocking of the philological problems of the Aryan nations. Mr. Thomson's happy discovery of the linguistic and ethnological relationship of the Maori races to the aboriginal Turanian races of Peninsular India, or Bharata, forms the key to the solution of this interesting question. Mr. Thomson's examination advanced it to a stage which has been termed (in reference to the government of a State) "practical politics." All previous theories have seemed to me to lead to nowhere. Maori mythology, though interesting, like all mythologies, needed a key: as to the historical contests of the Maoris, the struggle of the Kilkenny cats patterns the lot. Mr. Thomson's discovery marks a new departure, for it concentrates the study: the rays of diffusion that mark the spread of the Maori race converge to a focal point, Bharata.

With limited means for investigating so important a question, and a slender knowledge of the Maori tongue: were it not that the analogies, etc., between the Maori traditions and the Hindu lay so near the surface, I could not have ventured on the consideration; but the results *seem* so marked, and final, that I have ventured to bring them before you.

Postscript.

Since writing the above, I have come across the following interesting paragraph in the "New Zealand Magazine," from an article by Mr. W. H. L. Ranken, on "Mahori Migrations," which bears out the deductions advanced in my paper. Mr. Ranken says:—

"Their mythology (Samoan) is that of the dawn of civilization, and may contain coincidences with Asiatic or other beliefs, but no more; for instance, a legend of a deluge, which is found everywhere. But they have some traces of serpent-worship, in giving their Pluto a serpentine form. This is more likely imported than indigenous; for the snakes of their isles are few, small, and harmless, most unfit to impress the savage's mind with any powers he would glorify his god with; and there are unmistakable remains of stone worship, as it prevailed in the East, a cultus of the generative principle—the same which extended from Ceylon and India to Persia, Egypt, and Carthage, and which the Persian priest Elagabalus introduced to Rome when he became emperor. There are monoliths in Samoa, and in other isles, used to procure fecundity in animals, to procure rain, and such purposes."

In my next paper I hope to prove that the resemblance between Polynesian beliefs—such as the Deluge—and Asiatic beliefs is very much more than mere coincidence, and are pre-eminently attestive of historical contact; the evidence being as strong as any I have placed before you in this paper on the stone and serpent-worship, which Mr. Ranken attests must have been derived from elsewhere. It will be seen that the monoliths are used for exactly the same purpose as the Maoris employ the *puta-tieke* tree; the practice being a survival of the "cultus of the generative principle," as indicated. The coincidence theory is too facile an explanation to be trusted, and merely "draws a red-herring across the scent," and serves to retard investigation. When the "stone worship and serpent symbols" are scattered from Great Britain—by way of Carthage, Egypt, Ceylon, the Pacific Islands—to the ruined cities of Central America, the reading is "historical contact," not "coincidence." One race has carried it, the Phœnician *Kna*, the Polynesian *kanaka*, to the former denizens of Turanian India, or Bharata.

The importance of Mr. Turnbull Thomson's theory, that the Maori and other so-called Malayo-Polynesians originally migrated from Bharata, the ancient name for Peninsular India, can hardly be exaggerated; for, as I suggested in the latter end of my paper on this subject, the name *kanaka* connects the race with the *Kna* or Phœnicians, and *Kanaanites*. I have elsewhere shown that the Phœnicians originally were a Turanian race, inhabiting this very region, whence they migrated to the Mediterranean. *Kan* (the Biblical Cain), was a name for a Turanian race inhabiting Peninsular India in times *preceding*, as well as *after*, what is generally termed the Deluge, a traditional echo of which is preserved in the Hebrew and other eastern writings. *Kan* is a name of the god Krishna, a deity originally Turanian, as I have tried to show; and the second Buddha was named *Kanaka Buddha*, a name that connects him with the Turanian *Kan*, the Phœnician *Kna*, or *Knas*, and the Polynesian *kanaka*. The racial name is still preserved in Peninsular India, as the Coast of *Kanara*, and the *Karnatic*, whence the different lines of migration passed eastward and westward. That *Kan* is a name of Krishna is evidenced in the name Kânpur (Cawnpore)=the city of Krishnâ; and, as further evidence of Krishnâ's Turanian origin, I may mention that at the shrine of Pooree, or Juggernâth, the original Turanian Trinity—Rudra or Siva, Uma or Kali, and Juggernâth or Krishnâ—claim the exclusive devotion of the pilgrims; a fact that points to the intimate relation that I have tried to establish in my paper as existing between them—viz., as the father, mother, and offspring of all Turanian forms of trinities.

The name *Maori* can also be traced to Turanian India. Mr. W. L. Ranken, in his essay on "Mahori Migrations," already quoted from, speaking of the name Maori, as applied to themselves by the copper-coloured Polynesians, says: "This name varies with the dialects of the different groups: it is in some *Mahoii*, in others *Maori*, and in many *Mahori;* by the last, the name would be recognised by more members of it than by any other name." If it might be inferred from this that the original form of the name was *Mahori*, this approaches so nearly the form *Mohari* of Southern India—that is, the *Mahars* or scavenger-caste, as known to Europeans, that I think there can be little doubt that these latter represent, on the Asiatic Continent, a people that has had since aboriginal times a very wide diffusion: on the one hand, peopling the islands of the light-coloured Polynesians; on the other, (and in intimate connection with Phœnicians,) the northern regions of Africa—the former the *Maori*, or *Mahori*, the latter the *Mauri* (inhabitants of Mauritiania), later known as Moors.

The late Rev. R. Taylor suspected that there was a connection between the names "Maori" and "Moor," but, in common with others, he imagined that the Maori races represented one or more of the lost tribes of Israel; and thus, the Moor being deemed an Arab, he accounted for racial affinity. For the theory there was some amount of seeming foundation, in the striking similarity of certain customs and traditions. But the true explanation is to be found in the fact that both Hebrew and Maori inherited, equally with the Phœnicians, much that is common both to Egypt, Phœnicia, Babylonia, and India—that is, Turanian customs and traditions.

Another feature that points the connection of Maori, Egyptian, and Turanian tradition, is the connection of the *Atua Potiki* (or "child-gods") of the Maoris with the *Ptah* of Egypt, and the *Pataikos* of Phœnicia. "The Phœnician *Pataeki* were the children of *Phtha*, also called children of Sadik." The Egyptian Ptah=the opener, and was represented as a *bow-legged dwarf*, or *fœtus* = the Phœnician Pataikos, "the Creator of the world, the sun, and moon, out of chaos (*ha*), or matter (*mu*)." These quotations from "Chambers' Encyclopædia" enable me to confirm much that I have advanced about the Maori Tiki, conclusions that I arrived at before I came across this further evidence. Here we have *Ptah*, *Pataikos*, and *Potiki* = the "child or opener of the womb of Nature," the *anthropomorphic Deity* or Creator, represented as a *bow-legged dwarf*, or *fœtus*, a description that exactly describes the *heitiki* (Ahua-Tiki) of the Maoris, the much-prized greenstone ornament, which is worn round the neck as an image or remembrance of Tiki, and the *type* of all the images that figure in Maori carvings, and probably explanatory of them; these, moreover, form the only approach to images found among the Maoris. As Tiki represented the Creator, who is said by Maori tradition to have created man in his own image, as an Ahua-Tiki, or Tiki's likeness, it was just to represent him (Tiki) as an anthropomorphic deity of the form of a fœtus. As the Egyptian *Ptah*, the *Pataikos* of the Phœnicians, created the universe, with man, out of chaos (*ha*); so the Maori Potiki, or Tiki, creates man, (*he potiki*, as "a gift of Tiki,") from the chaos (*po*). At least this is the rendering of *potiki* as given by Mr. Taylor. The etymology is, however, possibly, not to be trusted, and fanciful; and at all events only "punningly" strengthens, by an etymological resemblance, the more important fact of an identity of fossil names.

I have already in my paper striven to identify *Tiki* (the Chinese *Taiki*) with the anthropomorphic deity corresponding to the third member of a series of Turanian triads; I have also shown that he corresponds in function, and even in some forms in name, with Rudhra (*Mahadeo*), or Siva of the Aryan triad or Trinity; similarly his wife Pani corresponds, as was shown, to Kali or Uma, the mother-goddess. I had not, at the time of writing my paper, the data to identify the form Pani with any known goddess having a name in any way resembling it. I have since, however, in the Phœnician connection, come upon traces of a probable solution, which fits in with or answers all the features of the case. Bearing in mind, then, that Pani is only another name for Umâ or Kali, a mother-goddess, we find a corresponding goddess worshipped in Western Asia by the Phrygians and others, and later by Greeks and Romans, Rhea, the mother of the gods, who is also Kybele, or Kybebe, a goddess of Turanian origin, and corresponding *probably* to Kali. *Ky-bebe* is possibly only a form of *Kala-bebe*=black woman in Hindustani, and equivalent to Kali, which Kybele also resembles. She was emphatically the mother-goddess, and was called *Ma* or *Ammas* (mother,) which is exactly the Hindustani *amma*=mother. This is not very far from the idea of Uma, another name of Kali, and corresponding to Hema, or Houmea, or Pani, of the Maoris. Now this cult of a *mother-goddess* of Western Asia, in common with other features, such as Baal worship, and the phallic worship (already pointed out as common to India, Babylonia, Egypt, and Phœnicia,) appears again among the Celts in Britain and Ireland. The phallic image of Rudhra, the *Maha-deo* or *phallos*, appears in Phœnicia and Greece as the *mudros*, and in Ireland as the *muidhir*. Now, besides this phallic symbol, the Celtic Irish had a "father-god" and a "mother-goddess." The father-god was called *Daghda-Mor*=Dada Maha, or *Maha Dada* in Hindustani, that is, "the great-father." Now as *muidhir* is equivalent to *Maha-deo* in Hindustani, the symbol of Rudhra or Siva, that is the *phallos*, the worship of *Daghda-Mor* is probably identical with, or closely connected with, the cultus of *Maha-deo*; the "great-father" being one with the "great-god" that symbolised generation. Now the wife of *Dagdha-Mor* (the great-father,) was the mother-goddess that gave her name to the River Boyne, *Banna;* which is just the Maori *Pani*, also the mother-goddess; and, thus, again, the Phrygian Kybêbê or Kybelê, the Egyptian Isis and the Hindu Kali. The fact that the Maori and the Phœnician sprang from the same aboriginal race, the *Kna*, or *Kanaka*, and are not of the race of the Hebrew, but of that of the Turanian *Cain*, fully explains the connection between the Irish goddess *Banna*, and the Maori *Pani*.

Thus, from regions the antipodes of one another, fossils from the detritus of historical drift may be taken and compared, and their identity or affinity be determined. Thus, the *Mahuta* (or *phallos*) of Maori (*Kanaka*) tradition is found in its original form in India as *Maha-deo*, (the home of the Turanian *Cain*, or *Kàn*, being the Land of Nod = India,) and is represented in Phœnicia, the new home of the children of *Kain*, or *Kenan*—that is, the *Knas*, or *Kenaanites*—in the name *mudros:* and in Celtic Ireland, where, probably, Phœnician colonies intermarried with and civilized the savage Aryans, in the form *muidhir*. Similarly, the Maori *Potiki*, the Hindu *Batcha*, the Egyptian *Ptah*, and the Phœnician *Pataikos*, or *Pataeki*, (and perhaps the Greek *Bachus* and the Chinese *Taiki*,) all refer to the child-god, the anthropomorphic deity, the creator, or demiurge. While I think it may be conceded that the Maori *Pani*, or *Hema*, is one with the Hindu *Uma*, or *Kali*; the *Kybelê*, or *Kybêbē*, called also *Ma* or *Ammas*, (that is, the mother-goddess) of Western Asia; the *Isis* of Egypt, and *Banna* of the Keltic Irish; and the *Ish-tar*, or *Astarte*, of the Phœnicians (*Ish-tar* meaning "black woman"); the "dusk mother," (*Eostre* of Northern Europe,) the East, from whose womb the Sun-god is born: known among the Maoris as Tawhaki, (or, more properly, Karihi,) in India as Krishna, in Egypt as Horus, in Greece as Bachus, or any other sun-god.

With reference to my deductions as to the *kumara* root being a Phallic symbol, equivalent to the *yoni* or womb of Nature, a particular form of which (as Mr. Colenso informs us) was designated "Pani's canoe," I have somewhat further to add, confirmatory of what I advanced on that head. I tried to show the identity of the Maori Pani, the Hindu Kali, and the Egyptian Isis; as also that "Pani's canoe" was one with the Hindu *yoni*, or womb of Nature, often symbolised as a boat, and thus connected with Kali (the wife of Rudra, who was represented as Mahadeo, or the *phallos*,) and the "Ship of Isis," and had a common significance. From the fact that a *kanaka* form of the name *kumara* was *umara*, I inferred the possibility of the *latter* form having been the original one, and thus as possibly connecting it with *Uma*, one of the names of Kali. I have since learnt that one of the names of Kali (a name that is given to the extreme point of Peninsular India, that is, Comorin,) is *Kumari:* and *Kumari* is sufficiently near *kumara* to clinch the connection that I sought to trace by inference.

I have but to add, in bringing this investigation to a close, (that is to say, the Turanian portion of the subject,) that if the conclusions I have advanced are borne out by the facts adduced, any disappointment that the lovers of the Maori, and things Maori, may feel at the identification of the *Mahori* race with the *Mahari*, or scavenger caste of India, is amply compensated for by their connection with the illustrious Phœnicians; to whom the ancients owed so much, that even the Greeks thought it no reproach to acknowledge and insist on their own obligations to them.

ART. LXX.—*Notes on Blasting at Ahuriri Bluff, Napier, in connection with the Construction of the Breakwater.*

BY JOHN GOODALL, M. INST. C.E.

[*Read before the Hawke's Bay Philosophical Institute, 19th April, 1886.*]

Plate XXVIII.

THE starting-point of the Napier Breakwater being from Ahuriri Bluff, where the sea at high-water washes the base of the cliffs, it was found necessary to make room for the erection of working plant, offices, block yards, and other purposes. To enable this to be done, and also to procure rubble stone for the works, it was decided to blow down the face of the cliff, immediately adjacent to the works. This cliff is over 300 feet in height, and is composed of alternating strata of limestones and sandstones. At a height of 50 feet from high-water, two drives were put into the hill, each 90 feet in length and quite straight, in different directions. These were turned at right angles, and driven 12 feet further, and turned again at right angles to the original direction and driven 8 feet, making double elbows. The mouths of the drives were 3 feet wide by 5 feet high. They were narrowed at the extremity as much as possible, so that a man could just work. The end of the drives led into chambers prepared for the explosives used. The material worked into was a bed of sandstone, moderately soft at first, but gradually becoming harder and more difficult to work, till at last three men in three shifts (a man to a shift) would extend the drive 2 feet only; while, at the start, the same complement of men in the same time could do 5 feet.

The first drive put in was for a charge of blasting-powder, consisting of eight tons (2,000lb. to the ton). The inside dimensions of the chamber were 6 feet 6 inches cube, containing about 275 cubic feet of space. It was carefully match-lined with well-seasoned timber. The powder used consisted half of English make, and half Colonial, made at Dunedin. The filling in of the chamber was an anxious piece of work: the barrels and boxes in which the powder was contained were opened at the mouth of the mine, and the contents were emptied into specially-constructed wooden buckets, bound with brass. The men were not allowed to have matches in their possession, and had to go in the mine without boots; and every other precaution was taken, so that there was not the least chance that a spark could be generated anywhere in the mine. The only lights allowed were one in each elbow, consisting of bull's-eye lanterns in recesses let into the rock. When the chamber had been half-filled, the igniting charge, consisting of a pound canister of fine gunpowder, was placed in the centre of the chamber; and from it were led two lighting-trains—one of gunpowder, in a train for a *flash*, the other of Rickford's slow-fuse; both of these were encased in timber. To sit on four or five tons of loose powder, while fixing the igniting-charge and the lighting-trains, gives one a peculiar sensation, which is greatly enhanced by the fiery purplish-red glint from the facets of the powder, reflecting the meagre light of the bull's-eye lantern 10 feet off, giving it the appearance of being on the point of explosion. When the chamber had been filled, the opening was timbered up, and a dry stone wall was built against the timber, all interstices being filled with fine material well rammed. This was continued to the first elbow; the corner being very carefully built, as well as the next elbow. The space between the two elbows had an intermediate stone wall, the rest of the space being filled in with loose material, well rammed. The main drive was then filled in to about half-way to the mouth with loose material, and a wall of stone every 10 feet. The two trains of fuse and gunpowder were carefully adjusted before the filling in began: and, on reaching the end of the filling-in, were extended 24 feet further, both with fuses.

The mine was fired on 8th March. Both fuses were lighted, and in 12 minutes the explosion occurred. This showed that the *flash*, or powder-train, had fired the mine. The fuse of 24 feet would occupy about 12 minutes to reach the powder-train, which would connect with the powder-chamber almost instantaneously.

As observed from one side, it appeared as if the face and brow of the hill rose slightly, accompanied by a slight report; opened out, apparently in strips; stood still for a moment, as if undecided whether to fall back or over—then immediately it went over with an immense crash and rumble, with occasional other minor rumbles, caused by the fall of overhanging material.

which could not be seen on account of the great cloud of dust that had arisen. The material that fell into the sea caused a small wave of about 5 feet high to roll off the shore.

The estimated amount of spoil thrown down was 52,000 cubic yards, equal to about 87,000 tons in weight; the work effected was therefore about 12,180 times the weight of powder used, the result being better than given in Professor Rankin's work on engineering, where the average effective work is set down at about 10,000 times.

The cost of this blast was :—

Blasting powder	£526
Mining and tamping	141
Timber and carpentry	13
Total	£680

Each cubic yard displaced, therefore, cost rather over 3d., equal to each ton a little less than 2d.

The shock of the blast was felt nearly all over Napier, much more in some localities than in others, irrespective of distance. Where it was most felt it resembled a sharp earthquake shock.

The second mine was charged with two tons (4,000lbs.) of Nobel's dynamite, and was fired on the 2nd April. The chamber was 5 feet long, 3 feet 6 inches wide, and 5 feet high. No timber or other lining was used, and the dynamite was packed in its paper wrappers. Two trains of fuse were attached to detonators, embedded in dynamite cartridges, and a few detonators were placed in the adjacent cartridges. The fuses were led away from the mine in timber casing to near the mouth of the drive, which was tamped up in the manner described for the powder blast. Dynamite being a very safe explosive to handle, the precautions taken for the powder blast were not enforced, and the workmen were able to go about in their boots and to use naked lights, and no feeling of uneasiness prevailed as when charging the powder mine. The length of the fuses were 72 feet each; and the mine fired in a little over half an hour after they were lighted.

In both cases the explosive chambers were situated 85 feet from the face of the cliff.

The effect of this latter blast was wonderful—its action extended far away behind the blast: the hill opened obliquely from the blasting point; the face of the cliff rose, spread out like a fan opening, and without any hesitation came down with a thundering crash, followed by a low rumbling and a great cloud of dust. There was but a small report, and very little overhanging material left. Immediately above where the charge had been fired a regular funnel had been scooped up to the top, by the pent-up vapours seeking an outlet.

The estimated amount of rock displaced was 151,000 cubic yards, equal to about 252,000 tons.

The cost of this blast was :—

Dynamite	£500
Mining and tamping	140
	£640

Each cubic yard displaced, therefore, cost a little over 1d., equal to each ton at ·6 of a penny.

The effective work of the dynamite amounted to lifting over 140,000 times its own weight, and did proportionately twelve times the work that the powder did.

The shock of this blast did not appear to be so much felt as the other; and in many places it was not noticeable, where the shock of the powder blast had been felt.

Art. LXXI.—*The Aryo-Semitic Maori.*

By A. S. Atkinson.

[*Read before the Nelson Philosophical Society, 1st November*, 1886.]

In the last volume of the "Transactions of the N.Z. Institute," vol. xviii., there is a paper by Mr. E. Tregear, entitled "The Maori in Asia." On reading it, I found it referred to and might be called a continuation of a previous work, by the same author, called "The Aryan Maori."* The latter I had not then seen, but at once procured and read it; and it would be saying little to say that I found both full of interest and novelty: indeed, to me, but very little used to philological inquiries, Mr. Tregear's methods and his results were alike startling.†

His main thesis is: that the Maori race is of the same family stock as the Indo-European, or Aryan, races; that the Maori language is a more ancient form of the common language spoken before their dispersion by the common progenitors of all these races; and that the main proof of this lies—I was going to say embedded in, but really, on the very surface of, the Maori language itself, and is educible upon a comparison of the Maori vocabulary with the vocabularies of those languages hitherto exclusively called Aryan.

* "The Aryan Maori," by E. Tregear (Wellington, N.Z., 1885).

† It is proper, though to those of you who know me quite unnecessary, to say, in the beginning, that I have not the least claim to be called a Maori scholar; the utmost I can claim is that I have been a student of the language, as opportunity offered, for a long time; though for how long, looking at results, I would rather not say.

The magnitude of Mr. Tregear's undertaking will be apparent when you remember that, though many have tried, no one, in the opinion of some at least of the greatest living philologists, has hitherto been able to bridge the chasm which separates the Aryan from the Polynesian languages, any more than that between the Aryan and the Semitic; indeed, if I understand Professor Whitney rightly, in his opinion, and that of others, with the means at present available it cannot be done.

And, evidently, Mr. Tregear is fully conscious that he is undertaking a great task. It is not one, but all the learned men of Europe he hopes to set right. Speaking of Dr. Latham's view, "that the Polynesian languages show a thoroughly insular or oceanic character," he says: "It is this mistake, made by all the other European scientists also, which it is my endeavour to correct." And he enters upon the work with a corresponding confidence; indeed, it is not likely that, without unusual courage, he would ever have undertaken such a task, much less have carried it through. "I will now," he says,* "proceed to state certain facts, on which I have such reliance that I feel positively assured, if any one will take the trouble to follow my reasoning, he will share my convictions before he reaches the end of this small work, however incredulous he may be at the outset." What these convictions are, he states at the end of his Introduction, distinctly, and with considerable force; without any of that unpleasant hesitancy which so often characterizes men of science dealing with questions of remote antiquity. He says:—

"I now proceed to assert—

"Positively,

"1. That the Maori is an Aryan.

"2. That his language and traditions prove him to be the descendant of a pastoral people, afterwards warlike and migratory.

"3. That his language has preserved, in an almost inconceivable purity, the speech of his Aryan forefathers, and compared with which the Greek and Latin tongues are mere corruptions.

"4. That this language has embalmed the memory of animals, implements, &c., the actual sight of which has been lost to the Maori for centuries.

"Probably,

"1. That he left India about 4,000 years ago.

"2. That he has been in New Zealand almost as long as that time.

"To prove these bold assertions is my task in the following chapters."

* "The Aryan Maori," p. 5.

I ought perhaps here to confess that, on first reading this, I was not only a little incredulous, but I even doubted whether Mr. Tregear was altogether in earnest. I saw, however, I must be wrong, on noticing that "The Aryan Maori" came from the Government Printing Office, and that "The Maori in Asia" not only appeared in the "Transactions," but was there awarded the place of honour; a sufficient sign that the learned editors of our only scientific journal deemed it at least a serious contribution to science: this, of course, was more than enough for me.

Mr. Tregear distributes his proofs under several headings: Language, Animals and Customs, Mythology, Time of Migration, Esoteric Language, and others; but it is on language and its evidence that he mainly relies: it is his linguistic method, including his method of exegesis, which is at once his peculiarity and his strength, and it is to this that I wish to call your attention.

"It does not follow," he says, "because two peoples have (even many) words in common that they are closely connected by descent. . . . But if there be two nations, all whose vital words come of the same stock, then there are two nations whose ancestors were brothers."

But how to find out the identity of these vital words? that is evidently the fundamental question lying at the root of the whole inquiry.

Unfortunately Mr. Tregear does not, as some do, begin by enunciating and discussing his method, but, with just a hint of its nature, leaves his reader to discover it by its use. After mentioning, and illustrating by an example or two, some of the difficulties of the etymologist with the European languages, he says: "These examples are as shadows of what the student of European tongues must look for. My task is an easier and more delightful one: the reader will be able to follow the derivations with ease and pleasure." It is this method, or faculty, of easy derivation and of not less easy interpretation, which enables Mr. Tregear not only to charm his readers by the way, but, after a remarkably short time spent upon the road, to bring them a very long distance from where they started.

In his two works he compares a very large number of Maori words with those of Sanskrit, Greek, Latin, English, and other Aryan languages: unfortunately, as I have said, the principles guiding him in so doing are not explicitly laid down, but the following, I think, are among them:—

1. Reduce the given words, as nearly as is easily practicable, to a common alphabet; then pair any two which have a more or less similar appearance or sound, and a more or less similar meaning; and then treat the components of each pair so formed as derived one from the other, or as both derived from some third form, and, in either case, as giving evidence that the languages from which they have been taken are cognate.

2. Comparison may be made between word and word, or between a part of one word and part of another; or a monosyllabic root in one language, Sanskrit for instance, may be compared with a single syllable in a Maori word; and this syllable may be taken in any part of the word: one syllable, for instance, and that the less permanent, of an apparently dissyllabic root, as Sanskrit, *tu* (to grow), and Maori, *tupu* (to grow), of which there is a common variant with the same meaning, *tipu;* or in an apparently non-radical part, as Sanskrit *ma* (measure), and Maori *mataki* (inspect); or it may be made up of parts of two syllables, an apparently non-radical prefix being joined to the first letter of the root, as Sanskrit *gon-e* (an angle), Maori *kon-oni* (crooked), *noni* being the radical, and capable of separate use (and *cf. tanoni*).

3. If the word to be compared has letters or combinations of letters which the Maori has not, the Maori pronunciation of the word, (as nearly as a Maori can manage it,) may be taken as the basis of comparison. But this pronunciation need not always be that which apparently an ordinary Maori would give, nor always uniform. Hence, for instance, Sanskrit *re* may be pronounced in three different ways, according to the different words it is compared with, *i.e.*, as *we*, *whe*, or *whi*; and so Sanskrit *siv* will not be pronounced *hiwi*, or *hiui*, but *hui*, or even *tui*, if the last should happen to be the word for comparison. This seems a new and useful extension of the law of attraction or assimilation.

4. Comparison may be made with words in the most suitable period of their life-history: a word from the Vedas, or a word of current English, may alike be compared with a current Maori word, and an identity declared "upon the view." This, it will be observed, does not ignore the historic method, but subordinates it.

5. It is not necessary to discuss, or to state the laws (if any) which govern phonetic change as between Maori and the several compared languages: such laws, if existing, must be considered of a very general and elastic character. Hence, for instance, while Sans. *k* and Gothic *k*, according to Grimm's law, have not the same etymological value, Maori *k*, though quite distinctive, may represent them both; and so with other letters and other languages. Again, Sans. *d*, *dh*, *l*, and *r*, may all be represented by Maori *r;* whilst some of these (*d* and *dh*), as well as *t*, and even *s* and *ch*, will, upon occasion, stand for Maori *t:* on the other hand, as I have said, Sans. *v* will represent both the simple and the aspirated Maori *w*.

6. It is not necessary to discuss the possibly difficult but certainly interesting question in phonology: how the copious, and in many points much stronger, alphabets of the Aryans were evolved from an alphabet at once as scanty and as definite as the Maori.

7. Nor is it necessary to make any systematic critical examination of the structure of Maori words, so as to distinguish between radical and non-radical—perhaps formative—parts, and ascertain their respective functions:

8. Nor to inquire as to the relative and absolute permanence and the etymological value (1) of the several Maori vowels, and (2) of the consonants; nor as to the rules which govern their occasional interchange:

9. Nor to compare *inter se* the existing Maori dialects, differing greatly as some do—the Moriori, for instance, and the Rarawa—from the commoner types; nor the language of to-day with such older fragments as exist: so as to ascertain whether, in the language itself, there is any evidence that it has changed, or is changing, and, if so, in what way.

10. Nor to compare the Maori with the other island languages, in order to ascertain, as far as is possible, the archaic forms of the whole group; and whether all the differences observable can be legitimately treated as divergences on the part of the other languages from the true type preserved unaltered in the Maori.

It is evident that these rules, positive and negative, (nowhere, as I have said, explicitly stated, but, as I think, necessarily to be inferred,) relieve the etymologist of infinite labour and care, and allow him to proceed with equal freedom and confidence: if he is not altogether *lege solutus*, it may, I think, be said that he is left free to treat each word upon its own merits; or, to put it in a slightly different form, the slow plodding of the method of investigation—the following of footsteps often obscurely visible, if visible at all—is superseded by direct vision. Mr. Tregear may therefore fairly claim that his method should be called "the method of insight," and that philology, in his hands, has been raised to the dignity of an intuitional science.

It would be impossible by a few extracts to do justice to the long lists of words, more or less similar in appearance and meaning, which Mr. Tregear has industriously collected: they must be seen to be fully appreciated. Many of the pairs, indeed, if standing alone, might not have been thought very well matched. The Sanskrit *Twachtri*, the thunder god, for instance, does not seem particularly like Maori *whatitiri*: nor is *Dhori*, the bull, very like the Maori prefix *tara*, thought by Mr. Tregear to mean bull; while if Hindustani *tat*, darling, is the same as the Maori *te tau o te ate*, it must surely be in a state of advanced phonetic decay. On the other hand, many are so much alike that Mr. Tregear, without, so far as appears, any other evidence, is able to pronounce them identical. "The Maori word *taura*, a rope," he says, "is pure *taurus*, a bull; roping, or tethering, the bull being the Aryan first use of a rope." Again, "This word *pare*, a band for the hair, is derived from *pareho*, the head; and this *pareho* is only our English word 'brow,' the forehead. We see this word in two forms in Maori; the Scottish word *brae* means the brow of a hill, shortened [*i.e.*, I presume the Scottish word is shortened,] in Maori into *rae*, the forehead, or a headland; again, it [the Scottish word] is lengthened out into *pareho*, the head." Here you will see that Mr. Tregear's method enables him at a glance to connect two Maori words by one Scotch one—a result which might have taken the slow historic method an indefinite, perhaps an infinite, time to accomplish. Again, Mr. Tregear says the Maori *karapiti*, grapple, *is* [English] grapple; Maori *tangai*, the bark, is English tan (for dyeing), and tannin; Maori *hae*, to hate, is (French) *häir*, and (English) hate; Maori *kiri*, the hide, is (English) curry, to dress hides; and so on, through a long list.

But Mr. Tregear is, in my opinion, undoubtedly at his best in discovering and describing the Aryan animals known to the Maoris 4,000 years ago, and now only preserved as fossils in their language.

"Knowing," he says, "that the Maoris were strangers to the sight of certain animals until these were introduced by the Europeans, I resolved to try and find if there was any proof in the verbal composition by which I could trace if they had once been familiar with them." He looks in the Maori language for what he calls "graft-words," words like our "lion-hearted," in which the name of an animal is a component part. He says: "I took the frog as my first subject. There was no Maori word for it, nor an Aryan word until I tried Sanskrit.

"Sanskrit, *bheki*, the frog. He was [in Maori]:—

"*Peke*, leaping over.
Pepeke, drawing up his arms and legs.
Tupeke, jumping up.
Hupeke, bending his arms and legs.
Peki, chirping or twittering.
Peke, all gone, without exception."

He adds: "This *was* the frog—there could be no doubt of it." In these six words, then, lies the whole evidence that the Maoris once knew the frog: you will observe that, cogent as the proof is, it is still more compendious. Yet, if I might suggest, and not seem to be gilding refined gold, there is one word more wanted to complete the picture—that is, *hikupeke*. Now, *hiku*, you may remember, is the tail of a fish or reptile; *peke*, we have just seen, is the frog: *hikupeke*, therefore, must be literally "frog's tail." But what is the modern meaning of the word? You will see in Williams's Dictionary that it is "to be shortened, so as not to hang down low." Could you have a more exact or picturesque description of a frog's tail?

He goes on to say: "Encouraged by this I tried the cow. I found *kaupare*, 'to turn in a different direction,' and was struck by its resemblance to (Sans.) *go-pala*, a herdsman. I looked at *kahu*, the surface, and found it illustrated by the example, '*kahu o te rangi*.' At once I recognized the old familiar expression, 'Cow of heaven,' a sentence to be met with in every work concerning the Aryans." A little further on he says, (tracing the natural history of the cow, and its relation to man, in the Maori Dictionary): "The cow was *kahui*, in herds; *kahurangi*, unsettled ('sky-cow,' moving about like clouds); *kakahu*, clothes for him (his dress was leather); *kauhoa*, a litter, ('cow-friend,' so they used cattle to ride on); *kahupapa*, a bridge (a bridge was a 'flat cow' on which he crossed streams); *kauika*, it lay in a heap;" etc.

But though the Maoris used a Sanskrit name for their cow, they "once knew the bull by a word like the Latin *taurus*, a bull. *Tara*, he had courage; *tarahono*, he lay in a heap; [this lying in a heap seems to have been a habit of the Aryan cattle, perhaps peculiar to them]; *tararau*, he made a loud noise; *tararua*, he had two points or peaks (horns); *tarawai*, he broke the horizon line [?]; *tareha*, he was red; *taru*, he ate grass; *taruke*, they lay dead in numbers;" etc. "But well as they knew him by this name, they knew him best," Mr. Tregear says, "as Latin *bos*, the bull." [Hence, as Maori *po* = Latin *bos*:] "*Pohaka*, he ripped up; *ponini*, was red; *porhiri*, he whisked his tail;" and others. I will only give one other, but that ought not to be omitted. "There is," says Mr. Tregear, "a good test-word here—a word so short that we have no extra letters hiding the roots—the word *poa*. *Poa* means 'to allure by bait,' in modern Maori. If, as I believe, *po* means bull (*bos*), then we have only *a* left. In Sanskrit, *aj* is to go, or drive, represented by Maori *a*, to urge or drive. If 'urge-bull' is the old word for enticing, alluring by bait, what *was* it? An Aryan word, the Greek *poa*, grass, is the exact word. That was what they coaxed the bull with; and in after centuries, when they had forgotten grass as pasture, (only knowing it as weeds,) and the animals which fed on it, the old 'bull-coax' graft-word was kept for 'alluring by bait.'"*

I will only now mention one or two other animals, and that briefly, though I am sorry to omit any; for it would well repay the curious to watch whilst, under Mr. Tregear's guidance, the whole Aryan menagerie files out of this ancient, but heretofore unsuspected, Noah's Ark—the Maori language.

The tiger is one of the two animals which have perhaps most severely tried Mr. Tregear's method; but it, too, is subdued and

* I may remark, in the *sotto voce* of a note, that, according to Liddell and Scott, the Epic form of *poa* (*poie*) had one of those inconvenient "extra letters," besides a different termination.

led out. Mr. Tregear takes as his starting-point the Greek *tigris*, and he gives as the Maori pronunciation of this, *tahika;* in this, out of consideration for his reader, he is giving the result, without the difficult intermediate steps which led up to it. It is, I believe, agreed that the Greek *iota* was sounded like the continental (or Maori) *i*. If, therefore, a Maori were set to pronounce *tigris*, he would (or should), I think, say *tikiri*, or *tikirihi*, according to the prominence given to the final *s*. This, however, would embarrass the etymologist, putting him altogether on the wrong track. But there is another, and much more widely known Aryan word for the same animal, our own word "tiger." Now, if a Maori were set to pronounce the latter he would certainly say *taika*, or *tahika:* which, therefore, (since *tigris* = tiger in sense, and tiger = *tahika* in sense and sound,) Mr. Tregear legitimately takes as the basis of comparison. He then shows how: *Taheke*, "he was quick;" *tahekeheke*, "he was striped;" *taheke*, "he came down like a torrent;" *tahere*, "he was ensnared;" and, most desirable if unexpected consummation, *tahere*, "he hung himself." It would be historically as well as zoologically interesting to know whether this last statement is to be taken in a special or, as seems to be intended, in a general sense; whether, that is, the practice of suicide was as universal a characteristic of the Aryan tiger as the being striped, or the coming down like a torrent.

The last I will speak of is one which equally, if not in a greater degree, shows the power of Mr. Tregear's method. It is the horse: and he discovers and identifies it by means of a single Maori word, a verb of general meaning; or, as he puts it: "The horse is mentioned but once, and that not as Greek *hippos* but Latin *equus* (early pronunciation *ekus*). The Maori word is *eke*, to mount a horse; although they had lost the animal, they kept the meaning of this." Of course, during the interval when they had no horses—by the theory for about 4,000 years—they had to use this verb in a quite general sense for getting upon anything, as on to a mountain, or into a canoe; indeed, the canoe itself was said to *eke* when it touched the beach—but this only makes the discovery of its secret the more remarkable. And the discovery is not only of interest linguistically, but as showing—can we say, to demonstration?—that the primitive Aryan was a horseman. The Greeks of the time of Homer, I believe, had lost the habit, if not the art, of riding.

Now, in the conclusion of "The Aryan Maori," Mr. Tregear puts his reader into this dilemma: "The man," he says, "who has read this book, if not ossified by prejudice, is a man convinced, and a future fellow-labourer." With only these alternatives before me, I much prefer to be convinced; and so I tender my services, such as they are.

In the first place, then, I will venture to supply two or three of the more obvious omissions in Mr. Tregear's application of his method.

There are some words in the Maori language which not only throw light upon the old Aryan ways of life and habits of looking at things, but satisfactorily explain some of the commonest, and yet most obscure, expressions in modern Aryan languages—our own especially. Most of us in early youth have been complimented by our elders, perhaps more than once, on having found "a mare's nest:" a singular expression, the force of which we soon learned to appreciate, but the true origin of which, I venture to think, has not hitherto been disclosed. Now, as you are aware, a common Maori word for a nest is *kowhanga*: What is the etymology of this? *Ko*, in composition, as Mr. Tregear has taught us, means "cow;" *whanga* means "to lie in wait," or say "to lie waiting;" hence *kowhanga*, a nest, was originally the place where the cow left its young one waiting for it; that is, was the cow's nest. But there is another common word for nest, *owhanga*. Now, the sheep appears in Maori as *o*, (allied, Mr. Tregear says, to the Greek *ois*,) by similar reasoning, therefore, *owhanga* is seen to be "the sheep's nest." I have not yet found the exact word for a horse's or mare's nest; but who, with these other examples before him, will doubt that it once existed, and only became ridiculous in an age which had forgotten its etymology?

There is another word still more interesting, for it not only explains another common but obscure West Aryan saying, but is proof of an important fact which Mr. Tregear seems to have overlooked—that the Maoris, after first visiting New Zealand, returned to their ancient home before settling here. The saying explained is: "a cock-and-a-bull story;" and the word which explains it is *kakapo*. This last word is, as you know, the name of a large ground-parrot, now only found in the bush on the west coast of this island. Its name was hitherto thought to signify "night parrot," in accordance with its nocturnal habits—a satisfactory explanation till the new method revealed the truth. For *kaka*, it appears, is the Sanskrit form of our word "cock;" *po* is "a bull:" *kakapo*, therefore, will mean "the bull-like *kaka*, or cock." But the Aryan bull was not so much physically large as morally terrible; and hence, under its Maori name, was, as Mr. Tregear points out, the etymon of our English word "Bo-gey, the demon of darkness." Now, remembering this, and coupling with it the saying I have quoted, what does this word *kakapo* reveal, even to the amateur philologist? First, there become visible the adventurous few of those primeval navigators peering into the gloomy recesses of the New Zealand forest, and there for the first time seeing in the dusk this strange bird: not flying, but uncannily marching; not cracking nuts, or eating fruits like a reasonable parrot, but nibbling the grass and herbage like a quadruped;* "grunting while so doing, if satisfied," or "uttering a discordant shriek, if irritated;" big naturally, but looking far bigger in the uncertain light; in all ways most impressive to the primitive imagination. Then our voyagers are seen, returning to the family home in Asia; and when they relate there all they have seen, and how, among other strange and wonderful things, there was a *kaka-po*, "a cock just like a bull," what wonder if those who had stayed at home, including our Teutonic ancestors, received the narrative with incredulity and ridicule, and so took with them to the West the dim remembrance of this first story about "a Cock and a Bull," as the very type of a traveller's tale.

Again, whence does our well-known venomous spider get its name, *katipo?* This might be taken to mean "biting in the night," perhaps "biting secretly," the latter, curiously enough, an exact translation of its generic name.* But as a *graft-word* it might not only mean "bite the bull," a thing many little animals might do, but "stop the bull," the very acme of power to an Aryan mind.

Mr. Tregear has pointed out with striking effect that the syllable *nga* in several Maori words, (*ngarara*, *kapenga*, etc.,) really stands for *naga*, "the great serpent" or "crocodile" of the first inhabitants of India; from which, indeed, the latter took their name. The *naga* seems to have played a very important part in the early history of the Aryans, and hardly less so in the development of Mr. Tregear's theory. But though, as I have said, he has shown us in several cases how *nga* should be *naga*, he has omitted some important applications of his own rule. Take, for instance, Maori *ngaru*, a wave: read it as *naga-ru*, and its meaning is obvious. *Ru* is "to shake;" *naga-ru*, therefore, is the great (sea) serpent shaking himself, and so ruffling the water. But even in the ocean there is one greater than this marine *naga*. You will remember that the Maori Neptune is called *Tangaroa*. Why? A mere Maori scholar, I think, would not be able to say: but if you take *nga* as being *naga*, it becomes transparent. *Ta* is "to dash down," *nga* is "*naga*," *roa*, "long, great:" *Tanagaroa*, then, is "he who dashed down (overcame) the great sea serpent." Could you wish for a sea-god a more appropriate name?

Again, Mr. Tregear cites the proverb, "*He koanga tangata tahi, he ngahuru puta noa*," which he translates literally, "At planting, single-handed: at harvest, all around." Now, as commonly understood, *ko* is a Maori implement, the analogue of the

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* *See* Buller's "Birds of New Zealand," p. 31, etc. It is not meant that it would not eat fruit if it could get it, but that it takes its commonest food by "grazing"—the term actually used in *loc. cit.*

* *Lathrodectus.* *See* Thorell, "On European Spiders," p. 95.

spade; hence, *koanga*, "digging, planting:" but to Mr. Tregear *ko*, of course, means "cow." *Ngahuru*, again, means "ten,' and here, as commonly understood, "autumn, or harvest time," (*i.e.*, the *tenth* month from May or June, the beginning of their year). But Mr. Tregear says: "*Huru* is exactly the Gothic *ulu*, the English wool; the word as now used by the Maoris being applied to the hair of an animal, the feathers of a bird, etc., only because they had lost the sheep. *Ngahuru*, 'the wools,' (plural *nga*,) was the sheep harvest, the shearing." And he proposes the new reading of the proverb: "At cow-herding, one man; at sheep-shearing, many." But *ngahuru*, "the wools," used absolutely, is not a happy phrase, whether in Maori or English. Suppose, however, we take *nga* in its natural sense of *naga*, how is it then? *Naga* being a serpent, or crocodile, *nagahuru* would mean "snake's wool," or "crocodile's wool;" and the proverb would run: "At cow-herding, one man; at crocodile-shearing, many." And who could blame those simple people, if they *did* come in numbers to see that sight?

A philological Philistine, an unbeliever in the *naga* theory, might well object that if a Maori tried to say "*naga*" he would not say "*nga*," but "*naka*," and that therefore the word, if found at all in Maori, should be found in the latter form. If the justice of this criticism were admitted, the theory would suffer the loss of some most serviceable etymologies, but it would I hope, still survive. For, not only does the word *naka* appear in Hawaiian, and there mean "trembling, afraid," but there is in Williams's Dictionary a word disregarded by Mr. Tregear, and that is *nakahi*, and its meaning is "a serpent." I am quite aware that even Maoris would assert this was not a Maori word; but seeing that without it the *nagas* might be driven from New Zealand, just as they were getting established, and a most interesting theory suffer an irreparable loss, could not the new philology, which seems well inclined to adapt itself to the needs of its votaries, be induced to interfere, and to declare it to be an ancient Maori word? For supposing, even, it could be shown that some missionary or other Englishman had, as he thought, introduced the word to represent the English "snake," what would that have been but reminding our Maori brothers of a word they once knew well but had forgotten?*

* After I had written this, I found that Fornander, ("The Polynesian Race," iii., p. 244,) actually connects the Hawaiian *naka* with Saxon *snaca*, a snake; O. H. German *sneccho*, a snail; and Sanscrit *naga*, a serpent. In Hawaiian the Maori *k* disappears, *ng* becomes *n*, and *t* is represented by *k*: hence Hawaiian *naka* = Maori *ngata*, a form not so easily connected with *snaca*, etc. Evidently, an etymologist who has at command both these forms and feels at liberty, without discussing their relative age and stability, to use the one most suited to the occasion, possesses an instrument of great power.

I hope it will not be thought presumptuous if I suggest that, though Mr. Tregear shows not less than the usual boldness of a pioneer, he yet seems unreasonably timid in the limits he sets to the application of his own method. "It has," he says, "been asserted lately that the Maoris are children of Abraham. They will have to alter almost every important word in their language before it can be claimed that they are of Semitic parentage. Mauris or Moors they are not." I should have agreed with him before I had seen his method in use: but I am confident that he has supplied the means of proving that he has altogether under-estimated its power.

I have not a word to say against the Aryan affinity of the Maori or his language. It has been more than once pointed out, and, indeed, is obvious, that if we believe in the original unity of the human race, it is reasonable to suppose, or at least unreasonable to deny, the original unity of human language. But this is a far-reaching argument, and encourages us to look in all directions for our kin. I therefore propose, with the help of Mr. Tregear's method, to show, not that the Maoris are not Aryan, but that they are also Semitic—*i.e.*, *Mauri*. If I fail, it must be set down to my own incompetence, and not to the insufficiency of the method.

As a first step, then, I would venture to say a few words on the name "Maori," which (for the purposes of this paper) I would submit should be *Mauri*.

The word "*Maori*" is, confessedly, not a noun or a proper name, but an adjective. The Natives are not Maoris, as we call them, but *tangata Maori*, "Maori people," as I have been reminded by them, more than once. The word when applied to men is commonly translated "native;" on the other hand, *wai maori* has to be translated "fresh water." The same word in Hawaiian, *maoli*, is said to mean "indigenous," but also "real, true, genuine." The latter seems to be the fundamental, or very nearly the fundamental, meaning in both languages. As Dr. Codrington says, in his most instructive work on "The Melanesian Languages" (p. 82): "When a native says that he is a man, he means that he is a man and not a ghost; not that he is a man and not a beast. . . . There is in the [Mota] language *ta-maur*, 'live man,' as opposed to *ta-mate*, 'dead man,' or 'ghost;' no doubt the Fate and Sesake word *ta-moli* = *ta-maur*. . . . . In Saa, *mauri* is 'to live.'"* The word *maori*, also, it seems, was used in this way to distinguish the living from the dead man, and the real man from the fabulous or fictitious beings in human shape, such as the *Patupaiarehe*, the so-called fairies.†

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* *See* Dr. Shortland's "Maori Religion and Mythology," pp. 46, 47; a work full of valuable information, but all too short.

† In the Motuan, (of New Guinea,) *mauri* is "life," and "living."

It is consonant with this that Europeans were often, at first sight (and even afterwards,) taken for spirits, or beings from another world. Captain Cook, as is well known, was even thought by the Hawaiians to be their god *Lono* (Maori *Rongo*). We have, then: *maori*, *maoli*, *moli* (*cf.* Chatham Islands *Moriori*), *maur*, and *mauri*, all used in substantially the same sense; and this sense—of the word *maori* as well as of the others—seems to be, "living, not dead," and so "real, not fictitious;" and it is only a slight extension of the latter meaning to apply it to useful fresh water (*wai maori*), as opposed to useless sea water (*wai tai*). *Tangata*, I presume, originally meant the same as *tangata maori*, just as *wai* still commonly means the same as *wai maori*: the adjective in each case being only added to distinguish the real thing from its spurious rival. And here I may note that Max Müller (Lect. ii., 320) thinks the Latin *mare*, and other West Aryan names for the sea, meant "dead, barren water" (the French *eau morte*), as opposed to the living water (*l'eau vive*) of the running streams.

It seems, therefore, not unreasonable to conclude, provisionally, that *Maori* and *Mauri* are variants of one and the same word: which is the more ancient? In New Zealand, *Mauri* is, commonly at least, a noun, and is said to be "the heart, the seat of (some of) the emotions"—perhaps, rather, the seat of life, spirit, *anima;* and in this connection may be mentioned a word which looks like the root of it, *uri*, now used for offspring and, it seems, for other blood relations. Now, it is remarkable that, according to a very high authority, the first man in the Maori cosmogony was called to life with the formula, "*Tihe, mauri ora!*"—"Sneeze, living *Mauri!*" Hence, whatever the speaker may have intended by "*Mauri*," is it not obviously more ancient than "*Maori*," and by far the most appropriate name for primitive man? And if we find an ancient Semitic people known by this very name, are we not entitled to conclude—at least for this evening—not only that they are close kin to, but are indeed the progenitors of, the Maoris?

I will now, to borrow a phrase of Mr. Tregear's, introduce you to two sister tongues, Maori and Arabic; merely premising that I thought if I chose for comparison a language of which I knew only the transliterated alphabet, the power of the method would be the more signally displayed. I need not remind you that, though at one time it was fashionable to derive all human speech from a Semitic source, since the rise of comparative philology the Semitic "roots" were thought too peculiar and too stubborn to allow themselves to be satisfactorily allied with those of any other family. But this difficulty may be left for European philologists; "my task," as Mr. Tregear said of his own, "is an easier and more delghtful one: you will be able to follow the derivations with ease and pleasure."

I need only further remind you that Arabic *b*, *g*, and *l* represent Maori *p*, *k*, and *r*; while *d* will stand for Maori *r* or *t*; and *s*, commonly, for *h*.*

ARABIC.	MAORI.
Ard (pl. *aradi*), earth, ground	*Ara*, road; *m-ara*, cultivated ground

Hence the very word "Aryan" appears of Semitic origin.

awi, to go to, to reside	*awhi*, to draw near
bab, a gate, a door	*papa*, a sliding door
bahr, the sea	*para* and its compounds (*post*)
bakbak, noise as of water from bottle or pipe	*pakipaki*, to clap together, as the hands, or two waves meeting; *pake*, crackle, emit a sharp sound
baki, firm	*pake*, obstinate
baraghit, a flea	*puruhi*, a flea

This shows how long this little creature has been man's companion.

bu, a father	*pu*, a skilled or wise person
ba-kara, a cow or ox	*kara-rehe*, a quadruped (and see *post*)
bu-k, horn, musical instrument	*pu*, general name for wind instruments, as *pu-torino*, a flute
darab, drub, thump; this is English *drub*	
gild, the skin	*kiri*, the skin

These two are well connected by Torres Island *gilit*, the skin, which is more related to the one it is less like.

habs, a prison; (Eng.) *nabs*, he catches; (Lat.) *habere*, hold	*hopu*, catch
hak, to rub	*hakihaki*, the itch
haka, tell	*whaka*, reply to; *whaki*, reveal
hatab, firewood	*hatepe*, cut in two, as a tree; *tata*, to split firewood, etc.
harir, silk	*hara-reke*, flax; *hari*, carry; *here*, tie
har, sultry	*hana*, glow, give forth heat; hot
hara-m, illegal	*hara*, offence
hawa, sound, voice	*hawa-ta*, mutter
haw-a, wind	*hau*, wind
kaba, sullen	*kawa*, bitter
kabih, deformed	*kapi*, covered up
kadah, flint	*kara*, basaltic stone
kahr, force	} *kaha*, strength, power
kahhar, powerful	} *kaha*, strong, powerful

* For the convenience of the reader, I have marked off with hyphens the parts of words material for my purpose.

Arabic.	Maori.
kali, ground covered with herbage	*kari*, an isolated wood; to dig
kahweh, coffee	*kawa*, bitter
	kawakawa, a pepper tree (*Piper excelsum*)

Mr. Tregear says "the Maoris had not learnt to drink *kava*," the common Polynesian intoxicant, prepared from the root or leaves of a pepper tree, *P. methysticum*. If not, why did they call this New Zealand pepper tree by the old name? Moreover, the Rev. R. Taylor, a man who possessed a great deal of curious knowledge respecting the Maoris, is satisfied they carried on the manufacture of *kava* (or *kawa*) in New Zealand, and that this appears in the names of certain places, such as *Kawaranga*, and says that they still chew the root as medicine. In Arabia, we are told, *kahweh*, or coffee, (the primitive *Mauri* "*kava*,") was looked on as an intoxicant, and as such prohibited by the Koran. It is not surprising that the prohibition was vain, if, as is evident, its use dated from primeval times.

Arabic.	Maori.
kalab, insanity	*karapa*, squinting; often, it is said, connected with cerebral disease
ka-mar, the moon	*marama*, the moon
ka-nun, place for fire	*ka*, burn; *tu-nu*, roast
karar, conclusion, determination	*kara*, secret plan, conspiracy
karrabe, a large flagon	*karaha*, calabash with wide brim
kari-m, generous	*ha-kari*, a gift
katkatat, laughing loud	*katakata*, laughing often
kata,* cut	*koti*, cut
katakatakata,* cut to pieces	*kotikoti*, cut to pieces
katr, dropping, as water	*kato*, flow, as a river
khata, a mistake	*kata*, to laugh
khatt, mark or line drawn	*au-kati*, the celebrated boundary line drawn by the King Natives
khati, a sinner	*kati*, don't!
khudud, cheeks	*ngutu*, lips
kh-alik, creator	*ariki*, chief
ku'ah, a cap	*kura*, a head ornament
l-ahi-b, flame	*ahi*, fire
lama, shining	*rama*, a torch
ma, water	*ma*, (in comp.) a branch of a stream

* A final guttural being untransliterable is omitted.

ARABIC.	MAORI.
maraka, gravy	*mara*, prepared by steeping in water
mad, flow (of the tide)	*mate*, moving slowly as the tide
mabhuh, hoarse	*mapu*, to pant, to whiz
malih, beautiful, agreeable	*mari-e*, quiet, gentle ; *hu-mari-e*, beautiful
m-alik, a king	*ariki*, a chief
malu-kut, omnipotence	*maru*, power, authority
marrih, the planet Mars	*maru*, the planet Mars *
marrih, iron	*mari-pi*, a knife
maram, intention, purpose	*marama*, clear in mind
mat, to die	*mate*, to die
mawt, death	(Lat.) *mors* (*mort-*) death
na, our	*na matou*, ours ; *nana*, his
nuksan, injury	*nuka*, deceive
rah, go	*rara*, go in shoals
dar, ramble	*ko-rara*, go in different directions
	ma-rara, spread about
	hara, come
ra-s, the head, head man	*ra-e*, forehead, headland
	ra-ngatira, chief
rakha, the pleasures of life	*rakaraka*, to scratch

The pleasures of a primitive people are necessarily simple.

rami, throw	*rami*, squeeze
sa-dik, true	*ka tika*, it is true
salih, honest	*hari*, to feel or show gladness

It speaks well for the morality of the pristine *Mauri* that they had substantially the same word for honesty and happiness.

sakat, to fall	*taka*, to fall
sakil, heavy, oppressed with sleep	*hakiri*, hear or feel indistinctly
sana, light, splendour	*hana*, glowing, warm
tabut, a coffin	*tapu*, as from touching a dead body
tadwir, causing to turn in a circle	*tawhiri*, to whirl round
tahkik, truth	(by metathesis) *tika*, truth
taklidi, imitative	*takariri* (with *whaka*), vexatious (as by imitating or mocking)
takht, a bed	*takoto*, to lie down
tahnit, burying with odours	*tanu*, to bury
tahrik, provocation	*taritari*, to provoke
takkayah, pillow	*takai*, wrapper, covering; *takaia*, wrapped or rolled up

* *See* "Te Ika a Maui," second edition, p. 138.

Arabic.	Maori.
tal, an eminence, high ground	*tara*, a peak
takalluf, inconvenience	*takarure*, to be listless
taraf, flap, anything dangling	*tarawa*, hung up, dangling
tarakhi, proceeding slowly	*tarakihi*, a cicala ; anyone who has watched this insect will know how slowly it proceeds
tanin, a sharp sound	*tangi*, cry, make a sound
tannin, a large serpent	*taniwha*, a monstrous reptile
tawali, continuation, succession	*tawari*, almost broken off . *tawariwari*, bending from side to side
tawb, a great gun	*tau*, report of a gun
tawhim, giving what is desired to eat	*tawhi*, food
tawhe-d, unity	*awhi*, embrace
turak, forsake, forego	*turaki*, throw or push down
tut, a mulberry	*tutu*, a shrub with mulberry-coloured fruit
tuwani, delay, slowness	*tuwhana*, urge, incite
warak, leaf of a tree or book	*wharangi*, a broad-leaved shrub ; the leaf of a book
wa-kt, time, season	*w-a*, time, season
wata-d, stake, paling	*ti-watawata*, a palisade*

This list might, of course, be indefinitely extended, but these are enough. I will, however, take two or three of them a little more in detail.

Mr. Tregear says he has traced the word *ariki*, chief, "in every Aryan tongue"—a most creditable feat, apart from its intrinsic difficulty, seeing that there are said to be some forty of these languages living, and some twenty of them dead. He gives, however, only four or five examples:—"In Gaelic it is *ardrigh*, high king ; in old Slavonic, *zary* : in Greek, *arke*†, chief, *archon*, a chief magistrate ; in English *arch*angel, *arch*deacon, (*arke-diaconos*†) from the Greek." Now, *ardrigh*, *zary*, and *archon* may no doubt be considered like *ariki*, but not more like, I think, than Arabic *Kh-alik*, creator, and *M-alik*, a king, especially if, as is required in Maori, you vocalize the final *k*: while if you

* This I understand to be its meaning in the *Whakaaraara pa*, the chant of the sentinel to keep the garrison alert :—

"Tenei te pa,
Tenei te tiwatawata
Tenei te aka te houhia nei .
Ko roto ko au, e, e, e!

"Here is the fortress, here is the palisading, and here the creeper that binds it, whilst inside am I!"

Archdeacon Williams gives *tiwata*, but without assigning a meaning.

† This, I think, is not the ordinary spelling of this word.

want the very word itself (*l*, as often, being substituted for *r*) you will find it in the Agáwi of Abyssinia—a language which is at least claimed as Semitic, and in which a chief is called *aliki*.

Next, I will take the Arabic *bahr*, "the sea." This word evidently points to a primitive *Mauri* form, *para*; and it is precisely the latter which appears in many modern Maori "graft-words" descriptive of or relating to the sea: *Parauri*, "it was dark-coloured;" *pararahi*, "it was spread out flat;" but was liable to *parará*, "sudden and violent gusts of wind;" when it showed on its surface *parahi*, "steep slopes;" and, *parare*, "made a great noise." It not only appears in the names of fishes, and of the sperm whale (*paraoa*), but even in that of food itself, *pararé*, and *paraparahanga;* while the simple form duplicated, *parapara*, meant the "first-fruits of fish," and (consequently?) "a sacred place." A flood was, not inappropriately, called *parawhenua*, "sea (on) land."

But there is a still more important word of this group, strangely overlooked by Mr. Tregear when discussing the meaning of *Bharata*, the ancient name for India—and that is *Parata*. Now, who or what was Parata? One of the highest authorities we have on these matters, Mr. John White, says: "The Maoris account for the tides in the following manner: There is, in the deepest part of the ocean, a god, son of Tangaroa, called *Parata*, who is such a monster that he only breathes twice in twenty-four hours; when he inhales his breath it is ebb-tide, and when he exhales his breath it is flood-tide."* And it is he who also causes the whirlpool, which the Maoris call "*Te waha o te Parata*," or "*Te korokoro o te Parata*"—"the mouth (or throat) of Te Parata."† He was, therefore, the ocean—at least in its aspects of power—personified, or rather, deified. Now, remembering this, and that the ancient *Mauri* must certainly have been an eminently seafaring race—or their descendants would not now be found in islands as far apart as Madagascar, Hawaii, and New Zealand—it would surely not be surprising that, on arriving by sea in India, they should have given to that country the name of the deity whose power they had often experienced, and called it *Parata*, since corrupted into Bharata.

I have shown that Mr. Tregear points out and developes with surprising effect the "graft-words" which he finds in Maori relating to cattle, especially those containing *kau* and *ko*, meaning "cow," and *po* and *tara*, "bull."

The more ancient word, however, for cattle, appears to be *kar* or *kara*, preserved in the Arabic *ba-kara*, "cow or ox"; in

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* "Lectures on Maori Customs," i., p. 10.

† See, for the latter expression, Sir G. Grey's most valuable work on "Polynesian Mythology," second edition, part ii., p. 74

Maori as *kara-rehe*, "quadruped," and in many others given below; and, though a good deal mutilated in English, still in its essential part both in sound and spelling preserved for us in "calf."

A little while since, no one would have thought of looking in the Maori language for a life-history of those ancient cattle, but a competent method can discover and reveal it. Let us first take this word *kara* as meaning "cow:" then, *karawa*, she became a dam (lit. "cow-mother"); and, afraid of losing her calf, *karangata*, remained silent when called; but *karaua*, "the old man" (cow-herd), with *kararehe*, his dog (lit. "cow-beast") *karapoti*, "surrounded (and caught) her;" and *karatiti* "fastened her with pegs," *i.e.*, tethered her; whereupon, *karangi*, she "became restless," and *karangaranga* "bellowed frequently."

Then, taking it as meaning oxen: *karamuimui*, they "were in swarms," and fed upon *karamu* and *karangu*, the "cow-trees" of the settlers; but *karapiti*, they were "fastened side by side," (*i.e.*, "were yoked together," an important fact) and *karawhiu*, "the whirling thing" (lit. "cattle-whip,") being applied, they showed *karawarawa*, "weals or stripe-marks;" finally, *karapipiti*, they were laid "side by side," *karahu*, in "an oven;" and *karakape*, "hot coals and stones being taken up with two sticks," *kakara*, they became very "savory."

Of the other cattle-words, I will only mention one, *karaha*, "a wide-mouthed calabash," which, coming from the same root, shows that their first drinking vessels were of leather.

All this is of great interest, especially as showing that the ancient *Mauri* used their cattle for draught purposes, and made free use of their flesh for food; and, therefore, that we have here evidence of their language and customs long anterior to the Aryan worship of the cow. And this fact confirms the opinion of most philologists that any common origin of the Aryan and Semitic languages must be of the most remote antiquity.

The rhinoceros, *kar-kand*, we may assume, is named from the same root; like the horse, "it is only mentioned once in Maori." Mr. Tregear rightly claims, as an epithet of the bull, the word *tararua*, "the two-horned;" he will, I am sure, willingly concede that *taratahi*, "the one-horned," could apply to nothing but the rhinoceros.

I will only here refer to one other word, the Arabic *tannin*, "a great serpent," the same in origin as the Maori *taniwha*, "a great water monster." Mr. Tregear, I am glad to say, has already recognized the Aryo-Semitic nature of the *taniwha*, by connecting it on the one hand with the Sanskrit *tan*, "stretched out," and on the other with the Hebrew *Leviathan*. By the introduction of the great Arabian serpent, the happy family is now complete.

These, then, are my contributions, such as they are, towards the wider application of Mr. Tregear's method. In return, I hope I may ask that he will furnish his followers with better means than they yet have of answering objections which unbelievers are sure to make. Some will insist, and with a good deal of authority on their side, that the primary test of relationship in languages is in their grammars, and not in their vocabularies. Others will require more evidence of relationship in vocabulary than the mere juxtaposition in opposite columns of series of words more or less similar.

On the latter point, I confess, after what I had been doing myself, I felt a good deal uneasy on reading the following passages in Professor Whitney's "Life and Growth of Language," pp. 267 and 312 :—" The changes of linguistic usage are all the time separating in appearance what really belongs together: *bishop* and *évêque* are historically one word; so are *eye* and *auge;* so are *I* and *je* and *ik* and *egón* and *aham:* though not one of them has an audible element which is found in any other. And then the same changes are bringing together what really belongs apart; the Latin *locus*, and Sanskrit *lokas,* 'place, room,' have really nothing to do with one another, though so nearly identical and in closely related languages; likewise Greek *holos*, and English *whole*, and so on. We may take the English language (as too many do) and compare it with every unrelated dialect in existence, and find a liberal list of apparent correspondences, which, then, a little study of the English words will prove unreal and fallacious. . . . The whole process of linguistic research begins in and depends upon etymology, the tracing out of the histories of individual words and elements. . . . On accuracy in etymological processes, then, depends the success of the whole; and the perfecting of the methods of etymologizing is what especially distinguishes the new linguistic science from the old. The old worked upon the same basis on which the new now works—namely, on the tracing of resemblances or analogies between words in regard to form and meaning. But the former was hopelessly superficial. It was guided by surface likenesses, without regard to essential diversity which might underlie them—as if the naturalist were to compare and class together green leaves, green wings of insects, green paper, and green laminæ of minerals; it was heedless of the source whence its material came: it did not, in short, command its subject sufficiently to have a method. A wider knowledge of facts, and a consequent better comprehension of their relations, changed all this. Especially the separation of languages into families, with their divisions and subdivisions, the recognition of non-relationships and relationships, and degrees of relationship, effected the great revolution by changing the principles on which the probable value of particular evidences is estimated. It was seen that, whereas a close verbal resemblance between two nearly related tongues has the balance of probabilities in its favour, one between only distantly related tongues, or those regarded as unrelated, has the probabilities against it . . . There are, in short, two fundamental rules, under the government of which all comparative processes must be carried on:—(1.) Comparisons must have in view established lines of genetic connection; and (2) the comparer must be thoroughly and equally versed in the materials of both sides of the comparison. For want of regard to them, men are even yet filling volumes with linguistic rubbish, drawing wide and worthless conclusions from unsound and insufficient premises."

It is, I suppose, undeniable that the principles here laid down are thoroughly sound. The concluding language is strong, but not too strong where it applies; and we ought to be put in a position to show that it does not apply to what I have called the new, but ought to have called the newest, method.

And it is not only the charge of "insufficient premises" we may have to meet. For it may be further objected that, while in many cases the evidence is insufficient or altogether wanting, in many others what evidence there is tends in the wrong direction.

Take, for instance, the statement already quoted: "The Maori *kiri*, 'the hide,' is English *curry*, 'to dress hides.'" The identity, I presume, is declared upon such similarity as there is between them on the surface; what is the evidence against it? *Kiri*, "the skin," is a very widely-spread, and therefore ancient, Polynesian and Melanesian word. What is "curry"? According to Skeat, following Littré, it is from old French *con-roi*, "gear, preparation;" a hybrid word, made by prefixing *con* (= Lat. *cum*) to old French *roi*, order; but this *roi* is itself of Scandinavian origin, from Danish *rede*, "order," or "to set in order." It forms the second part of the word *ar-ray*: to "curry favour" is a corruption of to "*curry favel*," to rub down, or get ready a horse, of which *favel* was an old name. Now, if *kiri* was an original Maori word, whilst *curry* was coined in Europe within historic times, it is evident that their identity can only be by virtue of some extension of the doctrine of "pre-established harmony" well worth elucidation.

Again, Maori *rawhi*, "to seize," and *rawe*, "snatch," are coupled with old English *ravin*, "to obtain by violence," and *raven*, "a greedy bird." But, according to Littré and others, *ravin* comes from Latin *rapina*, whilst *raven*, Max Müller says, is from Sanskrit root RU (a general word for *sounds* of all kinds); so that, it would seem, if we looked to find through the Sanskrit a Maori relative for the raven, it should be not *rawe* or *rawhi*, but *ruru*, "the little owl." If, on the other hand, we were to follow Skeat, who derives *raven* from a root KRAP, also expressive of sound, we should have to give up the *ruru;* but, with the initial *k*, we should be still farther than before from the others.

I have mentioned that Mr. Tregear says "the Maori *taura*, a rope, is pure *taurus*, a bull;" but he seems to have overlooked the fact that *taura* itself occurs in Latin, and as a feminine form: I have even heard of its being translated "a female bull." The translation involves difficulties of its own, but is valuable as suggesting a possible relationship with the extreme West Aryan or Irish "bulls." I will only add that the Greek and Latin forms of the word, *tauros* and *taurus*, seem, according to Skeat, and Liddell and Scott, to have lost an initial *s*, the root being STU; so that, in this respect, the English word *steer*, which is from the same root, is the older.

Again, the Maori *taitea*, "fearful, timid," is coupled with (Gr.) *deido*, I fear. But it will be said, and I think truly, that *taitea* is really two words, *tai* and *tea*, (each of which enters freely into composition with many others), and that in any case its obvious meaning is its original meaning, "the white part" (*i.e.*, the sapwood) of a tree; as in the proverb, "*Ruia te taitea, kia tu ko taikaka anake,*" or shortly, "*Ruia taitea, waiho taikaka*"—"Throw away the sap, that the heart only may be left," *i.e.*, "Put the common people out of it, and let chiefs only take part." The meaning is the same, but the verbal antithesis is more obvious, if *taikura*, "the red (or brown) part," is substituted for *taikaka*. I may add that *kaikea* in Hawaiian is the same word, and has the same meaning of "sap-wood," from its whiteness. It seems reasonable, therefore, to suppose that if the dark-coloured, durable heart of the tree represented the competent man, or chief, the light-coloured perishable sap would represent incompetence in various forms, including certainly timidity. If *taitea* is to be etymologically connected with *deido*, the root of which is DI, it should, I presume, be through this root. But which half of the composite *taitea* are we to connect with it? Remembering the compounds of each, the choice is evidently embarrassing.*

Again, Sanskrit *dubdha*, "doubt," is compared with Maori *tupua*, which, as an adjective, Archdeacon Williams translates "strange," and Mr. Tregear adds, without giving his authority, "uncertain." Does its use as a substantive help to connect it with "doubt"? It means demon, or *taniwha*, *i.e.*, a water monster. And it is to be noted that the word appears also as *tipua*,

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* It might be thought that *tea*, "light-coloured," would naturally connect itself with fear, but, on the principle that a good horse cannot be of a bad colour, the *akatea*, the "white (barked) creeper," is from its durability taken as an emblem of strength and excellence, *e.g.*, "*Rangitihi te upoko i takaia ki te akatea.*"

and in that form makes the distinctive part in the name of the well-known southern lake, the so-called *Whakatipu* (not to mention the still more favoured "Wakatip!") which, as was long since pointed out, (by Dr. Shortland, I believe,) should be *Whakatipua, i.e., Whangatipua*, "the creek (or lake) of the monster," an appropriate name, as he, I think, suggests, in the days of canoe navigation.

"Another most interesting word," says Mr. Tregear, "*reo*, 'speech or language,' has its exact equivalent in the Greek *rheo. Rheo* meant 'to flow swiftly:' as a river word we find it in the Rhine, Rhone, etc.; in New Zealand we find it as *re-re*, 'a waterfall.' But there was another meaning for *rheo*, that of 'speaking quickly.' From the Anglo-Saxon form, *reord*, came our English word 'to read'; so that two English words ('read' and 'rhetoric') have Maori brotherhood through *reo*, 'speech.'" But, according to Liddell and Scott, *rheo*, "flow," is from root SRU, whence our word "stream," the *s* being lost in Greek and Latin: while *rheo*, say, and "rhetoric," (or, rather, the latter, for the former is a supposed word,) is from root ER or VER, whence also apparently, or from a nearly allied root, come Latin *verbum*, and our "word;" "read," on the other hand, according to Skeat, is from the root RADH. If this is so, our poor *reo*, being equally related to them all, will surely be left in the midst of these three roots, SRU, VER, and RADH—a *reo nanu*; a "much mixed," and (perhaps in a somewhat new sense) "confused" *reo*—like a donkey between three equally tempting, but far apart, bundles of hay.

I will only take one more word, and that as illustrating the difference between "the method of insight" and "the method of investigation." The word is the Maori *rakau*, a tree. It is treated by Mr. Tregear in this way: "Sanskrit, *ruhk* (Pali *rukkho*), a tree, Maori *rakau*, a tree"—and that is all: the reader is supplied with that amount of objective information, the rest he is by the theory expected to supply himself. Dr. Codrington also has occasion to treat of the same word. He shows that it is composed of two roots RA and KAU, and he traces these through a large number of island languages, which his investigations have shown to be related.* The latter, KAU, he says, appears in 28 out of the 33 words given by Mr. Wallace for the Malay Archipelago; and in 37 out of 40 of his own Melanesian list. It is therefore most widely spread, and of extreme antiquity. The form varies remarkably, from *kayu, hayu, kasu, hazu, kau, hau, kai, ngai*, down to *ai* and *ei*, and even, Dr. Codrington believes, to *ie*—a very long way from the beginning,

* "Melanesian Languages," p. 95. I hope it will not be thought presumptuous in an outsider to express the opinion that this work will mark an epoch in Polynesian philology, by showing the fundamental relation between the Polynesian and Melanesian languages.

but by appreciable steps. He adds: "It must be observed that in many words this [root *kau*] is compounded with some other, as Maori *rakau*, Santa Maria *regai*, the Mota *tangae*, the Duke of York *diwai*, San Cristoval *hasie*, Nengone *sere-ie*, Ambrym and Ceram *liye*, and *lyeii*. In the case of some of these, the natives who use them are well aware they are compound words. Thus, in Mota, *mol* is a native orange, and properly describes the thorn; *tan-mol* is the trunk and body of the tree; *tan ngae* is the tree regarded in the same way, *ngae* being the tree and *tan* the bulk of it. The Santa Maria people explain *regai* in the same way—*re* is the bulk, *ngai* the tree. Thus, the Maori *rakau* is explained."*

If you look at the amount of labour implied in Dr. Codrington's treatment of this one word, you will agree that the one defect of the method of investigation lies in its not being "delightfully easy."

In conclusion, I should like to make a practical suggestion, with little, if anything, that is new in it, and yet one that ought to be constantly repeated. It is clear that—whether Mr. Tregear's method is held to be scientifically sound, and therefore deserving of far wider application, or to need radical remodelling before it should be applied at all—it can, in regard to the Maori language, be as successfully applied by those who are not in New Zealand as by those who are, and in a hundred years as now: we might be deferring the good day, yet it would be only deferred. But there is one thing which, if not done now—within a very few years—and by us in New Zealand, will never be done at all—I mean the getting upon record all that is as yet unrecorded of the Maoris, their history,† life and language. The race, I trust, will survive as long as ours, or at least until it becomes merged in ours, but the peculiar knowledge of the race is perishing every day; the old men die, and there are hardly any, perhaps none, instructed as they were to take their place. This is no doubt inevitable, from the contact of the great majority of them with us and our ways. Think only of the difference in their habits of life and of thought, even of language, implied in their ability to buy such things as steel tools, clothing, and lucifer matches, instead of having to supply their place by their own peculiar skill and industry. Again, the spread of Christianity, of course, discredited and then practically abolished

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* I would ask: Is the likeness between the San Cristoval *hasie*, and Maori and Hawaiian *wahie*, "firewood," only accidental? If not, and Dr. Codrington's series in *ie* is continuous with the other, there are apparently in Maori two forms of the same word as wide apart as *wahie* and *rakau*.

† The forthcoming work of Mr. John White—his *magnum opus*, I feel sure I may say—should leave little to be desired on this branch of the subject.

their priests—"a professionally learned class"—and all the learning, the ceremonies and formulæ, connected with their so-called religion, with the *tapu* and witchcraft, with war, and with almost all the ordinary occupations of life, exist now in the memory of comparatively few. In short, all that constituted the *differentia* of the Maori people—that which, as expressed in speech and life, distinguished them from all other peoples—is surely and rapidly passing away. It is not in the least likely that this peculiar knowledge will be handed on as of old, except in fragments here and there; and the only sure way of preserving such parts as are not already on record, is by an immediate and systematic search.

Take only the question of vocabulary. Archdeacon Williams' Dictionary (a work for which every student of Maori must be grateful, and to which throughout this paper I have been largely indebted) contains, on a rough estimate, about 7,000 words; Andrews' Hawaiian Dictionary contains about 15,500 words. Now, there is no reason to suppose either that the whole of the Hawaiian words are in Andrews' work, or that the Maori language is less copious than the Hawaiian. In this department alone, therefore, making all allowances, there is an immense work to be done; and it will take many helpers, working for a long time, to do it effectively.

I would, therefore, particularly ask whether some organized effort in this direction is not possible?—some organization for bringing into relation with each other all who are interested in the matter, and are, in any way, qualified to help? Whether this could best be done through the Societies, who might appoint "Maori Committees," or by a separate organization having its head-quarters, say, at Auckland or Wellington, but in any case with local branches, and with corresponding members wherever there are Maoris to be found—I would not presume to say. But, looking from an ethnologic and linguistic standpoint, there is a great work yet to be done, and there is yet the opportunity, and I believe the means, of doing it, if those who are competent will only take the matter up.

ART. LXXII.—*Kahikatea as a Building Timber.*

By L. J. BAGNALL.

[*Read before the Auckland Institute, 18th October,* 1886.]

IN a paper read before this Institute by Mr. E. Bartley, on "The Building Timbers of Auckland," and printed in the last volume of "Transactions," a somewhat one-sided reference is made to kahikatea, and a very low estimate of its value as a building timber is given. As I have had during the past fifteen years excellent opportunities of observing the capabilities of the kahikatea of the Thames Valley, I propose placing before you such facts as will, I believe, give a more just appreciation of its merits.

The kahikatea of the Thames grows upon low-lying, wet ground, but whether it is better or worse than that which grows upon high and dry land, I am not in a position to say, as I have had no experience of the latter. I may here state that I have not been able to obtain any satisfactory reasons for supposing that there is any material difference in the two kinds, or that that growing on dry ground is any more durable than that which is found in the swamps. There are two marked features noticeable in kahikatea trees, as will be seen from the sections of two trees which I have here. The one is quite white all through, while the other shows very plainly the yellow heart, and the outer white, or sap part. The heart is much harder, and contains seams of gum near the centre. In the Thames forests the latter kind is by far the most abundant, the white kind being comparatively rare. The heart in kahikatea is proportionately much less than in kauri, totara, or rimu, and is irregular in form. Logs newly felled are so heavy that many of them barely float, and about 10 per cent. will sink; but, when cut into boards, and dried, the timber is reduced in weight fully 30 per cent. Sawn kahikatea presents a nice appearance. It is clean, and generally straight-grained, and, when dressed and polished, looks well in ceilings and for other indoor purposes. It takes a greater strain to break it than kauri, and does not shrink endways. Apart from the question of its durability, it is otherwise equal to any of our other timbers used for building purposes.

It is, however, more particularly to its durability that I desire to call attention, knowing that this is one of the first requisites of a building timber. For eighteen years the kahikatea of the Thames has been used in considerable quantities in building, but before the first sawmill was started several houses were built of kahikatea, sawn by hand. One of these houses is situated at Te Puke, and was built in 1850 by the late Mr. Thorpe, one of the first European residents of Ohinemuri. I have here a piece of board taken from the original building, which is in a good state of preservation. Here, also, is a section cut from the wall of one of the first seven cottages built at Turua, where the first steam sawmill on the Thames River was erected in 1868. It shows a portion of the ground plate, studs, braces, and weather-boards. You will notice that the stud has the bark on one corner, showing that it is sap-wood. These houses are eighteen years old, and the specimen I show is a fair representation of the state of preservation in which they all are. It has never had a coat of paint; in fact, only one of these houses has been painted, and the only parts which have been renewed are the verandahs and the heart of kauri shingles which covered them. I show you, also, a split kahikatea shingle taken from the roof of a house erected in 1872, which has stood the weather for fourteen years, the average life of heart of kauri shingles.

I could produce numerous other instances, from buildings at the Thames and elsewhere, of the weather-enduring qualities of Thames kahikatea; but these are shown as cases of severe trial, and I claim that the record will compare favourably with that of any other of our local building timbers under like conditions. I know that cases have been recorded where portions of buildings have gone to decay in four or five years, and I do not doubt the truth of the statement; but what does that prove?

I have here a piece of 9in. x 4in. heart of kauri joist, and a piece of flooring of the same timber, which were taken from the floor of a room in one of the public buildings in Auckland. This floor had only been laid six years, but it was so completely rotten that it had to be entirely renewed. I could cite other similar instances which have come under my notice; but would they prove that heart of kauri is almost worthless, when used for joists or flooring? Certainly not. I doubt if even kahikatea could have lasted any longer under the same conditions. Investigation into the circumstances will show that it would be absurd to suppose that any timber would have lasted long in such a place, being exposed to the dampness of the ground, which was within a few inches, and so completely enclosed that there was not the slightest chance of ventilation.

This is but one instance of the unfair treatment which our timbers are constantly receiving at the hands of sawmillers, architects, and builders. The logs are cut up at the mills, and, before the boards have had, in many cases, even a week to dry, they are hurried into their places in the building, painted, or papered, just because the contractor has only a few weeks to complete the work, or he will incur pains and penalties. Imagine the close, musty, fusty atmosphere the timber in the walls of such a house is subjected to, and say if it is any wonder it rots, or that fungoid growths and boring beetles are developed.

The use of unseasoned timber for building purposes is one of the most fruitful sources of decay. This is especially the case where kahikatea is used. It should be thoroughly dry before being used, and protected from dampness after the building is erected. The logs should not be allowed to lie long after being felled before they are sawn, and when sawn the timber should be carefully stacked and filletted for drying. To allow the logs to lie in the bush for any length of time, or the boards to be stacked close together in a heap, is certain, to my mind, to develope those germs which afterwards bring forth fruit in premature decay, or the successful attack of the larvæ of a small boring beetle.

It is in the liability to attack from this pest that the chief objection to kahikatea lies. I have had but few opportunities of noticing the habits of these insects, or of arriving at satisfactory conclusions as to the circumstances which favour their attack. I consider, however, the heart less liable to attack than the sap, and some pieces seem much more enticing than others of the same class. I noticed in an old building at Shortland, which was being pulled down last week, that one stud was completely destroyed, while only a few of the others had been touched. The weatherboards were quite sound and good, although the house was one of the oldest, and had but little care. Dampness and seclusion, if not necessary, are certainly favourable conditions for their operations.

The plan of building so general here is well calculated to assist these insects in their work. There is the strictest seclusion in the space between the weather-boards and the lining, while the latter is papered over, thus affording the utmost security to carry on the work of destruction. I prefer, where kahikatea is used for lining, that dressed timber should be employed; paper being unnecessary, the lining will not be so readily attacked. In Canterbury and Otago, where kahikatea is more used than in any other part of New Zealand, the dressed half-inch lining is sold in large quantities; while in Queensland, which now buys a large quantity of kahikatea, the wooden houses are generally built with single walls, the weather-boards being of the kind known as "rustic," and dressed and beaded on the inside. The frame-work is also dressed, and the partitions are of inch boards, planed, tongued and grooved, and beaded on both sides. This is done so that no harbour will be afforded for the white ant, and other noxious insects which abound there. I think a building so constructed would enjoy perfect immunity from the attack of what I may here call the kahikatea beetle; but as our climate necessitates houses with double walls, the obligation is laid upon us of discovering some simple yet certain remedy for this evil. I shall be glad of assistance from gentlemen of scientific and practical skill in this work, which, considering the extent of our kahikatea forests, is worthy of earnest attention.

Until this discovery has been made, let me urge every person about to build with kahikatea to use only seasoned timber; and here I would say that it takes a much longer time to season timber than most people suppose. Under the most favourable circumstances I do not consider that timber should be used until it has had six months' drying. Do not be in too great a hurry to paint a new house. Great injury is often done to timber by painting it before it is even half-dry. I consider, unless the timber is quite dry, that a building should have six months' exposure to the weather before it is painted.

I have used kahikatea for such purposes as fencing, planking bridges, and furniture, with good result. For fencing and planking the heart only should be used. I have several articles of furniture which are, so far as I can judge, as good, and likely to be as durable, as if they had been made of any other timber in the country.

In conclusion, while I have no desire to place too high a value upon kahikatea, I am anxious that it should take rank in accordance with its merits; and as it is a fact that those districts which have used it the most, and for the longest time, still continue to use it in preference to second-class kauri at the same price, I think it is entitled to take rank before the latter. In this opinion I know that some of the most experienced builders of Auckland, and I believe all at the Thames, concur. The rapidity with which our kauri forests are disappearing will ere long compel those who now affect to despise kahikatea to turn their attention to it as a substitute; and when, by the aid of science and experience, we are able to shield it from the attack of the aforesaid beetle, I feel convinced that it will prove itself no unworthy successor of that illustrious inhabitant of our Auckland forests.

NEW ZEALAND INSTITUTE.

NEW ZEALAND INSTITUTE.

EIGHTEENTH ANNUAL REPORT, 1885–86.

MEETINGS of the Board were held on the 18th August, 1885, and the 8th February, 1886.

The members who retired in conformity with clause 6 of the Act were: The Hon. Mr. Waterhouse, the Hon. Mr. Mantell, and Mr. Travers, all of whom were reappointed by His Excellency as Governors of the Institute.

The elected members of the Board for the current year are: Mr. McKerrow, Mr. Maskell, and Dr. Hutchinson.

There is at present one vacancy in the roll of honorary members, owing to the death during the past year of Dr. Carpenter.

The members now belonging to the Institute are:—

Honorary members	29
Ordinary members—	
Auckland Institute	299
Hawke's Bay Philosophical Institute ...	140
Wellington Philosophical Society ...	256
Philosophical Institute of Canterbury...	135
Nelson Philosophical Society	100
Westland Institute	77
Otago Institute	161
Southland Institute	70
Total	1,267

The volumes of Transactions now in stock are: Vol. I. (second edition), 390; Vol. V., 42; Vol. VI., 43; Vol. VII., 140; Vol. IX., 144; Vol. X., 176; Vol. XI., 55; Vol. XII., 62; Vol. XIII., 63; Vol. XIV., 85; Vol. XV., 197; Vol. XVI., 220; Vol. XVII., 250; Vol. XVIII., not yet fully distributed.

In May, 1885, the following memorandum of a proposed change in the form of publication was considered by the Board, and copies were distributed to the various affiliated societies:—

"I. That each society be left to publish its own proceedings in pamphlet-form or otherwise. The proceedings to comprise: 1. Minutes of meetings. 2. Abstracts of papers or short papers in full. 3. Reports on discussions.

"Each society publishing in pamphlet-form to be expected to exchange liberally with other incorporated societies.

"Papers published at length, or in exhaustive abstract, need not be sent to the Board for republication in the Transactions, unless they require fuller publication with illustration.

"II. The Board to publish transactions and memoirs only—namely: 1. An annual demy-octavo volume as at present, containing miscellaneous papers and general contributions, that require only slight illustrations, or do not form a whole or the definite part of a complete memoir or monograph on any subject. The octavo volume to be called 'Transactions,' and to be distributed free, as at present, to all members of the Institute. 2. A quarto volume of special memoirs and monographs that require full illustration, to be published in parts from time to time as funds permit. Authors to have an opportunity of revising the press and illustrations in the case of the quarto memoirs. The distribution of the memoirs to be on the following terms: To members of the Institute (exclusive of honorary members, who will get them free) at half cost-price, or by compounding by a single payment to the Institute, such compounders to be called Fellows of the Institute.

"That not more than one-fourth of the parliamentary grant be in any year devoted to publishing memoirs, unless in the case of an extra grant being specially made for such purpose."

As a step towards the adoption of this arrangement, a fresh agreement was entered into with the publishers on the 8th February, 1886, whereby they undertake the entire responsibility of placing the annual volume before the scientific public in Europe and America, and take half the risk incurred in printing the volumes required, to meet the extra demand thus created.

Under this contract the printing of Vol. XVIII. was commenced in March, and completed towards the end of May.

This volume commences a new series of the "Transactions of the New Zealand Institute," in which, for convenience and economy, the size of the page has been reduced from royal to demy octavo. An alphabetical index has also been added to the volume for the first time. A general alphabetical index of authors and subjects, for the seventeen volumes which constitute the first series, has been prepared, and will be issued to all members of the Institute.

Vol. XVIII. contains sixty-two articles, also addresses and abstracts of articles included in the Proceedings and Appendix.

There are 488 pages and 16 plates. The following is a comparison of the contents with that of the volume for the previous year :—

	1886. Pages.		1885. Pages.
Miscellaneous	72	...	80
Zoology	146	...	212
Botany	108	...	94
Chemistry	4	...	0
Geology	48	...	50
Astronomy	26	...	0
Proceedings	33	...	35
Appendix	51	...	65
	488		536

The cost of printing the previous year's volume (XVII.) was £590 17s. 5d. for 536 pages, and the cost of the present year's volume (XVIII.), the first of the new series, is £390 14s. 9d. for 488 pages, or £200 2s. 8d. less than last year's publication.

A statement of accounts by the Honorary Treasurer is appended, showing a balance to the credit of the Institute of £60 15s. 11d., besides a credit balance in the hands of the London agent of about £40.

Approved by the Board.

WM. F. DRUMMOND JERVOIS, Chairman. JAMES HECTOR, Manager.

22nd July, 1886.

NEW ZEALAND INSTITUTE ACCOUNT, 1885–86.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
Vote for 1885-86 ..	500	0	0	Balance due for printing Vol. XVII.	63	18	10
Contribution from Wellington Philosophical Society, one-sixth annual revenue	21	3	6	Advertising	4	2	0
				Purchase of second-hand volumes of "Transactions of New Zealand Institute"	1	12	0
				Printing Vol. XVIII. ..	390	14	9
				Balance	60	15	11
	£521	3	6		£521	3	6

22nd July, 1886.

A. STOCK, Honorary Treasurer.

PROCEEDINGS.

WELLINGTON PHILOSOPHICAL SOCIETY.

First Meeting. *30th June*, 1886.

Dr. Hector, President, in the chair.

Papers.—1. "Report on the Infusoria of New Zealand," from the Microscopic Section of the Society. Communicated by W. M. Maskell, F.R.M.S. (*Transactions*, p. 49.)

2. "On the English Scaly Lizard in New Zealand, *Zootoca vivipara*," by T. W. Kirk. (*Transactions*, p. 67.)

3. "Note on the Occultation of Jupiter and its Satellites, 16th April, 1886, as observed at Petone, New Zealand," by Dr. Hector.

Times by watch, approximate to New Zealand mean time: Disappearance of 1st satellite, 11h. 28m. 20s.; 2nd satellite, 11h. 30m. 40s. Planet: 1st limb, 11h. 31m. 35s.; 2nd limb, 11h. 32m. 27s.; 3rd satellite, 11h. 34m. 0s.; 4th satellite, 11h. 35m. 15s. Reappearance: 1st satellite, 12h. 42m. 30s.; 2nd satellite, 12h. 44m. 45s. Planet: 1st limb, 12h. 45m. 30s.; 2nd limb, 12h. 47m. 10s.; 3rd satellite, 12h. 48m. 0s.; 4th satellite, 12h. 49m. 20s. Observed with a 4in. refractor, 100 diameter eye-piece. At disappearance of satellites no change, but sharp and sudden. The advancing limb of the planet on dark edge of the moon was *blurred* before it was flattened, and during the occultation the planet's disc was crossed by a distinct silvery streak parallel with the moon's edge, decidedly brighter than the rest of the planet, and distant about 4″ from the moon's edge. Between this streak and the moon's edge the light was only slightly, if at all, brighter than the rest of the disc. This streak maintained its position relative to the moon's edge until the planet was almost totally occluded, but the last film of light from the planet's limb suddenly shrank to a minute point of light, which disappeared sharply in the same manner as the satellites had done. The reappearance of the planet from the bright limb of the moon showed no silvery streak, but a dusky film seemed to divide the planet from the moon, as it passed from behind, and especially at the time of final emergence.

4. The President delivered an address. (*Transactions, p.* 461.)

Second Meeting: *4th August*, 1886.

Dr. Hector in the chair.

Papers.—1. "On the New Zealand Glow-worm," by G. V. Hudson. (*Transactions*, p. 62.)

2. "On a new Species of Giant Cuttle-Fish, (*Architeuthis kirkii*,)" by C. H. Robson. Communicated by Dr. Hector. (*Transactions*, p. 155.)

3. "On the Earth-worms of New Zealand," by W. W. Smith. (*Transactions*, p. 123.)

4. "On the Track of a Word," by E. Tregear. (*Transactions*, p. 482.)

5. "Additional Information concerning the Eruption at Rotomahana," by Dr. Hector. Illustrated by photographic views taken by Mr. C. Spencer.

Dr. Hector stated that the curves registered by the barographs or self-registering barometers at Auckland, Rotorua, Wellington, Lincoln (Christchurch), and Dunedin, had been received, and showed curious modifications, which might throw some light on these eruptions. The Lincoln barometer showed on the 21st May, at 3 p.m., a very marked indentation, that reappeared on many days at intervals of twenty-four hours. A similar, but inverted, notch was noticed on the 24th at Rotorua, and for some days subsequently, but was wanting at other places. A still more curious fact was, that further notches had appeared on the 28th June and the 1st July, (after the eruption,) at Lincoln, which made him doubt any possible connection between these curves of the barograph and our New Zealand eruptions. He pointed out that at the time of the Sunda eruptions, in 1883, such disturbances in the atmospheric pressure were noticed here and at other places, and suggested that possibly the recent eruptions of Etna, or some outbreak of Mounts Erebus or Terror, in the Antarctic Continent, might have something to do with the matter.

Exhibits.—Dr. Hector showed a new and valuable food fish, caught off the Island of Kapiti by Mr. S. H. Drew. It belongs to the genus *Pimelepterus*, all recorded species of which are confined to tropical seas; but Dr. Günther states in a private note that a fish of this kind caught in Sydney Harbour has been erroneously placed in the genus *Pachymetopon.* The name proposed for this new species is *Pimelepterus drewii.*

A specimen of *Girella simplex*, caught in the Wanganui River, also by Mr. Drew, was exhibited. This fish, Captain Gilbert Mair recognises as the true *Parore* of the Natives, which at certain seasons frequents the mangrove swamps in the North, and about the true nature of which there has been much uncertainty.

Third Meeting: 25*th August*, 1886.

Dr. Hector in the chair.

New member.—H. A. Gordon, F.G.S.

Papers.—1. "Notes in Reference to the Prime Causes of the Phenomena of Earthquakes and Volcanoes," by W. T. L. Travers, F.L.S. (*Transactions* p. 331.)

Mr. Crawford doubted if volcanoes were chiefly situated in tropical regions. He had been surprised to hear of late that the supposed craters in the moon were really made of ice. This would need explanation.

Mr. Hudson made some remarks regarding the fluid condition of the earth's interior not being compatible with the observed effects of the moon's attraction.

Mr. George referred to the difference in temperature of interior of the earth in different countries.

Mr. Maxwell said the contraction of the earth's surface was a prime cause. The earth's interstitial friction was sufficient to generate heat, which, when water is brought into contact with the heated parts, quite explains the explosions that take place.

Dr. Hector considered that the causes referred to by the author were very remote from the causes of the earthquakes and volcanoes of the present, or, indeed, any past geological period which we can study. How the globe solidified and assumed its present form is not the question: but what is the nature and origin of the force that produces the great mountain chains and the ocean beds? If we could drain the ocean-beds, we should find them only bordered by volcanic rocks, that occupy a very insignificant proportion in the Earth's crust, as compared with the stratified rocks. Take a line, for instance, from New Zealand in a great circle to the north-west, through the Indian Archipelago and South Europe, and we find a thickness of stratified deposits about 400 times the thickness of the same formations to the right or left. This is a common feature of all great mountain regions; in fact, there had been a steady depression or inflexing of the Earth's surface, in which deposits of sediment are continuous, until more than 30 miles' thickness had accumulated in that particular line. Then followed a great elevation, or reversal, of the same flexure, so that the sediments are largely removed by denudation, and the basement formation or rocky core of the original surface crust is actually laid open to view. Here, therefore, we have evidence of the Earth's surface having been engulphed to at least 30 miles; and yet in such mountains as the Himalayas, or Alps, volcanic rocks are almost wanting, the igneous rocks present being mainly such as result from deep-seated crushings. If we were dealing with a globe having only a thin shell, resting on a fluid, such flexures would necessarily have been accompanied by most terrific protrusions of the interior matter. Regarding the temperature of the Earth, it has been found that in the Sierra Nevada, in the Comstock lode, when they had gone down 2,000 feet, a temperature was reached at which the men could not work; water gushed from the rock at 145° Fahr., and the temperature could not be kept below 100°. That was 4,000ft. above sea-level, the mouth of the mine being at 6,000ft. At Stawell, in Victoria, the mines start at 800ft. above sea-level, and go down 2,400ft., that is 1,600ft. below sea-level; yet the miners are not in the least degree inconvenienced by increased heat. That shows that the increase of temperature must have been caused by other circumstances than the central heat of the earth. With regard to the objection offered by Mr. Crawford as to the ice on the moon, he mentioned a most interesting paper in "Nature," taken from an American source, by John Ericsson, who shows that a body exposed to space without an atmosphere would be reduced 142° below zero when turned away from the sun; while the side turned towards the sun would never be above 81° below zero.

Mr. Travers, in reply to Mr. Crawford, stated that we know perfectly well that the existence of water on the globe depends entirely on the presence of the atmosphere. Remove the atmosphere, and all the water would ascend into space and be diffused in the form of aqueous vapour. As to the surface of the moon being encrusted with ice, the theory is certainly new, and at variance with all telescopic observation. He then referred to the strides made in lunar photography, and upheld the other theories he had advanced.

2. "On the Honeydew of the *Coccidæ*, and their Fungus," by W. M. Maskell. (*Transactions*, p. 41.)

Mr. H. Travers said that the black fungus found on leaves was the scaly blight.

FOURTH MEETING: *8th September*, 1886.

Dr. Hector in the chair.

Papers.—1. "On Polynesian Folk-lore," by E. Tregear. (*Transactions* p. 486.)

2. "On a new Species of Moth, (*Pasiphila lichenodes*,) by A. Purdie, M.A. (*Transactions*, p. 69.)

FIFTH MEETING: *20th October*, 1886.

Dr. Hector in the chair.

New Member.—Mr. Hughes.

Papers.—1. "On the Waihao Greensands and their Relation to the Ototara Limestone," by Mr. McKay. (*Transactions*, p. 434.)

2. "On Tree Blight," by W. M. Maskell, F.R.M.S.

The author suggested that the Government be petitioned to take some immediate action in the matter, and try by every means to prevent the wholesale destruction of their trees by insects, etc. In his opinion it would be of far greater use to spend some of the vote to the Forest Department in preserving the trees, than in trying to plant olives in Auckland. He had been for some time trying to bring about some action in the matter, and he would move "That a deputation wait upon the Government and petition that something might be done."

Mr. Crawford seconded the resolution, which after discussion was unanimously carried.

Mr. Maskell proposed, and Mr. Chapman seconded, "That the Council of the Society be authorised to take steps to carry out this resolution."—Carried.

Exhibits.—(1.) A fine specimen of female salmon-trout which had been caught by Mr. Rutherfurd in the Hutt River, weighing 11 pounds, was exhibited by Dr. Hector. (2.) The Chairman exhibited a map of the recent earthquakes at Charlestown, which he had just received, and certain remarkable facts connected with them were discussed. (3.) A collection of fossils from Otago were also shown and described by Mr. McKay.

Dr. Hutchinson was nominated to vote in the election of Governors of the New Zealand Institute for the ensuing year.

SIXTH MEETING: *19th January*, 1887.

Dr. Hector in the chair.

New Member.—Mr. J. Esdaile.

Papers.—1. "On a Common Vital Force," by Coleman Phillips.

ABSTRACT.

The author states that his paper contains a subject partaking rather of philosophical inquiry than strict scientific research. But as late discoveries, such as the theories of Darwin, tend in the one direction of asserting "the

positive fluidity of the life-principle in nature," the discussion may lead to the affirmation of some definite principle. It may be assumed that the life-principle is a fluid far more subtle than ether, electricity, or any other of the unknown or unsolved forces of nature: That this fluid is the same in quality, whether used by man, animal, fish, bird, tree, plant, or insect, but differs in quantity; that it occupies a similar place in the economy of the planet, as the subtle ether (without which it is evident light could not travel) or magnetism, which affects the compass, no matter in what spot the magnetized needle may be placed; that this fluid differs from the other great forces of nature, although the life fluid, the subtle ether, and the force we call magnetism, may be variations of one great and as yet unsolved natural force. That the life fluid has some affinity with magnetism is evident, seeing that local magnets attract each other through the general law of magnetism, just as life acts upon life through the general principle of vital force. The author then supports his views by illustrating the identity of the agency, "or life fluid," in all manifestations of instinct and reason, and in all structural divergences both in animals and plants.

2. "On a Branching Fern-Tree," by J. Buchanan, F.L.S. (*Transactions*, p. 217.)

3. "New Plants," by J. Buchanan, F.L.S. (*Transactions*, p. 213.)

4. "On *Ixodes maskelli*, a Parasite of the Albatross," by T. W. Kirk. (*Transactions*, p. 65.)

5. "On a Curious Double Worm," by T. W. Kirk. (*Transactions*, p. 64.)

6. "Additional Notes on New Zealand *Coccidæ*," by W. M. Maskell. (*Transactions*, p. 45.)

Exhibits.—Additions to the Museum were exhibited:—(1.) Large shark's tooth. (2.) Fossils from Tata Island. (3.) Insects from Rio. Presented by Hon. Mr. Waterhouse.

Annual Meeting: 18*th February*, 1887.

Dr. Hector, President, in the chair.

Abstract of Report.

There were seven meetings held, and twenty-eight papers read, during the year.

One hundred and twenty new volumes had been purchased for the library, and 146 volumes bound.

The receipts for the year 1886-87 amounted to £275 9s. 4d., the expenditure £208 1s. 4d., leaving a balance in hand of £67 8s.

A report from the Microscopic Section of the Society was also read.

Election of Office-bearers for 1887.—*President*—Dr. Hutchinson; *Vice-presidents*—Mr. Travers and Hon. G. R. Johnson; *Council*—Messrs. Maskell, Brandon, Hulke, Govett, Pennefather, and Drs. Newman and Hector; *Secretary and Treasurer*—R. B. Gore; *Auditor*—W. E. Vaux.

New Member.—Mr. Clement Lee.

Papers.—The following papers were then read:—

1. "On the Occurrence of Bismuth at the Owen Reefs, New Zealand," by W. Skey. (*Transactions*, p. 459.)

Dr. Hector explained that he had collected this ore, and that this was the only metal required to make the list of metallic elements found in New Zealand complete. This discovery was interesting, as indicating the possibility of finding much more valuable minerals. He also gave an account of the locality where he had found the bismuth.

2. "On the Australian Moth (*Junonia vellida*) found in the Wellington District," by G. V. Hudson. (*Transactions*, p. 201.)

3. "On a New Method of Utilizing Silk Cocoons, suitable for New Zealand produce," by F. W. Pennefather, LL.M.

This was a method by which the cocoons could be used without winding off the silk, or a plan of using the material as floss-silk.

Exhibits.—Scoria from Galatea Fort, 15 miles from Tarawera; specimens from Te Aroha, containing large quantities of silver and only traces of gold; specimens from the Richmond Hill Silver-mine; coal from a new seam at Mokihinui (30ft. seam).

4. The following papers were taken as read:—

"On a New Species of *Alpheus*," by T. W. Kirk. (*Transactions*, p. 194.)

"On Trimorphism in Flowers of New Zealand Fuchsia," by T. Kirk, F.L.S.

"On New Species of *Podocarpus*," by T. Kirk, F.L.S.

AUCKLAND INSTITUTE.

First Meeting: 18*th May*, 1886.

Professor F. D. Brown, President, in the Chair.

New Members.—W. T. Firth, G. Thorne, jun.

1. The President delivered the anniversary address.

Abstract.

I propose this evening to place before you my views as to the future of this Institute, and I venture to think that the present is a very appropriate time for dealing with this subject, for it is a time at which the entire conditions of its existence are undergoing change. For many years after its foundation it was forced, owing to want of means, to restrict its attention to the barest necessities of its existence; its every step was a struggle, and those who helped to found it must now reflect with justifiable pride upon the condition which, in spite of all obstacles, it has attained. Now this long struggle is over, and, owing to the munificent bequest of the late Mr. Costley, and to the setting apart by the Government of certain lands to be sold for the benefit of the Museum, we have passed from a state of penury to one almost of affluence. Under these circumstances, it is absolutely necessary that we should each and all seriously concern ourselves about the work which shall be done, by what is now a great public institution, and one which, if it be rightly conducted, may exercise incalculable influence for good. If our means have been augmented, our responsibilities have been increased in no less proportion; what in the past might have been a trivial mistake may become in the future an error, the gravity of which we cannot estimate. By thus defining our plan of action beforehand, we shall avoid great waste both of labour and money, and shall, at the same time, advance more rapidly along the road of progress. Sir George Grey is fond of repeating the statement that a great nation is being founded in New Zealand, and if this be indeed true—and who shall deny it?—then we also are engaged in the work; and if our portion of the foundations, and it is no inconsiderable portion, be not well and truly laid, if we do not do our utmost to prepare for those who come after us and to hand down to them such a legacy as they have a right to expect, we shall most certainly earn their most hearty condemnation.

Of the many things which lie in the path of a Society like this, founded to encourage literature and science, and to foster the study of the Maori race, three were undertaken from the first—the formation of a Museum, the establishment of a Library, and the holding of meetings of the members of the Society.

First, then, let us consider what shall be our ideal museum, a museum which is by no means beyond our reach, and for the possession of which we might always be striving, though it might be many years before we realized it.

Formerly a museum was regarded as a place in which curiosities of all kinds might be provided with safe keeping. Remarkable stones, the arms of famous soldiers, the clothes of sovereigns, curious works of art, the heads of criminals, all had their places in the museum, and a most extraordinary medley they formed. There are such museums still in many a small European town. As the collections increased and became unmanageable, subdivision forced itself upon the attention, and the stones were separated from the arms, the works of art from the anatomical specimens. The improvement was obvious, but the museum still remained a mere collection of curiosities. After a time scientific classification entered the field, and the objects were arranged according to some system, elaborated by those who had paid attention to the special subject. It then became possible for the visitor who possessed the key to the classification to find his way amongst the collections, and even to observe instances of similarity or dissimilarity with reasonable facility; to those, however, who were not furnished with the key, the new arrangement offered no more and no better lessons than the old. To this day the great majority of museums remain at this stage, and they do so because those who are responsible for their management are conversant with the meaning of the classification; to them all seems clear enough, and they do not, and perhaps cannot, place themselves in the position of those who come to see the collections. This stage of improvement is, in my opinion, by no means the last which may be reached.

It must be remembered that a Natural History Museum is intended to be of use to two classes of individuals. The one class numbers, unhappily, but few persons; these are the mature students of Biological Science, who are enabled by virtue of their wide knowledge to read between the lines and to supply all those thoughts which are suggested by the collection to them, and to them only. If a museum were intended solely for the use of such persons, it would be exceedingly unwise to reject the ordinary classification; indeed, I do not advocate its rejection in any case, but simply the addition of another classification more suited to the second class of persons who make use of the institution. This class includes the great majority of our population—persons who are novices in the subject, and are quite unable to appreciate the meaning of the classification, or, indeed, to gather from it aught but the most confused impressions.

You are not all of you, any more than myself, familiar with all the details of biology, and I may therefore appeal to you to place yourselves in the position of the ordinary visitor to a museum, to look briefly over a collection of birds, of minerals, or of fossils, and then to sum up and estimate the value of the information you have acquired. You will then feel, if you do not already, that the collection fails in its chief object, if that object be, as I maintain that it is, to teach the masses ot the population something really valuable about the world we live in.

The ordinary museum is capable of suggesting thoughts only to those who have already mastered those thoughts.

If you know so much of science as to be unable to regard the collection from this point of view, and if you are doubtful of the justice of my assertions, then follow discreetly, but closely, some party of visitors, and listen to their remarks—their "Isn't that a pretty colour?" and their "Dear me, what a funny tail!" Or perhaps you will follow some more educated party, and will then be rejoiced to hear that the word "Ceylon" on a label calls up memories of a friend who once visited that country, or that in the opinion of the visitor certain feathers would make remarkably good salmon flies. In any case you will come away less confident that the heavy expenditure incurred in maintaining the Museum is fully justified.

Suppose, now, that we attempt a new classification—that we seek to show to the uneducated that there are relations, points of similarity and of dissimilarity, between objects, that we endeavour to bring these points into prominence, instead of leaving them to be clumsily extricated by those who are unaccustomed to the ideas involved; and what do you think will be the result? Why, that our museum, which was dead, will become alive, will rise, as it were, from the grave to tell its myriad stories; while every case will teem with suggestions of profound thought, which the most careless and the most ignorant will be unable to avoid having thrust upon them.

Let me render this more clear by an illustration taken at random from the domain of Natural History. Imagine to yourselves a case devoted to the exhibition of the varieties in the feet and legs of birds. You would find in it the long-legged, flat-footed heron or crane, the web-footed and short-legged water-fowl, the bird of prey with its powerful talons, the burrowing bird, the climbing bird, the running bird, and all others possessing typical forms of feet; you would find accompanying each a drawing of the conditions under which it is accustomed to live and seek its food, or, if the means of the institution permitted, you would find these conditions actually imitated; you would observe that many of the birds had near them drawings of the fossil birds their ancestors, or, at any rate, of their feet and legs; perhaps even you might see the fossils themselves. Further, to each bird would be attached a label, not of the ordinary bald and meaningless description, but one in which attention would be drawn to the points to be noted, and comparison suggested with other inmates of the case. From such an exhibit, a visitor who had never seen or heard of any other bird than a sparrow would learn, and would be almost forced to learn, whole chapters of ornithology. His interest in the subject would be aroused, he would cease to confine himself to feeble or flippant remarks, and would finally return to his home with the firm intention of finding out more about birds. Scores of similar groups of objects will suggest themselves immediately to anyone. The wings of birds, the teeth of mammals, the fertilisation of flowers, the protective imitation of insects, the means taken by insects to protect their eggs, might all form subjects of instruction and enlightenment. Nor need we confine the system to Natural History; we can arrange artistic productions so as to show how one idea has begotten another; how at a certain time the work of a whole people was influenced by one man's thought; how at another the condition of a nation, its prosperity or adversity, was reflected in its art. It will be clearly seen that such groups as are here suggested would differ from the ordinary museum collection in that they would be arranged solely with a view to the elucidation of one idea; whereas the usual arrangement endeavours to convey all possible knowledge at the same time. Those who are experienced in matters of education will not, I feel certain, long hesitate to decide as to which is the best system.

Our future museum, then, in each of its departments, should, as far as is possible, endeavour to fulfil two distinct purposes: it should by special grouping, and by plentiful description on labels and illustration by drawing, lay itself out to interest and instruct the inhabitants in general; and it should maintain, for the benefit of the learned, as complete and well ordered a collection as is possible. The collections required for the first purpose should be attractively and fully displayed; those for the second should be to a great extent kept in drawers or cupboards, only those specimens which are in some way specially remarkable being displayed in cases. By this means an enormous economy of space would be obtained, while the interests of the real student would be equally well if not better served. Nothing whatever is gained by an attempt to exhibit in glass cases the whole or even any considerable portion of the collections of a museum; and no specimen should be placed in a case, unless it is possible to give perfectly definite reasons for showing it to the public.

And now let us turn to questions which, because they are less fundamental, will not improbably be termed more practical. I have said that the first great improvement in museums consists in the separation of the collection into great classes. This subdivision is not only valuable from the administrative point of view, but is necessary in order to avoid incongruous ideas being simultaneously thrust on the visitor. Take our own museum—which is not subdivided, for the simple reason that there is but one room, and that an insufficient one, in which to place all the collections. Here we find that, while we are endeavouring to obtain definite ideas with regard to the skeleton of the moa, our attention is suddenly diverted by the brilliant colours of a vase of wax flowers; we are no sooner set musing upon the mysteries of artificial flower-making, than we are called off to wonder at the peculiarities of Maori archichecture; but while we are attempting to decipher the hieroglyphics emblematic of Maori tradition, we become conscious that close by us is the divine form of Aphrodite, and that a goddess from Olympus is smiling down upon the recent ornament of a Maori village.

Be it well understood that, in speaking thus of our collections, I do not in any way find fault with our excellent Curator, who has done all that he could reasonably be expected to do with the means and appliances at his disposal; nor do I attach any blame to those who have spared neither pains nor money to rear our young museum in spite of every kind of difficulty. The want of subdivision has been due solely to want of means, and now that the one want has disappeared the other ought rapidly to follow it into the past.

To subdivide our collections would be of very great value in quite another way. At present it is not clear that we are particularly interested in any special branch, and hence any person who may have devoted his attention to some subject, such as the accumulation of specimens of native work, is not led to feel that we also are engaged in the same direction. Gifts and bequests, which, as everyone knows, are the great support of institutions such as this, are not attracted, but find their way to England or to other towns in the colony, where it is presumed that they will be more prized and displayed with greater effect. By ignoring this aspect of the question we should, I am convinced, do our museum the greatest injury.

This re-arrangement of the museum in separate departments should, if possible, precede the construction of a museum designed for public inspection; it is, in my opinion, of infinitely more importance than the acquisition of new specimens with which to enrich the collections. It cannot, of course, be properly carried out without additional capital expenditure; but the interest on such capital would amount to less than is now expended on additions to the collections, which do not materially increase the value of the museum. Further, the annual numerical increase of the specimens would only suffer a temporary reduction, which would be recouped tenfold by the additional interest taken in the museum, and by the flow of donations which would undoubtedly follow. Thus, even from the point of view of the rigid economist, this subdivision must be admitted to be necessary. Moreover it would not, probably, be difficult to obtain the necessary capital or part of it as an advance from the Government, at a low rate of interest, or at none at all, on the £10,000 with which the museum is endowed.

There is, as far as I am aware, only one real difficulty in our way, and that is the extraordinary delay of the City Council in adopting decisively a plan for completing their excavations in this neighbourhood. By leaving open for years a question such as that of the future level of an important street, enterprise is checked, improvement rendered impossible, and the return from the rates diminished. I trust that some members of the Council will ere long move in this matter, and that we shall not have a vast scene of devastation permanently imposed upon the centre of the city.

While speaking of the subdivision of the museum, I should like to draw attention to the necessity of deciding without delay as to the precise nature of the collections to which we shall devote our attention. At present we have the beginnings of a natural history museum, of a museum of sculpture, or rather of plaster casts, and of an anthropological museum. Shall we continue always to keep up these three departments? Shall we, in the near future, be likely to add others to them? and, if so, what others? These are questions which must soon be answered, unless we wish to run the risk of wasting the funds at our disposal. In attempting to deal with them, we must be careful not to lose sight of the fact that this is not the only body in Auckland which possesses or will shortly possess a museum, and that it is extremely undesirable that small duplicate collections should be accumulated in different parts of the same town. This remark does not apply with the same force to artistic collections, such as those of oil paintings, which, by their very nature, are not capable of duplication, unless it be admitted that a copy of a picture is a duplicate of it: hence a picture gallery, if it be designed with a view to embody some particular idea, loses nothing of its value by the presence in the same town of other and even of far larger galleries. In other departments, however, duplication of collections involves much waste of labour, and a sad disregard of economy of administration

Let me give a few instances of the duplication which is already arising in our midst. In Natural History we are already competing with the University College, which possesses an increasing Biological Museum, limited it is true, but in some respects superior to our own. In Anthropology, we shall compete with the City, which has been promised by Sir George Grey a beautiful collection of weapons, utensils, and ornaments of Maori and South Sea Island origin. In Art, where, as I have said, the scattering of collections is less hurtful, we shall share with the City and with the Mackelvie Trustees the responsible position of artistic guides to the people of Auckland. Surely we ought to come to some understanding with these bodies as to which work shall be undertaken by them and which by us.

In the case of the University College, an arrangement of some kind is urgently needed, inasmuch as both that body and ourselves are bound to maintain a Biological Museum and a Biological Library. It seems to me to show no great solicitude for the public interest that no one has hitherto made the slightest attempt to avoid the waste caused by the annual expenditure of hundreds of pounds by the College authorities, and by ourselves, for purposes which are in the main identical. I am not prepared to suggest, and should not in any case presume to draw up, any agreement such as would meet the difficulty; but I have not the slightest hesitation in affirming that the biological laboratories of the University College should adjoin and be in material connection with this building. If such an approximation of the similar departments of the two institutions were brought about, you may rest assured that the Auckland Institute would not be the one of the contracting parties which would gain the least.

Another important question is whether we should attempt to add any new departments to our collection. One department there is, which would probably eclipse in usefulness to the citizens all which we now possess. I refer to a Department of Technology. The importance of this class of museum to a colony like this is so great, the arguments in favour of it so undeniable, the examples of increased national wealth and prosperity so numerous, that it would be impossible for me this evening even to place before you the merest outline of the good which a Technical Museum would effect. Suffice it to say, that in nearly all the large towns of England, of Continental Europe, and of America, technical museums and technical classes have been established, and that the people in these places are so impressed with their value and their necessity that they have not hesitated to expend enormous sums upon their acquisition. Thus the little State of Switzerland established, as long ago as 1854, a Technical Museum and School, upon which a sum of £20,000 is annually spent, besides erecting buildings, the mere extension of a portion of which cost some year or so ago £50,000. Again, the Kingdom of Bavaria, with its restricted territory and by no means wealthy population, has erected, at a cost of £157,000, a Technical Museum and School. These are instances of comparatively small attempts in this direction. In Berlin, the building at Charlottenburg, outside the Brandenburg Gate, has cost no less than £450,000. It is always a matter of astonishment to me that throughout New Zealand—and in this respect the colony stands almost alone among civilized communities—no attempt should have been made to satisfy the wants of the population in this respect, and this, too, in spite of the fact that we, of all peoples, most require it. For it is evident that our isolation from the great centres of civilization renders it imperative that the results of that civilization should be placed before us here. Other people can with facility inspect the structures, the manufacturing processes, the mining implements, and the agricultural improvements of their neighbours; and yet, as I have said, they have, almost without exception, found it necessary to establish technical colleges and museums within sight of their homes; we, who must journey 9,000 miles to the Eastern States of America and 13,000 miles to Europe, find that we have no need of institutions such as these.

Yet it is in technical knowledge that the future of this country lies. It must surely be apparent to every one that we cannot compete successfully on the same platform with the millions of India, or even with the dense and ill-paid populations of Europe. It can only be by the application of all our intelligence that we can hope to render the productions of Europe unnecessary to ourselves or place our own on the markets of the world with a fair prospect of remuneration. People talk of small agricultural holdings, of thrifty peasants and happy homesteads, thereby implying that the same grinding toil which was required to make a livelihood in Europe should be repeated here; but the colonist who is willing to do anything at all has outrun such drudgery as this. Give him knowledge, let him understand that ingenuity and invention, education and intelligence, are as compatible with, and as useful in agriculture as in any other occupation whatsoever, and he will cease to avoid the occupation of the land, and to stand listless at the corner of a street. Our aim here should be to make one man do the work of a score, and earn thereby a substantial remuneration; not to bring out here a score of poor creatures to do the work of one trained man, and thereby to cause a repetition of the social difficulties of the old world. Technical education will alone do this, and technical education we do not possess.

I do not, however, regard it as our duty to establish a technological museum. It would, in all probability, be better in the hands of those who, more than ourselves, are continually brought into contact with manufacturers, engineers, miners, and farmers. The wants of the people would be better gauged by our City Councillors than by ourselves, and I would suggest that they could make no better use of their new Art Gallery than to devote it to such a purpose.

It may not be our business to establish such a department, but I hold that our duty does not end with our Museum and Library; that, on the other hand, the maintenance of these is only a fraction of that duty. We have bound ourselves together to encourage literature, science, and the study of the Maori race. We are then, as far as regards these matters, to utilise the strength that lies in union in order to push forward projects which we regard as useful to the community; we are to initiate ideas, to collect evidence, and to do all those other things which must suggest themselves to a wealthy and important society bent on doing good to their fellow-men. If, then, we do not ourselves propose to have a technical museum, we can and ought to do our best to impress upon others its necessity. If we have not ourselves the means of maintaining an experimental farm and botanic garden, we should nevertheless strive to bring about the foundation by others of such an institution.

But let us return to the discussion of our future action with regard to those duties which we have already undertaken. Our Library should be our special care. We should decide, and that before we make any further purchases of books, upon adopting some definite plan, some leading idea, which should be our guide in the formation of the collection. There are many kinds of libraries, but they may, I think, all be classified under three heads—

(1.) Reference libraries.
(2.) Students' libraries.
(3.) Libraries for the general reader.

One library may, of course, if means permit, comprise all three departments. The reference library is intended for the use of persons who possess books of their own, but are unwilling to purchase large and expensive works, which are not only beyond their means, but which contain, perhaps, only a few pages of special interest to themselves. Take, for instance, that well-known work, or series of works, the "Encyclopædia Brittanica." We all, from time to time, would like to have the opportunity to refer to one or other of its articles, but this desire is not so urgent as to impel us to expend upon the purchase of the book some eighty or ninety guineas. The reference library helps us out of the difficulty. On its shelves the book is to be found, and being there used by numbers of people, justifies the money expended in its purchase. There are, of course, vast numbers of books of this character, but in the scientific world none are more important than the serials published under the auspices of the various learned societies; and to which must be added others, such as the "Philosophical Magazine," and the "Annales de Chimie et de Physique." If our library is to be a reference library, we must endeavour to collect all these books within its walls; and as the majority soon fall out of print, and rise thereby greatly in price, it behoves us not to put off their purchase for too long a time.

A student's library requires no definition: it is one which contains manuals, text-books, and treatises on various subjects, and selected monographs upon special branches of those subjects. It is the necessary adjunct of every college and high school.

A library for the general reader contains all those books which are termed "popular," all which are likely to interest or instruct the general public; in fact, all good and useful books other than those mentioned above.

Now, just as we saw that in the case of our collections, we are likely to do unnecessarily, and therefore wastefully, the same work as other bodies are bound to do; so here, we should remember that the City possesses a general library, and that the University College, of necessity, maintains a students' library. Our duty then would seem to be to form a reference library, to expend upon that the funds which we can spare, and not to fritter away those funds in the purchase of a number of books selected for no further reason than that they are nice books to have. If we form here a really good reference library, we shall be doing an incalculable service to our contemporaries, and a still greater service to our children, one for which they will never cease to be grateful.

To sum up the chief points of this very brief address—

(1.) We should subdivide our museum, so as to avoid incongruity of impression, and to facilitate classification and re-arrangement.

(2.) We should decide what departments of knowledge we propose to illustrate in our museum, and confine ourselves to these.

(3.) We should spend our energies to a large extent upon the formation of exhibits specially designed for the instruction of the people. To this must be added a system of ample labelling, or it will be of but little avail.

(4.) We should do our best to extend our influence in the community, and to make of this Society a real and active agent for those interests for which it was formed.

(5.) We should set up some definite aim with regard to our Library, and such aim should include the formation of a Reference Department.

In conclusion, let me beg of you not to regard this address as a mere mass of empty words, strung together for the purpose of filling the greater portion of an hour. The necessity of all which I have suggested has been graving itself on my mind ever since I have had the pleasure of being connected with this Society, and I have felt it my duty to put before you this evening my views with regard to the conduct of this institution—views which may differ in many respects from those of many among you, but which, I earnestly hope, will meet with your serious consideration. We are, as I have said before, no longer a private society, but a public body endowed with considerable means. We have become subject to public criticism; let us do all we can, then, to earn the approval of that public, which, after all, is, in the long run, no bad judge of right and wrong. If we stand still, if we hesitate to venture along the road which fortune has opened out to us, we shall signally fail in our duty. If, when we are called to account by public opinion, we have only to say, "Lo, I was afraid, and went and hid thy talent in the earth; lo, there thou hast that which is thine," we shall not improbably receive the answer, "Take, therefore, the talent from him, and give it him which hath ten talents."

Second Meeting: 14*th June*, 1886.

Professor F. D. Brown, President, in the chair.

Dr. Posnett delivered a lecture on "Primitive Property."

Third Meeting: 28*th June*, 1886.

Professor F. D. Brown, President, in the chair.

New Members.—E. W. Burton, Rev. J. S. Hill, Dr. Lawry, J. McLauren, Prof. H. M. Posnett, C. P. Winkelmann.

Papers.—1. Notes "On the Hot Springs in the Great Barrier Island," by C. P. Winkelmann. (*Transactions*, p. 388.)

2. "On Volcanic Dust," by Professor A. P. Thomas.

Fourth Meeting: 12*th July*, 1886.

Dr. Purchas in the chair.

Paper.—"Observations on the recent Eruption of Mount Tarawera," by S. Percy Smith, F.R.G.S., and J. A. Pond, Provincial Analyst. (*Transactions*, p. 342.)

Fifth Meeting: 26*th July*, 1886.

Professor F. D. Brown, President, in the chair.

New Members.—A. Montgomery, Carl Seequer.

Papers.—1. "Thermal Activity in the Crater of Ruapehu," by L. Cussen. (*Transactions*, p. 374.)

2. "The Tarawera Eruption, as observed at Gisborne," by Archdeacon W. L. Williams. (*Transactions*, p. 380.)

3. "The Tarawera Eruption, as observed at Opotiki," by E. P. Dunnerque. (*Transactions*, p. 382.)

4. "Notes on the Eruption of Tarawera, as seen from Taheke, Lake Rotoiti," by Major W. G. Mair. (*Transactions*, p. 372.)

5. Professor Thomas gave a verbal account of his recent journey to Rotomahana and Tarawera.

Sixth Meeting: *9th August*, 1886.

Professor F. D. Brown, President, in the chair.

Professor A. P. Thomas gave a lecture entitled "Wings: A Chapter in Evolution."

Seventh Meeting: *23rd August*, 1886.

Professor F. D. Brown, President, in the chair.

New Members.—Rev. J. Campbell, Dr. Challinor Purchas.

Papers.—1. "The Medicinal Properties of certain New Zealand Plants," by J. Baber, C.E. (*Transactions*, p. 319.)

Dr. Murray Moore spoke in favourable terms of the paper. He was confident that many New Zealand plants would yield drugs of considerable value. The active principle of the Karaka berry was worth investigation, as it was not improbable that it would be useful in paralytic affections. He gave an instance of the curing of a severe case of dysentery by means of an extract prepared from the root of *Phormium tenax*, and mentioned several other well-known plants which promised to be of service in medicine.

Mr. Stewart mentioned the Kawakawa (*Piper excelsum*), the Raukawa (*Panax edgerleyi*), and the Horopito (*Drimys axillaris*), as likely to prove of medicinal value.

Mr. Adams also commented in favourable terms on the paper. With respect to the poisoning of cattle by Tutu, he pointed out that cattle running freely over the country were rarely if ever poisoned, but if fed in grass paddocks, and then suddenly turned out into the bush, great mortality often ensued. He instanced several plants that might have been included in Mr. Baber's list.

2. "New Species of *Pselaphidæ*," by Capt. T. Broun.

3. "The Two Theories: Evolution or Creation," by J. Buchanan.

Eighth Meeting: *6th September*, 1886.

Professor F. D. Brown, President, in the chair.

Professor Brown gave a lecture on "The Luminosity of Flames."

Abstract.

He commenced by pointing out that a flame was the burning of vapour, never the burning of solids, or of a liquid body. He illustrated this by lighting an ordinary candle, and showed how the tallow had to be melted and volatilised before there was a flame. He elucidated the same theory by blowing the candle out and then igniting it immediately with the light two inches away from the wick. He then proceeded to point out that solid bodies sometimes burnt intensely but without flame. This he illustrated with a piece of charcoal burnt in oxygen. Professor Brown then pointed out from these experiments that a flame was a vapour burning in the air, and that there must be a surface where they joined for combustion to take place. By a series of most interesting experiments he showed the hollowness of flame, and that the hollow contained a combustible vapour; and, by another series of experiments, showed that the flame was a shell separating a combustible from a non-combustible substance. He pointed out that

flames were not always luminous, and by a series of experiments he showed that the luminosity of flames arose from solid particles contained within them, which became white-hot. This theory he illustrated by leading the smoke from a turpentine flame into a Bunsen burner, making the flame of the latter luminous: also by scattering powdered chalk in the flame. He gave further illustrations of this theory by the combustion of magnesium and phosphorus, proving that the luminosity was due to the presence of particles. Professor Brown then dealt with the arguments against this theory, as, for instance, the flame from arsenic. This he explained was an oxide, but he could not illustrate it, as without special provision there would be danger from the fumes. He, however, gave an illustration from carbon sulphide, which when applied to the oxygen jar created some sensation. There was a brilliant light for a moment and then a loud explosion, which created some consternation amongst the audience. He, however, showed that even here there was a solid body in the flame. Professor Brown then in a very interesting manner proceeded to show by a series of experiments that the luminosity of the flame of coal gas was due to the carbon particles contained in it.

Ninth Meeting: 20*th September*, 1886.

New Member.—Dr. Davy.

Papers.—1. "New Species of *Coleoptera*," by Capt. T. Broun. The following species were described:—

Species.	Locality.
Group, Pogonidæ.	
Oöpterus collaris	Mount Arthur
,, pallidipes	,,
Group, Anchomenidæ.	
Tarastethus alpinalis	,,
Group, Bembidiidæ.	
Bembidium anilloides	Moko Hinou Island
Group, Staphylinidæ.	
Quedius fuscatus	Mount Arthur
Group, Pselaphidæ.	
Pselaphus citimus	Howick
Tyrus armatus	,,
Exeirarthra enigma	,,
Group, Cryptophagidæ.	
Telmatophilus olivascens	Mount Arthur
Group, Melolonthidæ.	
Stethaspis prasinus	Wellington
Costleya discoidea	Mount Arthur
Group, Dascyllidæ.	
Mesocyphon pallidus	,,
,, laticeps	,,
Cyphon pauper	,,
,, discedens	,,
,, flavescens	,,
,, nigritulus	,,
,, fuscifrons	,,
,, fulvicornis	,,
,, ornatus	Waitakerei
Cyphanus dubius	Waitakerei Range
Cyphanodes vestitus	,,
Atopida suturale	Mount Egmont

Species.	Locality.
Group, MELYRIDÆ.	
Dasytes oreocharis	Mount Arthur
Group, HELOPIDÆ.	
Agadelium geniale	Puysegur Point
Group, ANTHICIDÆ.	
Anthicus fallax	Howick
Cotes nitida	,,
,, punctata	,,
Group, ŒDEMERIDÆ.	
Techmessa attenuata	,,
Techmessodes versicolor	Waitakerei Range
Cladobius properus	,,
Exocalopus pectinatus	Mount Egmont
Family *Curculionidæ*.	
Cladopais mirus	Mount Arthur
Phrynixus simplex	Mount Egmont
Eiratus pyriformis	Mount Arthur
,, rugosus	Waitakerei Range
Dorytomus grossus	Mount Arthur
Eugnomus nobilis	,,
,, ænescens	,,
,, cyaneus	,,
,, tarsalis	,,
Oreocharis vittata	,,
,, dealbata	,,
Hoplocneme inæquale	Puysegur Point
Stephanorhynchus nigrosparsus	Mount Arthur
,, insolitus	Wellington
Aphela testacea	Cape Saunders
Acalles adamsi	Mount Arthur
,, concinnus	Waitakerei Range
Crisius picicollis	Moko Hinou Island
,, signatus	Mount Arthur
Group, COSSONIDÆ.	
Rhinanisus cheesemani	,,
Group, PLATYPIDÆ.	
Platypus gracilis	Mount Egmont
Group, CERAMBYCIDÆ.	
Gastrosarus picticornis	Nelson
Somatidia grandis	Wellington
Family, *Phytophaga*.	
Allocharis morosa	Canterbury
Metaphilon curvipes	Mount Arthur
Aphilon convexum	Howick
,, latulum	Taranaki

2. "The Mollusca of the Vicinity of Auckland," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 161.)

3. "Ornithological Notes," by A. Reischek, F.L.S. (*Transactions*, p. 188.)

4. "A Descriptive Account of the White Terrace at Rotomahana," by J. Martin, F.G.S.

Abstract.

This paper contained a series of observations and measurements taken at Rotomahana in November, 1883, and November, 1885, giving the most minute and careful details of the structures lately known as the White and Pink Terraces, and of the phenomena of thermal activity there exhibited.

The result of these observations was in favour of the theory that the activity of the Terrace geysers had been gradually increasing; having been in their initial form steam vents, which had decomposed the tufaceous rocks into felspathic mud and clays, which with increasing activity became converted into a silicious cement; the fundamental structure of the Terraces being due to the deposit in a plastic condition of the material removed from the cauldron, subsequently indurated by the percolation through the mass of the intermittent silicious overflow.

The paper was illustrated by a series of photographs, taken and prepared by Mr. Martin, which were afterwards exhibited by lime-light.

Tenth Meeting: *4th October*, 1886.

Professor F. D. Brown, President, in the chair.

Mr. A. J. Vogan gave a lecture entitled "Recent Explorations in New Guinea," being an account of the results obtained by the recent expedition sent out under the auspices of the Geographical Society of Australia.

Eleventh Meeting: *18th October*, 1886.

Professor F. D. Brown, President, in the chair.

Papers.—1. "Notice of the Discovery of Moa Remains on the Great Barrier Island," by S. Weetman. (*Transactions*, p. 193.)

2. "On the New Zealand Species of *Coprosma*," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 218.)

3. "Ornithological Notes," by A. Reischek, F.L.S. (*Transactions*, p. 184.)

4. "Kahikatea as a Building Timber," by L. J. Bagnall. (*Transactions*, p. 577.)

A long discussion took place, in which the value of kahikatea as a building timber was fully described, and the precautions that should be taken in using it pointed out.

Twelfth Meeting: *14th November*, 1886.

Professor F. D. Brown, President, in the chair.

Papers.—1. "Notes on a Salt Spring in the King Country," by Professor F. D. Brown.

2. "The Land and Fresh-water Shells of the Thames District," by J. Adams, B.A. (*Transactions*, p. 177.)

3. "The Work of Earth-worms in New Zealand," by A. T. Urquhart. (*Transactions*, p. 119.)

4. "A Descriptive Account of the Little Barrier, or Hauturu Island," by A. Reischek, F.L.S. (*Transactions*, p. 181.)

5. "The Whence of the Maori," by W. D. Blyth. (*Transactions*, p. 515.)

Annual General Meeting, 21*st February*, 1887.

J. A Pond, Vice-President, in the chair.

Abstract of Annual Report.

Fourteen new members have been elected, and 36 names have been removed from the roll of the Institute since the last annual meeting. Of these, 5 have been withdrawn through death, 18 by resignation, and the remaining 13 from non-payment of subscription for two consecutive years. The number on the roll is now 278.

Among the deaths, the Council regret to have to mention the names of Mr. J. Richmond (of Messrs. Hesketh and Richmond, for many years legal advisers to the Institute) and Mr. D. Nathan. The latter gentleman bequeathed a sum of £100 to the Auckland Institute.

Finance.—For full particulars of the financial position of the Institute, reference should be made to the Treasurer's balance-sheet, which is appended to this report. The total revenue has been £942 9s. 6d.; the yearly subscriptions amounting to £232 1s. The interest received from the invested funds of the Costley bequest has amounted to £631 14s. The total expenditure has been £1,062 3s. 11d., leaving a balance of £119 14s. 5d. due to the Bank of New Zealand. With respect to the Museum Endowment, there is little to report. Several small blocks of land have been sold by the Waste Lands Board, but the greater part of the purchase-money is still in the hands of the Government.

Meetings.—Twelve meetings have been held during the year, at which 29 papers on various subjects were read.

Election of Officers for 1887:—*President*—Professor A. P. Thomas, F.L.S.; *Vice-presidents*—Professor F. D. Brown, B.Sc., and J. A. Pond; *Council*—C. Cooper, Rev. E. H. Gulliver, M.A., Hon. Colonel Haultain, E. A. Mackechnie, Major W. G. Mair, J. Martin, F.G.S., J. M. Moore, M.D., T. Peacock, M.H.R., Rev. A. G. Purchas, M.R.C.S.E., S. P. Smith, F.R.G.S., Rev. W. Tebbs; *Trustees*—E. A. Mackechnie, T. Peacock, M.H.R., S. P. Smith, F.R.G.S.; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—J. Reid.

The following paper was taken as read:—

1. "On the *Foraminifera* of the Hauraki Gulf," by Dr. R. Hauesler, F.G.S. (*Transactions*, p. 196.)

THE PHILOSOPHICAL INSTITUTE OF CANTERBURY.

Popular Lecture No. 1: *28th April*, 1886.

Dr. W. H. Symes, President, in the chair.

"Recent Advances in Electricity," by Professor Bickerton, F.C.S.

First Meeting: *6th May*, 1886.

Dr. W. H. Symes, President, in the chair.

New Member.—Mr. T. H. Foster, M.A.

Papers.—1. "On the Geology of the Country between Oamaru and Moeraki," by Professor F. W. Hutton. (*Transactions*, p. 415.)

2. "Note on the Geology of the Valley of the Waihao," by Professor F. W. Hutton. (*Transactions*, p. 430.)

Second Meeting: *2nd June*, 1886.

Dr. W. H. Symes, President, in the chair.

The President announced that Mr. C. Chilton had resigned his position as Secretary, owing to his removal to Dunedin; that the Council had accepted his resignation with regret, and had accorded him a hearty vote of thanks for his services to the Institute.

Paper.—"The Geology of the Trelissick or Broken River Basin, Selwyn County," by Professor F. W. Hutton. (*Transactions*, p. 392.)

Popular Lecture, No. 2: *14th June*, 1886.

Dr. W. H. Symes, President, in the chair.

"The Life and Works of Ivan Turgenieff," by Miss Lohse.

THIRD MEETING: *5th August*, 1886.

Dr. W. H. Symes, President, in the chair.

New Member.—Mr. W. Dinwiddie.

Papers.—1. "On the Opening Lines of the Antigone of Sophocles," by Professor F. W. Haslam, M.A. (*Transactions*, p. 504.)

2. "Observations on the Development of Flower of *Coriaria ruscifolia*," by Mr. T. W. Rowe, M.A. Communicated by Professor F. W. Hutton. (*Transactions*, p. 317.)

POPULAR LECTURE, No. 3: *30th August*, 1886.

Dr. W. H. Symes, President, in the chair.

"The Volcanic Eruption in the North Island," by Professor Hutton, F.G.S.

FOURTH MEETING: *3rd September*, 1886.

Dr. W. H. Symes, President, in the chair.

New Members.—Messrs. G. J. Anderson, C. J. Frank, and H. Wilson.

Papers.—1. "On the Age and Subdivisions of the Sedimentary Rocks in the Canterbury Mountains," by Sir Julius von Haast, K.C.M.G., F.R.S., D.Sc., Ph.D. (*Transactions*, p. 449.)

Professor Hutton criticised the paper, on the ground that the researches of the Baron von Ettingshausen, which formed the basis of the paper, bore out the views of Dr. Hector rather than those advocated by Sir J. von Haast.

2. "Observations on the Glands in the Leaf and Stem of the *Ngaio*," by Miss C. Alexander, B.A. Communicated by Professor F. W. Hutton. (*Transactions*, p. 314.)

The President announced that the Institute, having been asked to take part in the formation of an Australasian Association for the Advancement of Science, to be inaugurated in celebration of the centenary of the founding of the Colony of New South Wales, had appointed Mr. S. H. Cox, F.C.S., F.G.S., to represent them at the preliminary meetings about to be held in Sydney.

FIFTH MEETING: *7th October*, 1886.

Professor F. W. Hutton, F.G.S., in the chair.

New Members.—Dr. Hunt, Captain Garcia, Mr. W. T. Charlewood.

Papers.—1. "Transcendental Geometry and Mr. Frankland," by Mr. G. Hogben, M.A. (*Transactions*, p. 510.)

2. "Notes on the Anatomy of the Limpet," by Mr. J. A. Newell, B.A. (*Transactions*, p. 157.)

3. "On the New Zealand *Noctuina*," by Mr. E. Meyrick, B.A., F.E.S. (*Transactions*, p. 3.)

Popular Lecture, No. 4: 11*th October*, 1886.

Dr. W. H. Symes, President, in the chair.

"What is Art, and Who are Artists?" by Mr. S. Hurst-Seager, A.R.I.B.A.

Annual Meeting: 4*th November*, 1886.

Dr. W. H. Symes, President, in the chair.

New Member.—Mr. G. Anderson.

Papers.—1. "On the so-called *Gabbro* of the Dun Mountain," by Professor F. W. Hutton. (*Transactions*, p. 412.)

2. "On Poisoning by Metallic Antimony," by Dr. W. H. Symes.

3. The Annual Report and Balance-Sheet were read and adopted.

Abstract.

Six ordinary meetings have been held, at which 10 papers have been read. During the year 12 new members have joined the Institute, but 31 have retired. At present the number on the books is 116. Several additions have been made to the library, and an order for a considerable number of new books has lately been sent to London. Mr. S. H. Cox, F.G.S., has been appointed to represent the Institute at the preliminary meetings of the proposed Australasian Association for the Advancement of Science, to be held in Sydney.

The balance-sheet shows: Total receipts, £146 8s.; total expenditure, £105 14s. 3d., leaving a credit balance of £40 13s. 9d. The reserve, consisting of the subscriptions of life-members, is now £59 16s. 9d.

The following officers were elected for the session 1887:—*President*—G. Hogben, M.A.; *Vice-Presidents*—Professor F. W. Haslam, M.A.; Dr. W. H. Symes, M.D.; *Treasurer*—H. R. Webb; *Secretary*—W. Dinwiddie; *Committee*—Professor F. W. Hutton, F.G.S., R. W. Fereday, S. Hurst-Seager, A.R.I.B.A., T. Crook, Dr. J. Irving, S. C. Farr; *Auditor*—C. R. Blakiston.

OTAGO INSTITUTE.

First Meeting: *15th May*, 1886.

The meeting took the form of a Conversazione.

Second Meeting: *8th June*, 1886.

Professor Parker, President, in the chair.

New Members.—J. Braithwaite, Justin McCarty, Dr. Davies, Rev. H. Belcher, LL.D.

Papers.—1. "Description of New Native Plants," and "A Notice of *Stipa setacea*," by D. Petrie, M.A. (*Transactions*, p. 325.)

2. The Chairman exhibited a series of skulls, painted so as to show the modifications of homologous bones.

3. The Chairman exhibited a stuffed specimen of the great Blue Shark.

Third Meeting: *13th July*, 1886.

Professor Parker, President, in the chair.

New Members.—C. Chilton, M.A., E. Morrison, Dr. Ogston.

Mr. A. Wilson gave a lecture on "The Border Ballads."

Fourth Meeting: *10th August*, 1886.

Professor Parker, President, in the chair.

New Member.—Dr. Roberts.

Paper.—1. The President read a paper "On the New Zealand Species of *Palinurus*." (*Transactions*, p. 150.)

2. The Secretary showed some reproductions of old maps recently added to the University Library.

Fifth Meeting: *7th September*, 1886.

Professor Parker, President, in the chair.

New Member.—G. A. Fenwick.

1. A communication from the Royal Society of Victoria, as to a proposed antarctic expedition, was read.

2. A letter was also read from Professor Liversidge, Sydney, as to founding an Australasian Scientific Association.

3. Dr. Hocken then gave a lecture, the fifth, "On the Early History of New Zealand."

Sixth Meeting: *28th September*, 1886.

Professor Parker, President, in the chair.

Dr. Hocken gave his sixth lecture on "The Early Histor of New Zealand.

Seventh Meeting: *12th October*, 1886.

Professor Parker, President, in the chair.

1. The Chairman showed some embryos of the Kiwi.

Paper.—2. Dr. Belcher read a "Note on Latin Place-Names." (*Transactions*, p. 507.)

Eighth Meeting: *2nd November*, 1886.

Professor Parker, President, in the chair.

New Member.—A. T. Urquhart.

Paper.—Dr. Belcher read a paper on "The Structure of the Greek Theatre."

Ninth Meeting: *17th November*, 1886.

Professor Parker, President, in the chair.

New Member.—M. J. S. Mackenzie, M.H.R.

Papers.—1. "On New Species of *Araneidea*," by A. T. Urquhart. (*Transactions*, p. 72.)

2. "Descriptions of New Native Plants," by D. Petrie, M.A. (*Transactions*, p. 323.)

3. "Description of New Spiders," by P. Goyen. (*Transactions*, p. 201.)

4. Mr. Chapman exhibited some Katipos from the North Island.

5. The Secretary read the annual report, as follows:—

ABSTRACT.

During the session nine general meetings have been held. The first took the form of a conversazione. At the other meetings eleven papers were read. The Council has asked the Rev. Tenison-Woods, of Sydney—a corresponding member of our Institute—to represent this Society at the proposed Association of Scientific Societies in Australasia. During the year eleven new members have joined the Society. The receipts for the year are £109 19s. 6d. The expenditure has been £67 17s. 9d. The balance of assets over liabilities is £210 13s. 10d.

6. The President delivered an address.

ABSTRACT.

It now only remains for me to bring my term of office to a conclusion by delivering the usual presidential address.

First of all, I must refer to the great loss which this Institute has sustained by the death of Mr. Robert Gillies. Mr. Gillies took an active share in the preliminary meeting for the establishment of the Institute, and was at once elected on the Council, continuing a member of that body until last year, when the illness which finally proved fatal prevented his attendance. In 1876 he occupied the presidential chair at a time when the Society was at the height of its prosperity.

In 1875, Mr. Gillies read a paper on "The Habits of the New Zealand Trap-door Spiders;" and in 1887 a paper "On the Nests of some Trap-door Spiders from other Localities;" and one "On recent Changes in the Fauna of Otago," all three papers being published in the "Transactions." Of late years Mr. Gillies's spare time was chiefly given to astronomy, and he spared no expense in furnishing his private observatory with the latest and best instruments.

I may mention some matters in which Government assistance is urgently needed in the cause of science. One is the adequate protection of native birds, especially of the kiwi, kakapo, and weka. Lately, by some unaccountable blunder, some of the ferrets so rashly introduced to keep down the rabbits have been liberated on the western side of Lake Manapouri, where there are no rabbits but large numbers of flightless birds. I am told, on good authority, that the wekas in the Manapouri District have already visibly decreased; and unless vigorous measures are taken to counteract this foolish—nay, criminal act, the most interesting members of our unique avifauna will be doomed to speedy extinction.

A second subject to which I wish to draw attention is the advisability of establishing a Fisheries Board for the Colony. Our marine fisheries ought to be among our most important industries; but to make them so, accurate information as to the habits, food, and reproduction of the food-fishes is absolutely necessary. At present I believe I am correct in saying that we know nothing, or next to nothing, of the life-history of a single one of them, and much of our knowledge as to their food and habits is derived from the frequently untrustworthy and always inexact information of fishermen.

What is wanted for the purpose of developing our fisheries is a marine laboratory, presided over by a competent naturalist who has been trained for this particular work, and furnished with aquaria and breeding grounds, a small steamer for dredging and trawling, etc. In such an institution systematic observations would be made and recorded from year to year, and a series of exact statistics compiled, which would serve as the basis for legislation on the preservation of native or the introduction of foreign fishes. As far as I have been able to make out, some locality in Cook Strait—say in the neighbourhood of Wellington—would be the most suitable place for such an institution. Perhaps, when the Wellington University College is established, it may be found possible to combine the Professorship of Biology with the Directorship of the Colonial Marine Laboratory.

As you are aware, attempts have been made this year towards a sort of federation of learned societies in the British Empire, a movement which may be said to have commenced when the British Association met at Montreal two years ago. The Royal Society of New South Wales has called a preliminary meeting of the proposed "Australasian Association for the Advancement of Science," and has invited the British Association to send delegates to a meeting at Sydney in 1888. The difficulties in the way of such a scheme are great and obvious, but the advantages to men of science in these colonies would be so immense that I sincerely hope my friend and fellow-student, Professor Liversidge, who appears to be the prime mover in the matter, will succeed in his endeavours. Every naturalist in these colonies must of necessity suffer from an ever-present sense of the immense disadvantages he labours under through his isolation from other workers. The ideas which at home he would absorb without effort in ordinary intercourse with others, must here be acquired, if at all, by a laborious course of reading; so that a man with limited leisure and limited capacity for assimilation feels himself getting gradually out of touch with the onward movement, and looks forward with dread to the time when he shall have become hopelessly fossilized.

I have often wished that the Royal Society of London, the great parent of all scientific societies in the Empire, could adopt towards those men of science who labour *in partibus infidelium* some such system as the Roman Curia adopts with regard to Colonial bishops—summon them to headquarters every few years. Unfortunately, in our case there is no body of faithful to pay expenses, so I fear the matter is hopeless. But an Australasian Association, if only it can be kept going, might do a great deal towards remedying the evil, by allowing widely-separated workers to meet and exchange ideas. The main difficulty is, of course, the great distance separating the chief towns of Australasia, and the consequent expense to which members attending the meeting would be put.

In conclusion, I wish to make a few remarks upon some important recent advances in biology. Everyone has heard of the discovery by De Graaf in Germany, and by Baldwin Spencer in England, of a median eye in certain lizards, and notably in the Tuatara. The organ in question is very minute—barely visible to the naked eye—and is embedded in the fibrous tissue filling up an aperture between the parietal bones on the roof of the skull. The skin over this "parietal foramen" is frequently semi-transparent, so that the eye, small as it is, is probably not entirely functionless. In structure, it is remarkable for agreeing, not with the ordinary paired eyes of vertebrates, but with those of many invertebrates. It is connected by a nerve with a part of the brain called the "third ventricle," thus having precisely the relations of that apparently anomalous organ the "pineal gland," which, lying as it does in the very centre of the human brain, was considered by Descartes to be the seat of the soul.

Researches carried on during the last few years by Ahlborn and other observers pointed to the conclusion that the pineal body was to be looked upon as a rudimentary eye, or at least as a sensory organ of some sort; but the demonstration of this view by the discovery of well-formed though minute median eyes in existing vertebrates, may fairly be called one of the most important anatomical discoveries of this generation, and well worthy to rank alongside another biological discovery which awakened a great deal of interest in the colonies two years ago—that of the fact that the monotremes (*Platypus* and *Echidna*) are viviparous, and have meroblastic eggs, like reptile and birds

These discoveries, however, important as they are, can hardly be said to extend the domain of biology. Each can be placed at once in its appropriate pigeon-hole, and, although necessitating a reconsideration of the ordinary views on certain speculative matters, they have no effect on the fundamental conceptions of the science. But there is a series of researches now being carried on by numerous workers in Germany, France, and England, which seem, as it were, to open a new vista, and promise to have as profound an effect on the biology of the future as the work of Schwann and Schleiden—the founders of the cell theory—had on that of fifty years ago. I refer to the researches on the minute structure of cells and nuclei, on the exact nature of the phenomena accompanying the maturation and impregnation of the egg-cell, and of those accompanying secretion in gland cells. One sees a new department of molecular biology unfolding before one's eyes, the various vital processes becoming more and more obviously matters of molecular physics and chemistry.

It would take several addresses of the length of this to give even an outline of this fascinating subject. As it is, I can only refer those who wish to acquaint themselves with the line of inquiry to which I refer to three articles in the "Encyclopædia Britannica"—that on "Physiology" by Professor Michael Foster, and those on "Morphology" and on "Reproduction" by Mr. Patrick Geddes. Suffice it to say, for the present, that biology is daily becoming at once more exact and more philosophical.

I have now only to resign this chair to my friend Mr. Chapman, whom I beg to welcome in the name of the Institute as a man in whom wide and curious learning is happily combined with legal acumen, and whose influence will, I feel sure—especially if seconded by a rise in wool—do much to restore this Society to the state of prosperity in which we all wish to see it.

7. The office-bearers for the ensuing session were elected as follows:—*President*—F. R. Chapman; *Vice-Presidents*—Prof. Parker, A. Wilson; *Secretary*—G. M. Thomson; *Treasurer*—J. C. Thomson; *Auditor*—Mr. Brent; *Council*—Dr. Hocken, G. M. Barr, Dr. De Zouche, E. Milland, Dr. Scott, D. Petrie, C. Chilton.

WESTLAND INSTITUTE.

ABSTRACT OF ANNUAL REPORT.

The number of members on the roll is 85, and the total receipts, including a balance of £22 17s. 1d. carried forward from last year, amount to £229 9s. 3d. The expenditure has been £203 4s. 11d., of which £17 6s. 1d. was expended in purchasing 95 volumes of new books from Melbourne, and £23 was remitted to England for books. The assets exceed the liabilities by £15 18s.

During the year there have been twelve ordinary Committee meetings and one special meeting.

ELECTION OF OFFICERS FOR 1886–87.—*President*—J. P. Will; *Vice-president*—Rev. H. Gould; *Treasurer*—Jno. Nicholson; *Committee*—J. N. Smyth, R. Cross, Captain Bignell, J. Elcoate, A. H. King, E. B. Sammons, C. Horgan, M. Atkinson, C. F. A. Broad, J. W. Souter, M. L. Moss, G. J. Roberts; *Secretary*—Richard Hilldrup.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

First Meeting: 19*th April*, 1886.

The President in the chair.

1. The President delivered an address, in which he brought forward the desirability of establishing a marine station for biological research, and for the study of the mode of propagation of the food-fishes of our coast.

2. The Hon. Secretary exhibited and made a few remarks on *Polypodium novæ-zealandiæ*, *Fusonius cunninghami*, and *Lindsaya viridis* recently collected in this district.

The following were noted as having been obtained near Napier since the last meeting:—Hawk-billed Turtle (*Caretta imbricata*), a young Whale (*Dolichodon layardii*), and a fine specimen of the Fox-tailed Shark (*Alopecias vulpes*), 12ft. 6in. long.

3. Mr. N. Heath communicated the results of some experiments he had made in freezing eggs.

Second Meeting: 10*th May*, 1886.

The President in the chair.

1. *Papers*.—"Origin of Earthquakes," by J. Hardcastle. (*Transactions*, p. 338.)

2. "Occultations, and graphic Methods of computing them," by J. Harding.

3. The Hon. Secretary exhibited rock specimens from Karamea (Red Island); dried skin of *Centriscus humerosus*, or Snipe-fish; a small *Sepiola* in spirits; and some fossils.

4. The members of the Society at this meeting unanimously agreed that the Council should offer to Mr. Colenso the honorary life membership of the Society.

Third Meeting: 14*th June*, 1886.

The President in the chair.

Paper.—"On the Blasting Operations at the Napier Bluff," by J. Goodall, C.E. Samples of the explosives used were exhibited. (*Transactions*, p. 549.)

Exhibits.—The Hon. Secretary exhibited: (1.) a collection of beautiful shells from Southern India; (2.) a set of fossils from Petane; (3.) specimens of the volcanic dust which fell on the deck of the "Southern Cross," from the Tarawera eruptions.

FOURTH MEETING: 12*th July*, 1886.

The President in the chair.

Papers.—1. "On the Geological Structure of the Timaru Downs," by J. Goodall, C.E. (*Transactions*, p. 455.)

2. "On the Marine *Mollusca* of the East Coast of the North Island of New Zealand," by A. Hamilton. (Introductory.)

Exhibits.—The Hon. Secretary exhibited: (1.) specimens from the south side of Mount Tarawera, collected by Mr. W. Munro; (2.) cinders and mud from Morea and Wairoa, sent by Mr. Bold, C.E.; (3.) a number of fossils from Scinde Island, shown by Mr. G. White; (4.) a large box of foreign *Coleoptera.*

The Hon. Secretary announced that he had recently visited Wellington, and had arranged with Dr. Hector for extensive additions to the Museum, from the duplicates in the Colonial Museum.

FIFTH MEETING: 9*th August*, 1886.

The President in the chair.

Papers.—1. "Description of a Curiously Deformed Bill of the Huia," by W. Colenso, F.R.S. (*Transactions*, p. 140.)

2. "Further Observations and Notes on the Gestation, Birth, and Young of a Lizard, a Species of *Naultinus*," by W. Colenso, F.R.S. (*Transactions*, p. 147.)

3. "A Description of a New Species of Orthopterous Insect of the Genus *Hemideina*," by W. Colenso, F.R.S. (*Transactions*, p. 145.)

4. "A few Observations on the Tree-Ferns of New Zealand, with particular reference to their peculiar epiphytes, their habits and manner of growth," by W. Colenso, F.R.S. (*Transactions*, p. 252.)

5. "On Traces of Volcanic Dust-Showers at Napier, Petane, etc.," by H. Hill, B.A. (*Transactions*, p. 385.)

6. "On the Remarkable Sagacity of Small Birds," by Mr. G. Kells, of Napier. Communicated by Mr. N. Heath.

Exhibits:—Specimens were exhibited by Mr. Colenso, illustrating his papers; and also specimens of a small fly recognized by Mr. Maskell as the hitherto unknown male of *Icerya purchasi*, the wattle blight.

The President, at the commencement of the meeting, took occasion to congratulate Mr. Colenso on his election as a Fellow of the Royal Society.

The following resolution was moved and carried:—

"That the members of the Hawke's Bay Philosophical Institute have received with much satisfaction the news that a Fellowship has been conferred by the Royal Society of England upon the Rev. W. Colenso, one of its members, and they authorize that the fact be entered upon the minutes of the proceedings of the Society; and, further, that a letter be sent to Mr. Colenso in the name of the Society, and signed by the President and Secretary, congratulating him upon the honour he has received from the Royal Society in recognition of the services he has rendered to the cause and advancement of science."

SIXTH MEETING: 13*th September*, 1886.

The President in the chair.

Papers.—1. "On the Causes of Volcanic Action," by J. Hardcastle. (*Transactions*, p. 338.)

2. "An Enumeration of Fungi recently discovered in New Zealand, with brief notes thereon," by W. Colenso, F.R.S. (*Transactions*, p. 301.)

3. Mr. N. Heath communicated to the Society the result of an experiment made by Mr. Murray, of Napier, who procured some porpoise-skins from the Mahia, and had them prepared in England, hoping that they might be of use for the manufacture of boots, &c.; but the result showed that the skins were utterly worthless, and the tanner informed Mr. Murray that porpoise-leather is made from the skin of a small species of whale (*Beluga*).

Exhibits.—The Honorary Secretary exhibited stuffed specimens of *Gonorhynchus grayi* and *Chilomycterus jaculifera*, and two species of Holothurians from Port Ahuriri. Mr. Heath brought a skin of *Diodon maculatus*, presented to the Museum by Captain Crayshaw, of Dunedin. Mr. H. O. Johnson, of Hastings, lent for exhibition a beautiful specimen (in spirit) of *Coronula balænarii*, on which were growing three fine specimens of *Alepas cornuti*. Casts of the vertebra and humerus of *Mauisaurus haasti* were also shown, and a beautiful kiwi-feather mat, lent by the Hon. Secretary.

SEVENTH MEETING: 11*th October*, 1886.

The President, Dr. Spencer, in the chair.

Papers.—1. "A Description of some newly-discovered Phænogamic Plants," by W. Colenso, F.R.S. (*Transactions*, p. 259.)

2. "A Description of some newly-discovered Cryptogamic Plants," by W. Colenso, F.R.S. (*Transactions*, p. 271.)

3. "Description of a new *Scaphites*," by H. Hill, B.A. (*Transactions*, p. 387.)

4. "On the Geology of Scinde Island," by H. Hill, B.A. (*Transactions*, p. 441.)

5. "On the Fishes of Hawke's Bay," by A. Hamilton, of Petane.

6. "On the Nest of a curious Trap-door Spider," by A. Hamilton, of Petane.

EIGHTH MEETING: 12*th November*, 1886.

The President in the chair.

1. The President delivered his valedictory address.

ABSTRACT.

In bringing to a conclusion this, the twelfth session of our Philosophical Institute, I think I am in a position to congratulate you on the progress that has been made since the last annual meeting. The number of papers read during the session is 22, a number considerably in excess of the average of previous years. The subjects treated of, also—including Botany, Zoology, Geology, Astronomy, Earthquakes and Volcanoes, and miscellaneous—are sufficiently varied to show that the number of our scientific observers has not diminished, nor has their zeal decreased.

At the opening meeting of the session, I announced to you that the Council had acquiesced in a proposal to ask the aid and the concurrence of the various branches of the New Zealand Institute, in bringing before the Government and in representing the advantages which would accrue to the colony by the establishment of a Marine Biological Laboratory. To this effect a circular was drawn up and a copy forwarded to the Presidents of the Philosophical Societies in the colony, in May last. Answers have now been received from all; and with the exception of one, which declines to join in making any representation to the Government, and one which, whilst fully approving of the principle indicated in the circular, is not prepared to further it at present, all are favourable. Copies of the circular were forwarded also to a number of gentlemen of scientific standing, with a request that they would favour your Council with their opinion and advice; and also, if favourable to the scheme, with their interest. Out of nine letters sent, answers have been received from five gentlemen, all of whom expressed their willingness to support the proposition. Several, however, suggested modifications in the scheme as laid down. This, of course, was nothing more than was to be expected. The details of so large a plan necessarily require much consideration from various points of view before they can be amalgamated into definite and feasible order. The first great point has, however, been, we think, established—that is, the advisability and the practicability of such an institution, and the fact that the project has secured the approval of a large proportion of the scientific men in the colony. As to the economical advantages that would accrue to the country from such an establishment, it is not difficult to show that they would be great. Of the edible fishes which are to be found on our coasts, and in our rivers, comparatively little is known. Their habitats, their spawning (both as to season of year and as to locality), their numbers and comparative value, the best methods of cultivating and capturing them, and, with perhaps few exceptions, their natural history, have never been systematically studied. The cultivation, also, of oysters and edible crustaceans would be fostered, and thus not only would the colony derive the benefit of a largely-increased supply of new, cheap, and wholesome foods, but employment would be found for a considerable population of fishermen, and a class of hardy seagoing people would be founded and encouraged—a class from which, in Great Britain, America, and other countries, the navies are so largely recruited.

I hope before any long time transpires we may see that the Government of this colony is prepared to encourage, if not entirely to maintain, a Marine Biological Laboratory.

I mentioned at the beginning of the session that the Council proposed to commence the formation of a botanical collection, as a special feature in the Museum. A commencement has been made, sufficient to form the nucleus of what it is hoped will eventually become a representative herbarium of the flora of this part of New Zealand.

A short time ago a circular was received from Professor Liversidge, of the University of New South Wales, containing a proposal to establish an Australasian Association for the Advancement of Science, somewhat on the lines of the British Association, and asking this Institute to unite in the scheme. Copies of the circular are laid on the table for the information of any members who may take an interest in the proposal.

As a result of some communications which passed between your Vice-president and the Government, your Council has been encouraged to apply for a site on which to erect a building for the purposes of the Institute. Nothing definite has as yet been settled, but we have reason to hope that a suitable piece of land may be obtained.

2. The President then read a most able and interesting paper on *Microbes.*

3. A number of specimens were shown under the microscope.

4. The President then read a paper on the volcanic eruption at Tarawera.

Abstract of Annual Report.

During the year eight ordinary meetings were held, at which 24 papers and notes were read. The Council have held eight meetings. The Council have opened negotiations with the Government for a building site for the Society. Mr. F. H. Meinertzhagen, of Waimarama, now in England, deposited about 100 volumes of valuable scientific works and books of reference in the library of the Institute. In addition to this, books of the value of £16 0s. 6d. were purchased. Numerous geological specimens and other objects of interest were presented by the Director of the Colonial Museum.

The receipts for the year, including cash balance carried forward from last year, were £118 9s. 10d., to which has to be added the sum of £150 which was on fixed deposit. The expenditure has been £73 10s. 8d., and £100 has been invested on mortgage; and a cash balance of £47 9s. 7d. carried forward.

Election of Office-bearers :—*President*—J. Goodall; *Vice-president*—F. C. W. Sturm; *Council*—J. S. Caro, J. Hardcastle, R. C. Harding, N. Heath, H. Hill, W. I. Spencer; *Hon. Secretary*—A. Hamilton; *Hon. Treasurer*—J. N. Bowerman; *Auditor*—T. K. Newton.

SOUTHLAND INSTITUTE.

FIRST MEETING: 18*th May*, 1886.

Archdeacon Stocker, Vice-President, in the chair.

New Members.—J. L. McDonald, A. Highton, B.A.

Paper.—"Our Remote Ancestors: Who were they?" by Dr. Galbraith.

SECOND MEETING: 15*th June*, 1886.

Archdeacon Stocker, Vice-President, in the chair.

Paper.—"St. Briavels and the Forest of Dean," by Mr. John McPherson.

THIRD MEETING: 13*th July*, 1886.

Dr. Galbraith, President, in the chair.

Paper.—"Evolution," by Archdeacon Stocker.

FOURTH MEETING: 17*th August*, 1886.

Dr. Galbraith, President, in the chair.

Paper.—"Electricity as a Motive Power, and as a Lighting Agent," by A. Highton, B.A.

FIFTH MEETING: 21*st September*, 1886.

Dr. Galbraith, President, in the chair.

Paper.—"Optical Illusions," by Mr. Baker.

SIXTH MEETING; 12*th October*, 1886.

Dr. Galbraith, President, in the chair.

Paper.—"Heat," by Mr. Ireland.

SEVENTH MEETING (Special): 21*st December*, 1886.

Dr. Galbraith, President, in the chair.

Paper.—"Antarctic Exploration in connection with Steam Whaling," by Mr. Charles Traill. (*Transactions*, p. 470.)

ADJOURNED ANNUAL MEETING: 5*th April*, 1887.

ABSTRACT OF REPORT.

The number of members on the roll is 72. The course of fortnightly lectures in connection with this Institute were well attended, and paid expenses. Only 34 members paid their subscription, but in spite of this drawback £20 has been expended in books; and, in addition, the library has been increased by many donations from the United States Geological Department. Credit balance in Colonial Bank, carried forward, £66 4s. 1d.

OFFICERS FOR 1887.—*President*—Venerable Archdeacon Stocker; *Vice-president*—A. Highton, B.A.; *Treasurer*—Mr. Robertson; *Secretary*—Edmund Webber; *Council*—Messrs. Bailey, McLean, and C. Tanner, Dr. Closs and Dr. Galbraith. *Hon. Secretary*—Edmund Webber.

NELSON PHILOSOPHICAL SOCIETY.

[Abstract of Proceedings omitted to be returned.]

13*th April*, 1885.

Dr. L. Boor, Vice-President, in the chair.

Mr. R. T. Kingsley exhibited a specimen of *Peripatus* caught in Nelson, and read a description of same.

Mr. A. S. Atkinson also exhibited a specimen of *Peripatus* caught at Belgrove, and stated reasons for its recent new classification.

Paper.—"The Sublimities of Common Astronomical Facts."

4*th May*, 1885.

The Bishop of Nelson, President, in the chair.

Paper.—"Localization of Faults in Telegraphy," by Mr. J. C. Lockley.

1*st June*, 1885.

The Bishop of Nelson, President, in the chair.

New Members.—The Rev. J. P. Kempthorne, Mr. Smythe, and Mr. W. Bond.

Paper.—"The Connection between Mind and Body," by the Rev. Edward Shears.

3*rd August*, 1885.

The Bishop of Nelson, President, in the chair.

Paper.—"Nelson Surveying, Past and Present," by Mr. J. S. Browning.

31*st August*, 1885.

The Bishop of Nelson, President, in the chair.

Paper.—"The Proper Functions of Government, and the evils arising from overstepping them," by Mr. J. Meeson, B.A.

[Proceedings for remainder of 1885 are printed in previous volume.]

2*nd March*, 1886.

A. S. Atkinson, President, in the chair.

New Member.—Mr. H. M. B. Marshall.

Contributions to Museum.—Collection of Moa bones, by Mr. C. Lewis; carved spear from Fiji, by Mr. G. H. Gore Martin; two seagulls' skins, by Mr. F. Huddleston; two specimens of *Helix hochstetteri*, one marine *Alga*, by Mr. J. Mackay; Blue-Mottled Crow, by Dr. Boor.

Dr. Hudson exhibited two varieties of worms found in the pipes of the Nelson Waterworks.

Paper.—"Technical Education," by M. Fearnley, M.A.

5*th April*, 1886.

A. S. Atkinson, President, in the chair.

New Member.—Dr. Cressey.

Contribution to Museum.—Mounted specimen of *Apteryx oweni*, of unusually pale colour, by Dr. Boor.

Paper.—"Forestry and its Uses," by W. Wells.

Photographs of the Hot Lakes and Terraces were exhibited and described by the Bishop of Nelson.

5*th July*, 1886.

A. S. Atkinson, President, in the chair.

Mr. R. Kingsley exhibited two living specimens of *Naultinus elegans* (?) from Westport—an adult female, and a young one born in captivity. He doubted if they altogether corresponded with the figure and description given in the "Transactions of the New Zealand Institute."

The Hon. Secretary made a communication* on "The Germ Theory of Disease," as introductory to one he intended shortly

* This communication did not represent original matter.

to submit on "The Experiments and Researches of M. Pasteur with regard to Rabies, and the Treatment of Hydrophobia by Preventive Inoculation." Some excellent microscopical specimens of germ disease, lent by Dr. Boor, were shown under a powerful $\frac{1}{10}$th immersion object.

6th September, 1886.

A. S. Atkinson, President, in the chair.

New Member.—Rev. A. Cecil Wright.

Contribution to Museum.—Specimens of volcanic products from Tarawera District, from Professor Hutton.

The Hon. Secretary gave a description* of "M. Pasteur's researches regarding rabies and his treatment of hydrophobia by preventive inoculation."

COUNCIL MEETING: *26th October*, 1886.

A. S. Atkinson, President, in the chair.

The Bishop of Nelson was nominated to vote at the election of a Governor of the New Zealand Institute.

Mr. H. S. Cox, F.G.S., of Sydney, was requested to act as a delegate for the Society at the inauguration meetings of the Australasian Association for the Advancement of Science.

ANNUAL MEETING: *1st November*, 1886.

A. S. Atkinson, President, in the chair.

The Treasurer's report showed that during the past year four new members had been elected; that the loss through death, removals, and withdrawals had been 26; that the present number of members was 57; and that the balance in hand was £36 4s. 11d.

The Secretary's report showed that there had been seven ordinary meetings and twelve Council meetings held during the past year, and that valuable additions had been made to the Library. The number of original papers read had been eight; but some communications, not original, had been made, and a variety of objects of interest had been exhibited.

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* Did not contain original matter.

Election of Officers for 1886-87 :— *President* — J. T. Meeson, B.A. ; *Vice-presidents*—The Bishop of Nelson and A. S. Atkinson ; *Treasurer*—Dr. Hudson ; *Secretary*—Dr. Coleman ; *Council*—Dr. Boor, Dr. Cressey, R. Kingsley, J. Holloway, and J. S. Browning ; *Curator*—R. Kingsley.

Paper.—" The Aryo-Semitic Maori," by the President, A. S. Atkinson. (*Transactions*, p. 552.)

6th December, 1886.

Mr. J. Meeson, B.A., President, in the chair,

New Members.—Mr. J. H. Bettany and J. Keyworth, M.D. Lond.

The Bishop of Nelson gave an account of his recent visits to Tonga, Samoa, and Fiji, describing the Governments, vegetation, scenery, character of the inhabitants, etc., of those islands.

7th February, 1887.

Mr. J. Meeson, B.A., President, in the chair.

New Members.—Mr. W. Justice Ford, M.A., and the Rev. A. Ralph Watson.

New Associate.—Mr. J. G. Bartel.

Paper.—" The Volcanic Eruption of 1886 at Tarawera," by the Bishop of Nelson, illustrated by charts and drawings kindly lent by Dr. Hector.

7th March, 1887.

Mr. J. Meeson, B.A., President, in the chair.

New Member.—Mr. George Ashcroft.

Mr. R. T. Kingsley exhibited a specimen of volcanic product from the South Island, which from its character and other circumstances went to show that there existed a line of volcanic agency running from quite north to south throughout the two islands.

Mr. D. Grant exhibited skeleton (not perfect) of a species of Moa.

Paper.—" The Relation between Mind and Body," by the Rev. Edward Shears.

APPENDIX.

Meteorology.

Comparative Abstract for 1886 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	30·115	1·430	59·1	12·5	46·0	153·0	28·0	·374	73	32·640	165	165	813, on 8th Sept.	6·3
Previous 22 years ..	29·973	..	59·1	..	..	..	..	·395	73	42·782	187	..		..
Wellington	29·958	1·676	54·4	12·1	47·0	150·0	27·0	·338	79	54·477	169	191	700, on 9th Dec.	4·2
Previous 22 years ..	29·921	..	54·7	4·0	..	..	..	·337	72	51·773	158	..		..
Dunedin	29·916	1·892	51·3	15·2	54·0	..	..	·289	75	52·632	178	119	610, on 26th Nov.	5·9
Previous 22 years ..	29·875	..	50·3	..	..	..	..	·277	74	34·665	164	..		..

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.		
	1885.		1886.	1885.		1886.	1885.		1886.	1885.		1886.
Auckland	56·4	..	56·9	64·6	..	66·9	59·7	..	61·5	52·7	..	51·2
Wellington	53·5	..	52·6	60·6	.	61·7	55·6	..	56·9	48·3	..	46·4
Dunedin	50·6	..	51·5	56·4	.	57·9	51·7	..	53·1	44·7	..	42·5

NOTES ON THE WEATHER DURING 1886.

January.—A fine month, with moderate rain; wind generally from N.E., and moderate; temperature about the average. Earthquake at Rotorua on 26th at 4.30 p.m., slight. Meteor in South on 11th.

February.—Generally fine weather, with little rainfall, except in North; wind moderate, and from N.E.; temperature above the average.

March.—In the North rainfall below the average, but in the South rather in excess; temperature generally below the average; a tolerably fine month. Earthquake at Rotorua on 30th at 1 a.m., slight.

April.—On the whole fine, though total rainfall above the average; winds moderate generally, the temperature rather above the average. Earthquakes at Rotorua on 22nd at 3 p.m., 28th at 4.30 a.m., and 30th at 5.30 p.m., and at Wellington on 19th at 9.25 p.m., all slight.

May.—In the extreme North small rainfall, but otherwise rain in excess and generally unpleasant weather with frequent squalls. Earthquake at Wellington and other places in the neighbourhood on 16th, about 4 a.m., smart. Comet observed in South, direction W.

June.—Generally a wet, cold, unpleasant month, with frequent strong winds and snow and hail. On 10th an eruption occurred at Tarawera, and there were earth tremors at Rotorua from 10th to 24th at frequent intervals, direction, N.W. to S.E. Earthquake also at Wellington on 29th at 12.30 a.m., slight, and at Dunedin on 23rd. Meteors seen in South Island on 11th and 12th.

July.—Rather showery, but on the whole fine weather, and rather cooler than is usual for this month. Earthquakes at Rotorua, frequent tremors, from 7th to 14th; at Wellington on 12th, at 7.30 a.m., slight, N. and S.; and at Dunedin on 2nd.

August.—An unusually wet, unpleasant month. Serious floods in the South; very cold and severe, with frequent snow-storms and strong wind. Earthquake at Rotorua on 29th, at 9 p.m.

September.—On the whole a showery, unpleasant month, and strong winds. Earthquakes at Rotorua on 20th, at 6.15 a.m., smart; and Wellington on 3rd, at noon, two smart shocks, E. to W.; and on 7th, at 7 a.m., slight, E. to W.

October.—A cold, wet month, with very unsettled weather, and frequently stormy Earthquakes at Rotorua on 25th, at 11.15 a.m., N.W. to S.E.; and at Wellington on 11th, at 4.12 p.m., slight, and 13th, about 8.30 p.m., very slight.

November.—Fine seasonable weather during this month, and rainfall under the average. Earthquakes at Rotorua on 5th, at 6 a.m, and on 17th at 1.30 and 5.10 a.m.; at Wellington on 10th, at 5 a m., E. and W., slight; 14th, two slight shocks, morning and afternoon; on 26th, at 1 a.m., very smart, and at 3 p.m., E. and W., slight.

December.—A fine month, with very little rainfall, except in South; wind frequently strong, and prevailing from N. and N.E. Earthquake at Rotorua on 28th, smart, at 10.20 a.m.

EARTHQUAKES reported in NEW ZEALAND during 1886.

PLACE.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Rotorua	26	..	30	22 28 30	..	‡10 to 24	‡7 to 14	29	20*	25	5,17, 29	28*	12
Taupo	..	..	..	..	..	..	..	..	..	28*	..	..	1
Gisborne	..	7*	..	..	..	..	..	..	1*	..	..	..	2
Wellington ..	..	..	..	19	16*	29	12	..	3* 7	11, 13	10 14* 26*	..	11
Feilding	..	..	..	..	..	..	..	..	..	..	26*	..	1
Greytown ..	..	..	..	..	..	..	..	..	..	..	26*	..	1
Masterton ..	..	..	..	..	..	..	..	..	..	..	26*	..	1
Carterton.. ..	..	..	..	..	..	..	..	..	..	..	26*	..	1
Wanganui ..	..	..	..	..	..	..	..	..	..	..	26*	..	1
Hawera	..	..	..	..	..	..	..	..	3*	..	..	..	1
Otaki	..	..	..	..	..	..	..	30*	..	..	..	..	1
Rangitikei ..	..	..	..	..	..	..	..	27	..	..	..	..	1
Kaikoura	..	..	..	..	..	..	..	..	3, 5, 7,26, 27	..	..	..	5
Nelson	..	..	..		..	..	..	..	3* 7	..	..	..	2
Blenheim.. ..	..	..	..	..	..	..	12	..	3* 7	..	..	..	3
Christchurch ..	..	..	..	..	..	23	..	..	3	..	..	..	2
Westport	..	..	..	..	..	..	..	..	3*	..	..	..	1
Greymouth ..	..	..	..	..	..	..	..	..	3*	..	..	..	1
Kumara	..	..	..		..	..	..	..	..	..	..	1*	1
Dunedin	..	..	..	..	..	23	2	..	..	..	..	..	2
Invercargill ..	..	..	..	..	..	23	..	..	..	..	..	..	1

NOTE.—The figures denote the day of the month on which one or more shocks were felt. Those with an asterisk affixed were described as *smart*, those with a dagger as *severe shocks*. 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.

‡ Numerous local vibrations connected with the Tarawera eruptions.

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