TRANSACTIONS

AND

PROCEEDINGS

OF THE

NEW ZEALAND INSTITUTE

1884

VOL. XVII.

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

BY

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CORRIGENDA.

PAGE.

5, line 3 from bottom, *for* corner *read* cornu

13, 16, 19 and 20, *for* Plate VII. *read* Plate VIII.

16, line 9, *read* Chermes (Anisophleba) pini,

20 and 31, *for* Plate VIII. *read* Plate VII.

151, line 20, *for* Phaomidæ *read* Phasmidæ

158, line 19, *for* Pupirora *read* Pupivora

167, to last 3 lines in table of dimensions, *add* from snout

179, line 16, *for* Wairau *read* Wairoa

260, line 1, *for* luteo-vivens *read* luteo-virens

263, line 10 from bottom, *for* vividulum *read* viridulum

268, line 22, *for* hyssoid *read* byssoid

270, line 23, *for* primatisect *read* pinnatisect

274, line 10 from bottom, *for* isolated *read* abundant

293, line 11, *for* heavier *read* hairier

314, line 22, *for* pisaniopsis *read* pisanopsis

342, line 9 from bottom, *for* lakes *read* caves

361, line 14, *for* Timaru *read* London

369, line 21, *for* straum *read* steam

369, line 14 from bottom, *for* Maddebûrg *read* Magdebûrg

372, line 23, *for* lava *read* Java

376, line 4, *for* Secchi *read* Facchini

376, line 8 from bottom, *for* Breithom *read* Breithorn

384, line 22, *for* intense *read* vitreous

403, line 22, *for* Cosee *read* Coxe

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

ABSTRACTS OF RULES AND STATUTES.

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

Section I.

Incorporation of Societies.

1. No Society shall be incorporated with the Institute under the provisions of "The New Zealand Institute Act, 1867," unless such Society shall consist of not less than twenty-five members, subscribing in the aggregate a sum of not less than fifty pounds sterling annually, for the promotion of art, science, or such other branch of knowledge for which it is associated, to be from time to time certified to the satisfaction of the Board of Governors of the Institute by the Chairman for the time being of the Society.

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

3. The bye-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 bye-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 bye-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.

WELLINGTON PHILOSOPHICAL SOCIETY.

Office-bearers for 1885.—*President*—A. K. Newman, M.B., M.R.C.P.; *Vice-presidents*—R. Govett, G. W. Grabham, M.D.Lond.; *Council*—T. King, W. T. L. Travers, F.L.S., F. B. Hutchinson, M.R.C.S., Martin Chapman, James Hector, M.D., Dr. Buller, C.M.G., F.R.S., Hon. G. R. Johnson, M.L.C.; *Secretary and Treasurer*—R. B. Gore; *Auditor*—H. F. Logan.

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 1885:—*President*—J. A. Pond; *Vice-presidents*—H. G. Seth Smith, Rt. Rev. W. G. Cowie, D.D.; *Council*—G. Aickin, Professor F. D. Brown, B.Sc., Hon. Colonel Haultain, E. A. Mackechnie, 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., T. Steel, Professor A. P. Thomas, F.L.S.; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—T. Macffarlane.

Extracts from the Rules of the Auckland Institute.

1. Any person desiring to become a member of the Institute, shall be proposed in writing by two members, and shall be 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 1885:—*President*—Dr. W. H. Symes; *Vice-presidents*—A. D. Dobson, T. Crook; *Hon. Treasurer*—H. R. Webb; *Hon. Secretary*—C. Chilton; *Auditor*—C. R. Blakiston; *Council*—Professor von Haast, Professor Hutton, Professor Bickerton, E. Dobson, G. Hogben, R. W. Fereday.

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 1885:—*President*—Professor Scott, M.D.; *Vice-presidents*—Donald Petrie, M.A., F. R. Chapman; *Hon. Secretary*—Professor Parker; *Hon. Treasurer*—J. C. Thomson; *Council*—R. Gillies, M.H.R., W. Arthur, C.E., Professor Mainwaring Brown, M.A., P. Goyen, J. R. Wilkinson, M.A., G. M. Thomson, F.L.S., Dr. Hocken.

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 1885:—*President*—W. A. Spence; *Vice-president*—T. O. W. Croft; *Treasurer*—J. P. Will; *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 special services rendered to the Institute, have been unanimously elected as such by the Committee or at the general half-yearly meeting. (2) Of members who pay two pounds two shillings each year. (3) Of members paying smaller sums, not less than ten shillings.

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

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

Office-bearers for 1885:—*President*—W. Colenso, F.L.S.; *Vice-president*—Thomas Tanner; *Council*—W. J. Spencer, S. Locke, F. W. C. Sturm, H. Hill, N. Heath, H. S. Tiffin; *Hon. Secretary*—A. Hamilton; *Hon. Treasurer*—J. N. Bowerman; *Auditor*—T. K. Newton; *Curator of Museum*—A. Hamilton.

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 1885.—*President*—T. Denniston; *Vice-president*—Dr. Galbraith; *Council*—G. Bailey, Dr. Closs, Dr. Wardale, W. Mchaffey; *Secretary*—W. S. Hamilton; *Treasurer*—W. R. Robertson.

NELSON PHILOSOPHICAL SOCIETY.

Office-bearers for 1884–5:—*President*—The Bishop of Nelson; *Vice-presidents*—A. S. Atkinson, Dr. L. Boor; *Secretary*—Dr. J. Hudson; *Treasurer*—J. Gully, jun.; *Council*—J. Meeson, B.A., J. Park, J. G. Holloway, J. Blackett, A. Greenfield.

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

NEW ZEALAND INSTITUTE.

ANNIVERSARY ADDRESS

OF

THE PRESIDENT,

HIS EXCELLENCY SIR W. F. D. JERVOIS,

G.C.M.G., C.B., ETC.,

DELIVERED TO THE MEMBERS OF THE NEW ZEALAND INSTITUTE, AT THE ANNIVERSARY MEETING, HELD ON THE 4th OCTOBER, 1884.

Plates I.–V.

GENTLEMEN,—

When I had the honour of presiding at the annual meeting in 1883, I chose as the subject for the inaugural address a brief review of the history of the New Zealand Institute, and of some of the advances made in the fields of science and literature during the previous year. I do not propose on the present occasion to follow the same course. Indeed, the annual volume of the Transactions and Proceedings has been so long in the hands of members that the time for commenting on the papers it contains is past. I will only remark that the Institute is to be congratulated on the resuscitation of the Nelson Philosophical Society.

Before entering on my subject this evening, however, I wish to make mention of one or two of the great men who have passed away during the last twelve months.

By the lamented death of DR. VON HOCHSTETTER the Institute has lost one of its honorary members, and another link with the early history of the colony has been severed. In his able work on the general and natural history of New Zealand, he has left behind him not only a noble memorial of his labours during the six years he spent here, but also a volume which will be of permanent interest to the people of this country.

The name of EDWARD SABINE, who has lately been gathered to his fathers at the ripe age of ninety-five, seems to carry us back to a former generation amongst men of science. Sixty-six years ago he accompanied the expedition in search of the North-West Passage, which was commanded by Sir John Ross, as astronomer; and, from that time until advanced age brought his labours to a close, he was a keen observer and able writer on terrestrial magnetism in all parts of the world, as well as other branches of natural science. He visited New Zealand in 1842, when attached to the expedition of the "Erebus" and the "Terror" into the Antarctic regions. His name deserves to be held in special honour by colonists as the originator of the establishment of colonial observatories; one of the most important results of which has been his discovery of the relation between magnetic perturbations and the spotted condition of the sun's surface.

In Isaac Todhunter the world has lost a man remarkable no less for the keenness of his intellect, the breadth of his learning, and the profoundness of his research, than for his simple-minded humility and earnestness of purpose. Not only was he one of the most brilliant mathematicians of his day at Cambridge, but also master of many of the languages of modern Europe, including Russian; at the London University he had carried off prizes for Greek Testament and Hebrew; throughout his life he was an earnest student of Biblical literature, and of most of the branches of theology. Born in poverty, and early thrown upon his own resources, he has left behind him a noble example of what may be achieved by talent aided only by indomitable energy.

Although Sir Charles Siemens was by birth and education a German, yet so much of his long and useful life had been spent in England, that he may fairly be claimed by the land of his adoption. At an early age he turned his attention to the investigation of matters connected with electricity; the cables which have bound all parts of the world together are to a great extent the result of the labours of him and his talented brother Werner; and he lived to see his efforts in one—as in many other departments of science—crowned with success by the opening of an electric tramway in the North of Ireland last year. At the time of his death he was engaged on a work which may, I hope, be carried on by others, and confer a lasting benefit on many millions—the abatement of smoke-fogs in large cities. I regret that time will not allow of my doing more than making a passing allusion to this great and celebrated man.

During the past year I have visited many of the fine harbours of New Zealand and some of its most interesting districts, but all parts of the colony have been so frequently described by former travellers, that

I do not propose now to give any general account of what I have seen during my journeying. As, however, one of the objects of this Institute is to take note of anything that may be of permanent importance to this country, I think it will not be out of place this evening if, as one result of my tours by sea and land, I make some remarks on the protection of the principal ports of the colony, and on the general defence of New Zealand. Of course, however, it will not be possible for me, in the course of an evening's address, to do more than give a general view of the principal points of the question.

Defence of New Zealand from an Imperial point of view.

The defence of New Zealand should be regarded from an Imperial and an Australasian, as well as from a local point of view.

The first line of defence of this, as of every other part of the British Empire, is on the lines of maritime communication. If the steamers and sailing-vessels that carry our exports and imports to and fro along the ocean highways were liable to be captured or destroyed by hostile ships, our commerce would be stopped. The result to the colonies would be disastrous. To Great Britain, it would be starvation.

The commerce of New Zealand alone is upwards of fifteen millions sterling per annum, whilst that of Australasia amounts to upwards of one hundred millions, about equal to that of the whole of South America and Mexico combined.

Naval squadrons are maintained by Great Britain in the British Channel, in the Mediterranean, in the North American and West Indian Command, in the Pacific, in China, on the East Indian Station, at the Cape of Good Hope, and last, not least, in Australasia. These are charged with the defence of British interests and of the lines of British commerce throughout the world, and in case of war would be largely supplemented by ships of the mercantile marine which are capable of carrying guns, and are otherwise adapted for warfare.

Bases for the naval defence of the empire are maintained and fortified by Great Britain, not only at Portsmouth, Plymouth, Chatham, Sheerness, Pembroke, Portland, Cork, and other places in the United Kingdom, but also at numerous places throughout the world, in positions advantageous for coaling, victualling, and refitting the vessels of war charged with the defence of our commerce.

Along the line from England to New Zealand by the Cape of Good Hope are the Islands of Ascension and St. Helena; at the Cape, Table Bay and Simon's Bay. On the route by the Suez Canal are Gibraltar, Malta, Aden, Perim, and Ceylon; then going between

Ceylon and Australasia, *viâ* Torres Strait, is Singapore. Proceeding by the westward route, a ship passes Ascension and the Falkland Islands; or, if, when the canal is completed, by the Panama route, Bermuda, Jamaica, and the Islands of Fiji.

It is a matter of interest to observe that in most of the British possessions, as in Australia and New Zealand, there is a local supply of coal available for marine and naval purposes.

Turning now to the map of the world before you, you will see how intimately Australia and New Zealand, in common with all parts of the empire, are concerned in the defence of British naval stations and in the efficiency of the squadrons which operate therefrom. You will also understand that it is of paramount importance that these stations should be rendered thoroughly secure. They cannot fulfil the conditions required of them if their anchorages, and the depôts and repairing establishments they contain, are not protected against hostile occupation, capture, or destruction, during the absence of the squadrons they are intended to support. It is, I know, often said that the defence of these stations should be dependent upon our fleet, but this view will not bear examination. The depôts are provided to enable our vessels of war to command the sea, and those vessels cannot possess the freedom of action which is necessary for the performance of their duties if they are either tied down to particular places, or are obliged to manœuvre with a view to the protection of those places. The Admiral on a station requires his ships for the defence of our commerce at sea, and he cannot detach them for the purpose of guarding particular ports. If our naval squadrons be employed in defending their depôts, we should (as I have often pointed out) be using the fleet to maintain the depôts, instead of the depôts to maintain the fleet. Our naval depôts, therefore, should be rendered secure in themselves and independent of the action of the fleet. They must be fortified and garrisoned. If so defended, we are enabled to hold them absolutely for the use of ourselves and our allies; and our war cruisers thus supported, and acting along the maritime routes of our commerce, can afford effective *protection* to that commerce. If unfortified, the depôts would during the absence of our squadrons be as much the property of the enemy as of ourselves, and would supply to hostile vessels the means of *attacking* our commerce.

Remember the case of the "Alabama." You well know what losses the mercantile marine of the Northern States suffered during the civil war in America, from the "Alabama" and other ships of that class cruising about on the tracks of commerce, and capturing and burning merchant vessels carrying the United States flag. You also know—from the account of his adventures, published by Captain Semmes, who commanded the "Alabama"—that it was owing to the want of vigilance of the United States naval authorities, and to their neglecting to place men-of-war cruisers in proper positions, that he was able for a considerable period to carry on his attacks unmolested. We further know that the "Alabama" at length became unserviceable from constant cruising; and in a disabled state, not being allowed to go into dock in any port to refit, she was sunk by the "Kearsage" in an encounter with that vessel, which she was not in a condition to avoid. Had the "Alabama" been able to refit and place herself in an efficient state, she might, perhaps, have defeated the "Kearsage" and commenced a fresh career against United States commerce. We learn from this case of the "Alabama"—if indeed the conclusion were not obvious without the lesson—the absolute necessity for ensuring to ourselves, by effective defence, the use of our naval stations throughout the world, in order that they may be denied to an enemy, and that he may thus be unable to keep the sea, at the same time that they provide secure bases for the movements of cruisers engaged in the defence of our commerce. It has been said that the success of the "Alabama" in attacking the commerce of the United States was due to her being able to coal in British ports; and that hostile vessels would be unable to make an attack on Australasia because of there being no means of coaling *en route*. The answer to this is that coaling stations exist in the Pacific Islands; but, even were there none, the improvements in the construction of steamers during recent years have been such that vessels can now steam 28,000 miles at a rate of twelve knots an hour without replenishing their supply of coal.

Defence of New Zealand from an Australasian point of view.

Now, considering the question from an Australasian point of view, the security against attack of certain ports in Australasia is an essential part of the maritime defence of this portion of the empire, and it will be seen that there are some which are of common interest to all these colonies. For instance, looking at the chart of the world before you, you will observe that all ships approaching Australia by the Cape or Red Sea routes must pass comparatively near to King George's Sound. If, therefore, this harbour were held by an enemy, his war-ships acting therefrom might cut off our steamers and merchant-vessels. On the other hand, if secured to us, our men-of-war cruisers could use that port as a base for the defence of our commercial marine. Again, you will see that the Derwent, on which is the Town of Hobart, occupies a central position, whence attacks might be directed against Australia and

New Zealand. The defence of an anchorage in Torres Straits, and of a harbour in the Fiji Islands, is also of common interest, both to this colony and to the Eastern Australian Colonies. Again, New Zealand is, as it were, an advanced shield to the south-eastern part of Australia, and this is the more important in view of the probability of canal communication being opened by the Isthmus of Panama. The harbours to the northward, the southward, and the centre of this colony are advantageously situated as centres for the naval defence of Australasia. If unprotected, however, they become bases for attack upon Tasmania, Victoria, or New South Wales.

The defence of these harbours is therefore not only of importance to the places themselves and to the colony to which they belong, but has a considerable bearing upon the defence of Australasia generally. There is, perhaps, no harbour in Australasia more suitable as a centre for naval defence than Auckland.

It will then be readily understood that it is most desirable that all the Australasian Colonies should unite to carry out defences in which all are interested, making an arrangement by which each would bear its fair share of the expense. Each colony in Australia is now engaged in carrying out a plan for its own protection; but there are matters relating to the general defence of the whole of Australasia which would be best dealt with by combined action. Unity of organization, and especially measures required for general naval protection which are common to the whole of these colonies, can only be carried out under federal arrangement. So far as defence is concerned, New Zealand is probably more interested than any other Australasian Colony in the question of federation.

In the absence, however, of any such organization, each colony must do what is necessary for its own defence, taking care at the same time that, as far as possible, its separate action shall harmonize with any future joint concert with its neighbours which may arise in the course of events.

Nature of attack to which Australasian Colonies are liable.

With respect to the nature of attack to which these colonies are liable in the event of Great Britain being at war with a foreign naval Power, I have often pointed out, on previous occasions, elsewhere, that there is no probability of an expedition on any extensive scale being despatched against Australia. In the improbable event of Great Britain ceasing to hold the command of the seas, such an expedition might perhaps be undertaken with a view of subjugating the colonies and finally annexing them. The very existence of the British Empire, however, depends upon her naval supremacy, and the question must obviously be considered on the assumption that that supremacy is, as it undoubtedly will be, maintained.

In the event of Great Britain being engaged in hostilities with any great maritime Power, the enemy would retain the most powerful portion of his fleet in European waters, or in the Atlantic, for the protection of his country, or for operations in the immediate neighbourhood of hostilities. If he sent his fleet, or any considerable portion of it, on an expedition against the Australasian Colonies, a sufficient part of our Home fleet would in turn be set free to intercept it; and our squadrons in the Pacific, on the China, the Australasian, and Indian stations, might, if necessary, be concentrated to oppose it.

But, whilst the bulk of the enemy's naval forces would be occupied in the immediate scene of action in Europe or America, he might no doubt despatch one or more cruisers, and possibly an ironclad, to operate against our maritime commerce, or make a descent upon Australasian ports, which, if undefended or insufficiently protected, would offer tempting objects of attack. Eluding our cruisers, and appearing suddenly on the coast of New Zealand or Australia, the enemy might capture the merchant-vessels in the harbours; or—under threat of bombardment, or after actually firing into one of the towns—demand and obtain payment of money. Or this object might be attained by an enemy landing a small force in the vicinity of a town, if steps were not taken to meet such a contingency.

Action of Australian Colonies respecting defences.

Of late years the Governments of the several Australian Colonies (I do not include Western Australia) have incurred considerable expenditure in providing defences for their principal ports. In 1877, accompanied by Colonel (now Major-General) Scratchley, at the request of the several Governments concerned, I visited all these colonies, and proposed measures for the defence of Port Phillip, Port Jackson, Newcastle, Brisbane, Port Adelaide, Hobart, and other places. I am glad to say that—thanks to the zeal and energy of Major-General Scratchley, who was charged with the carrying-out of the works—the recommendations made by me are now far advanced towards completion.

At Port Phillip batteries have been constructed and armed for the defence of the entrance and the West Channel, and a torpedo establishment has been provided with a view to applying torpedo defences in suitable positions in the channels within "the heads."

A design for an important marine fort, which forms part of the system of defence—with reference to which, accompanied by Major Cautley, I recently held a meeting at Melbourne with all the authorities concerned—has been prepared, but awaits a final settlement of the details before it is carried into effect. As regards floating defences, Victoria possesses the "Cerberus," a two-turreted ironclad monitor; the frigate "Nelson;" two fine gunboats; and three torpedo-vessels—one, the "Childers," a specially powerful craft. Guns will also be mounted in vessels belonging to the Harbour Department of Melbourne.

At Port Jackson forts and batteries have been constructed and armed, and a casemated battery, with iron shields, is now in course of completion. Torpedo defences have also been provided there. In connection with the defence of Sydney a fort has also been erected at Botany Bay. The defence of the important coaling station at Newcastle has been provided for by a fort and by torpedoes. The Government of New South Wales also possesses the "Wolverene," as a man-of-war training-ship, besides torpedo-vessels.

South Australia has provided a fine vessel of war—the "Protector"—for the defence of her sea-board, in addition to land batteries at Port Adelaide.

The Government of Queensland has constructed a work to command the approach to Brisbane, besides providing two gunboats and two torpedo-vessels, which will soon leave England for that colony.

In Tasmania, batteries and torpedoes, besides a torpedo-vessel, have been provided for the defence of Hobart.

In the Australian Colonies, moreover, military and naval forces have been organized or are in course of organization, and the services of officers of the Imperial Navy and Army have been obtained as desired by respective Governments.

Defence of New Zealand from a local point of view.

Now, it will be observed that, in proportion as Australia is defended and New Zealand is left defenceless, this colony is all the more open to attack. Moreover, owing to the position—to which I have before referred—that New Zealand occupies as an advanced shield to the principal parts of Australia, an enemy coming from the eastward would most probably first direct his attack upon her. Scarcely any steps have been taken however for placing this colony in a state to resist external aggression.

Four torpedo-vessels have been recently provided, and a few years ago some guns with ammunition and other appliances were ordered by the Government of the day, but as yet no arrangements have been made for placing them in position at the several ports for the protection of which they were intended.

Before these armaments could be properly turned to account, it was necessary that definite plans should be prepared of the works required for the defence of these harbours, and, with this object, the services of an Imperial officer—Major Cautley, R.E.—have been placed at the disposal of the Government.

The question of the defence of New Zealand has been ably reported upon by Major-General Scratchley, but, his visit to the colony being necessarily brief, he was unable to undertake the supervision of the designs of works necessary for the object, and no sufficient idea of the probable cost of them was at the time entertained.

Of all parts of Australasia, New Zealand, owing to her extensive seaboard and numerous harbours, is most in need of local naval protection. The principle on which the defence of the colony must be based is, that whilst the general protection of its commerce and seaboard is provided for by naval means, the chief cities and ports should be rendered secure in themselves by land batteries, submarine mines, and other local defences. By fortifying these places, the chief centres of wealth are absolutely protected, whilst each becomes a focus of refuge or action for the general naval defence.

The main general plan should therefore be to fortify Auckland Harbour, Port Nicholson, Port Lyttelton, Port Chalmers, and the Bluff Harbour; thus setting free the Imperial cruizers and any local naval force we may possess, and thereby greatly strengthening our power of general maritime defence. In fact, the fortification of these five ports is part and parcel of the naval defence of the colony.

It is obviously impossible, however, to fortify all the harbours of New Zealand. There are in this colony what I may call clusters of ports, at the north, the centre, and the south, which are capable of sheltering large ships, but at which there is only a small, in some cases no, population. In the north, besides Auckland, there are other fine harbours in Hauraki Gulf, viz., Kawau Harbour, Tamaki Strait, Coromandel Harbour; and, in the Great Barrier Island, Port Fitzroy and Port Abercromby. Again, to the northward of these, are Whangarei Harbour and the Bay of Islands (in both of which there are coal mines), Whangaroa Harbour, and Doubtless Bay. In the centre, besides Wellington, are Queen Charlotte's Sound, Nelson, Picton, and other ports and anchorages. To the southward of the Bluff Harbour there are, in Stewart Island, the grand harbours of Patterson's Inlet and Port Pegasus. At this part of the colony, moreover, to the south-west of the Middle Island, there are the numerous harbours at the Sounds.

The protection of all these, as also that of Napier, New Plymouth, Timaru, Oamaru, Hokitika, Greymouth, Westport, and other comparatively minor places, must be provided for by local naval forces acting as auxiliaries to Her Majesty's cruisers, and combined as far as practicable with other means of defence. At or near most of the places last named, field forces of riflemen and field guns would also be available for their protection.

Remarks respecting guns, submarine mines, &c.

Before referring to the plans for the security of the principal places of New Zealand, I will make some general remarks respecting guns and submarine mines, and the mode in which they should be applied.

I wish for a moment to draw your attention to the enormous increase which has taken place during the last twenty-five or thirty years in the size and power of guns.

When I first had to deal with fortification works, in 1852, and for several years afterwards, the most powerful piece of artillery was the smooth-bore 68-pounder. Now we have guns of 100 tons weight. In the large diagram before you, you see the 68-pounder shown inside the 100-ton muzzle-loading gun. The length of the 68-pounder is 10ft., whilst that of the 100-ton gun is 32ft. 6in. Here is a model of the 68lb. shot and of the cartridge for that gun; there is a model of the missile and charge for the 100-ton gun. The missile is 2,000lb. in weight, the charge is 550lb. of gunpowder, *i.e.*, five barrels and a half, and the two together measure about 10ft. in length! I may mention that some of these 100-ton guns are actually mounted at Gibraltar and Malta. In the more recent manufacture of powerful guns, however, breech-loading has been adopted, and the calibre reduced, whilst the length of the piece is increased, in order to provide the required capacity for the expansion of the gases of the very large charges used, which consist of very slow-burning powder. There are guns now in existence on this principle of 70 to 75 tons weight, which are superior in power to the 100-ton gun to which I have just referred.

It is scarcely necessary for me to say that I do not suggest that such enormous guns as those to which I have just referred shall be employed in the defences of New Zealand. Ships carrying armour of a thickness which these pieces are intended to pierce are not likely to find their way to Australasia.

The Government of New Zealand, in 1878, acting on the advice of a Committee assembled in London to consider questions relating to the defences of the colonies, procured from England a number of 7-inch and 64-pounder muzzle-loading rifled guns. These will form a considerable portion of the armament of the proposed works.

The 64-pounder is not an armour-piercing piece, though effective against vessels unprotected with iron plating; but the 7-inch gun is calculated to pierce 7 inches of iron at 1,000 yards, and 6 inches at

2,000 yards. It is, however, desirable that a few pieces of greater power should also be mounted on the batteries. I therefore consider that a few of the latest type of 8-inch breech-loading guns shall form part of the armament. These will pierce 7 inches of iron at 3,000 yards.

The question of the power of gun required in the defensive batteries of course depends upon the description of vessels by which these colonies may be attacked. All authorities agree that ships of war, of some sort, may make a descent upon Australasia, but a difference of opinion sometimes arises as to whether a hostile iron-clad is likely to appear in these waters. Though I believe that the class of vessel by which we are most likely to be attacked is a swift ship, of great coal-carrying power, such as I will hereafter describe, it appears to me that, in determining on our plans, it would be unwise to act on the assumption that vessels protected by iron-plates, in greater or less degree, may not be employed in the attack.

As regards the designs of the works for the reception of the guns already in the colony, as the carriages and platforms supplied for them are arranged for batteries "en barbette" (see Plate IV.), *i.e.*, guns with a wide sweep firing over a parapet, that system will, as a rule, be adopted. The only exception to this will be in a case, to which I shall hereafter refer, where it will be necessary to place the guns in casemates in order to protect them from fire from heights in their rear. Designs for batteries.

With respect to the guns not yet provided, it is proposed that they shall be mounted on "disappearing" carriages by means of which—excepting at the time of actual firing, when the gun and one man only is exposed—both gun and gunners are absolutely protected from an enemy's fire.

I pass on to consider the use of submarine mines, which should, when practicable, be employed in the defence of harbours, in order to stop an enemy's ships and detain them under the fire of the batteries. I am glad to find that Admiral Scott, of Dunedin, so well known at the Admiralty for the great improvements which he effected in regard to ships' gun-carriages, is specially advocating the adoption of this element of defence. Submarine mines.

Twenty years ago there was very little method in employing these engines of war, but now the application of them has become quite a complicated science.

They may be divided into three classes, viz., mechanical mines, observation mines, and electro-contact mines.

The first explode when struck, but, as they may be dangerous to friends as well as foes, should be applied with great caution. With the second, also called dormant mines, each mine or set of mines must be fired when the vessel passes over. The position of the enemy's vessel over the mine-field must therefore be accurately determined, and a careful watch kept both by day and night. With electro-contact mines the mine itself, or a smaller float above it, called a circuit-closer, indicates through the cable when contact is made with a passing ship. The mine can then be discharged under a hostile vessel, whilst a friendly one is allowed to pass over.

In arranging a field of submarine mines the passage of friendly vessels should be hindered as little as possible. If it extends across an entrance, say, from 1,000 to 1,800 yards, observation mines might be used from 400 to 800 yards from the observing station, and thus afford an open channel for traffic; whilst the rest of the field could be guarded with electro-contact and mechanical mines.

With regard to the position of a field of submarine mines, great depth of water is unsuitable; so is a broken, rocky bottom; tumultuous tide-rips, strong tides, and exposure to the unbroken force of ocean waves will disarrange the electric contact and in time damage the cables.

It must be borne in mind that submarine mines can be removed or rendered harmless by the deliberate action of an enemy working with boats—in countermining, dragging them, or cutting the cables by which they are fired, and that they must therefore be protected by the fire of artillery on the boats and on the enemy's vessels covering their action.

I will now briefly refer to the defences required at the principal harbours and towns.

AUCKLAND.

I have already spoken of what may be called the northern cluster of harbours. Auckland is the naval centre from which all these must be defended.

The town is situated on the south side of the harbour (see Plate I.), and upwards of 4,000 yards distant from the entrance—1,500 yards wide—between the North Head and the opposite shoal. There are two approaches to the harbour: one—the main channel—to the westward, the other to the southward of Rangitoto Island. These are alike lighted by a lighthouse on the Bean Rock, which is about 2,000 yards distant, and nearly to the eastward of the North Head. Both channels are well commanded from the North Head; and on that point, therefore, batteries should be established. It would be advisable also to place a battery on Takapuna Head, which will materially aid in the defence. These should be supported by a central work on Mount Victoria, which will act as a citadel by which absolute possession of the peninsula on the north side of the harbour will be secured. Some guns also, facing the entrance to the harbour, should be placed on the south shore at Resolution Point.

A field of submarine mines should be laid across the harbour in the most convenient situation to prevent an enemy running at full speed past the batteries and up the harbour, to a position out of range of our guns from whence he could fire into Auckland. It should be observed that there is deep water extending for upwards of four miles above the town.

As regards the defence of Auckland against a force landed, as it might be, in Tamaki Strait, on the southern shore of the Hauraki Gulf, this can only be met by a field force. There are excellent positions for such defence behind the Tamaki Inlet and the neck which divides it from Manukau Harbour. The difficulties of navigation will probably suffice for the defence of that harbour; but, if anything further be required, there is a favourable site for a battery near Onehunga.

The waters of the Waitemata, with the citadel on Mount Victoria and its outwork at Takapuna Head, commanding the narrow neck near it, will fully protect Auckland from land attack on the northern side.

PORT NICHOLSON AND WELLINGTON.

Port Nicholson stands in the same relation to the central cluster of harbours that Auckland does to the northern.

On examining the chart (see Plate II.) the first plan that suggests itself for the defence of Port Nicholson is to place lines of torpedoes between the reef under Dorset Point and Hind's Point, where the channel is only about 1,400 yards wide, and to establish a battery on Dorset Point, whence artillery fire might be brought to bear on hostile vessels covering attempts to remove the submarine defences.

The passage, however, being open to the full force of southerly gales, there would be considerable difficulty in establishing and maintaining lines of torpedoes across it in an efficient state, and in the absence of an efficient system of submarine mines no reliance can be placed on being able to stop attacking vessels at the entrance. Once past it, there would be nothing to prevent their running on, occupying the harbour, and levying a contribution upon Wellington.

Tempting, therefore, as is the proposal to rest the defence of Port Nicholson upon a system of torpedoes protected by artillery fire on the outer channel, this plan must be discarded in favour of one which will more surely effect the required object.

It will be seen, on striking an arc of 4,000 yards radius from Halswell Point as the centre, that the whole of the estuary within effective range of Wellington—including the entrance channel and Evans's Bay, but excepting a small portion on the southern side of the inner harbour (which, however, is well seen from Kaiwarra)—can be commanded from the Halswell Point Peninsula.

It is proposed therefore that batteries shall be placed so as to command the harbour, and the approach to it, at three points on that peninsula, namely, Halswell Point, Gordon Point, and the point about midway between the two; and that a station whence these batteries will be secured in the rear shall be established on Mount Crawford. Communications should be formed between these several positions, and a road of access to the peninsula should be made along the shore on the east side of Evans's Bay.

The batteries in the above-named positions, together with two or three guns on the high ground above Kaiwarra, will command every part of the harbour where an enemy's ship might take up a position, with a view of hostile action against Wellington. Torpedo-vessels would also aid in the defence.

A field-force acting from the central position of the barracks and the prison would be well placed for the support of the troops occupying the works at Halswell Peninsula or at Kaiwarra, and would also be in readiness to oppose any attempt at a landing in Island Bay.

This plan, whilst it will, under present circumstances, fully provide for the protection of Wellington, might in future years, if ever deemed desirable, be supplemented by defences on the outer line at Dorset Point, as also by batteries on Ward Island and Somes Island.

PORT LYTTELTON.

The defences of Port Lyttelton and Port Chalmers are not only of importance as regards the cities in their immediate neighbourhood, but also the whole east coast of the Middle Island.

The entrance to Port Lyttelton (the port of Canterbury) (see Plate III.), upwards of 2,000 yards wide—the depth being between 8 and 9 fathoms—is between two precipitous heads about 400 feet high, and it would be out of the question to defend it by submarine mines supported by batteries on the heads. Moreover, the shore on the main land on either side of the harbour is so steep as not to present sites suitable for works for the defence of the approach to

Lyttelton and of the harbour itself. Ripa Island, however—where the quarantine establishment is at present placed—is a very favourable site for a work to fulfil these objects, and here I propose that there should be constructed a battery by which you will observe the whole harbour will be well commanded. This work will be rendered perfectly secure against capture by assault, and will also be protected against being silenced by a body of men which an enemy might have succeeded in landing in the adjacent inlet, called Port Levy, and gaining possession for a time of the heights overlooking the harbour on the southern side. This last operation is one which, considering the precipitous character of the country, I do not conceive to be likely, but it is a contingency which, in the design of the work, should be provided against.

The guns on Ripa Island, thus completely secure against being silenced or against capture, will absolutely deny the use of the harbour to an enemy, and will prevent his taking up a position therein with a view of effecting any hostile object.

It would be desirable, however, to place some pieces of artillery on the North Shore, so as to bring a cross-fire to bear on an attacking vessel, and to command small bays on the southern side which are not seen into from Ripa Island. Torpedo-vessels will co-operate with the shore batteries, and will also prevent an enemy lying unmolested in Port Levy, Pigeon Bay, or Akaroa Harbour.

A field-force of artillery and infantry, acting from Lyttelton upon the road from Lyttelton to Sumner, would both aid in the defence of the harbour, and effectually prevent any attempt to land at Sumner and advance therefrom to Christchurch.

DUNEDIN AND PORT CHALMERS.

Dunedin, situated at the head of the estuary which forms the harbour of Otago (see Plate IV.), at about twelve miles distance from its entrance, is only divided from the sea by a low neck of land about a mile wide, which on the sea-side is called the Ocean Beach. Midway between the city and the entrance is Port Chalmers. During the last few years the water between Port Chalmers and the city has been considerably deepened, but Port Chalmers remains the anchorage for the largest ships.

It has been determined to construct a training-wall at the entrance to the port, opposite Taiaroa Head, and ultimately another but shorter one, in continuation of that head, with a view of deepening the channel. These harbour works will not, however, affect the plan of defence.

As observed by Major-General Scratchley, an enemy may either pass up the harbour and appear before Port Chalmers in order to capture or destroy the shipping there, or he might take up a position off the Ocean Beach, from which he could, if not prevented, throw shells into Dunedin, and thus enforce submission to a demand for a contribution.

As regards defence against the first mode of attack, the entrance to the port being under 600 yards wide, and the conditions being otherwise favourable, the channel can easily be barred by submarine mines covered by artillery fire from Taiaroa Head. This feature can be readily rendered secure against assault, and, within the enclosure so formed, guns should be placed in the most suitable positions for commanding the approach and the entrance.

For the defence of Dunedin against bombardment from the sea, batteries should be established, as has already been proposed, at Lawyer's Head and at Forbury Knoll, about 4,000 yards to westward of it. Torpedo-vessels might also aid in preventing hostile ships taking up a position whence he could throw shells into the city.

A field force would oppose any attempt of an enemy to land at Waikouaiti or other part of the coast outside the harbour in the neighbourhood.

THE BLUFF.

The importance of the Bluff Harbour (see Plate V.), which, though not very capacious, is of sufficient depth and size for large ships, is due, not only to its being the first port of entry and the last of departure in the south of New Zealand, but also to the circumstance that it is admirably situated as a centre whence vessels of war may issue for the prevention of the hostile occupation of adjacent harbours, or for general naval action.

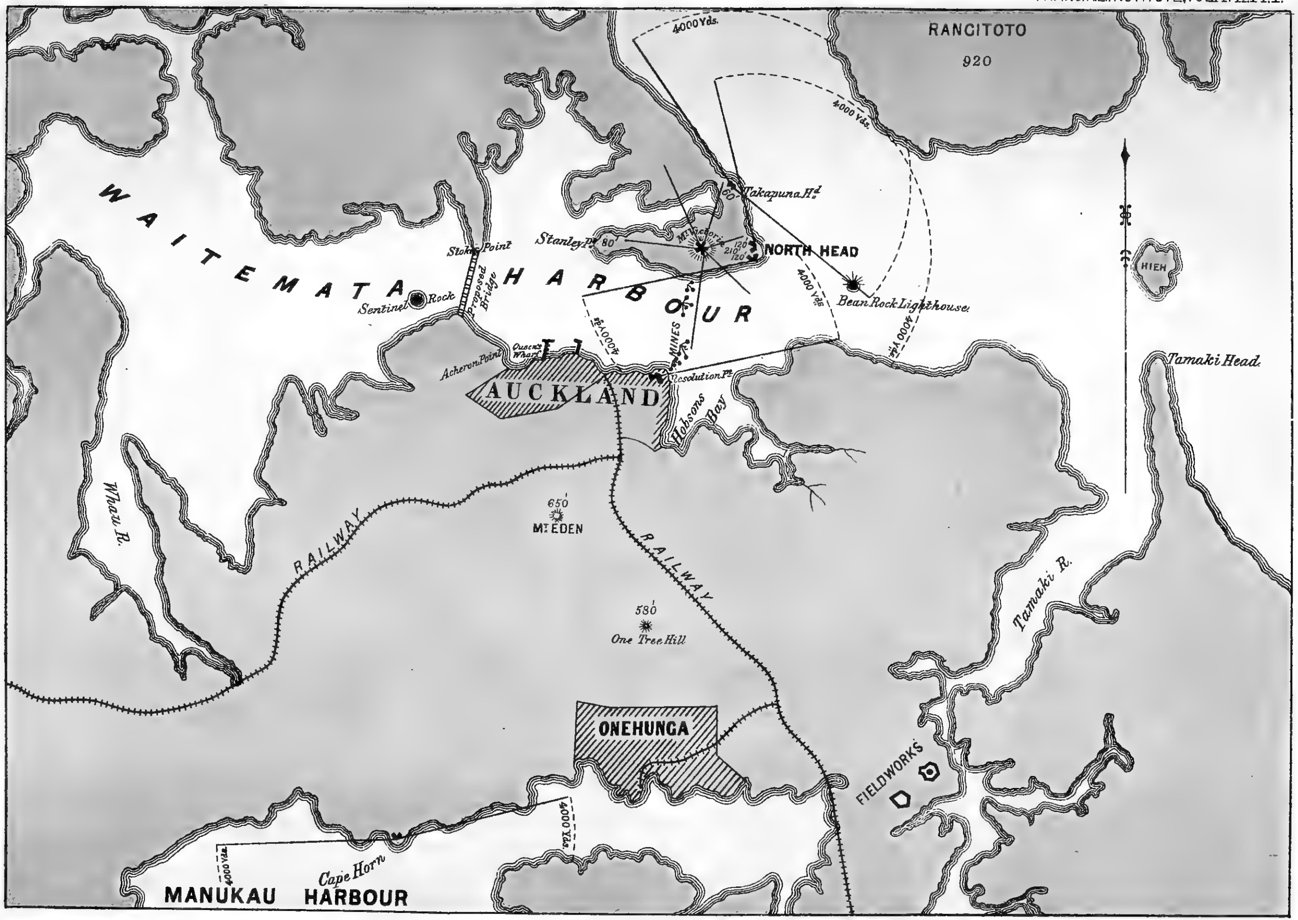
The obvious plan for the defence of this harbour is to occupy the peninsula east of the harbour, and on its highest point construct a fort which will deny the anchorage to an enemy, and command the approaches to it.

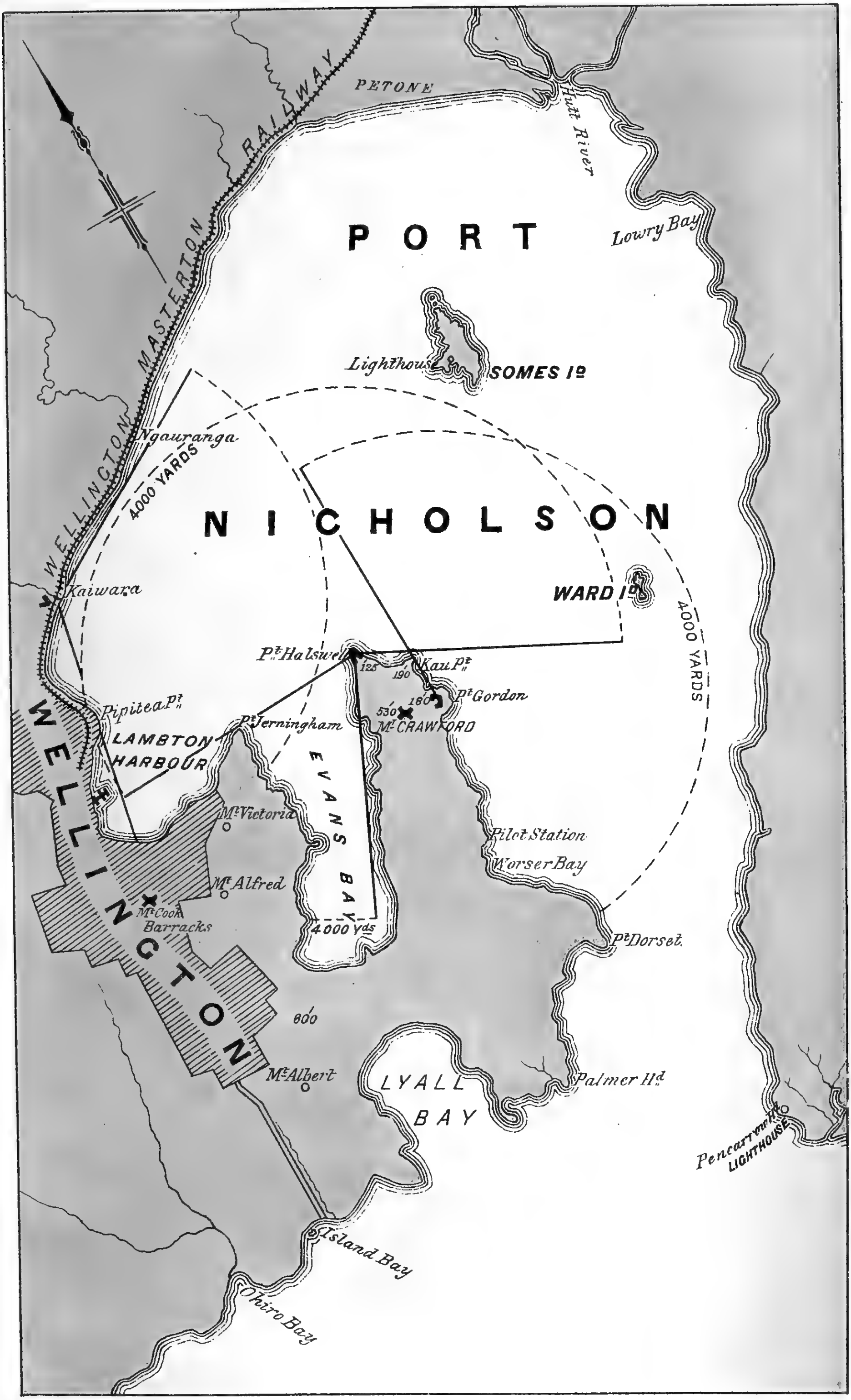
Submarine ground mines may be placed in the channel, which at its narrowest part is only 600 yards wide.

To prevent the landing of a small force at any point to westward of the entrance not commanded by the fort, and where he might possibly attempt to throw a force on shore, earthworks may be improvised, and a field force from Invercargill, eighteen miles distant, and connected with the Bluff by railway, would co-operate in the defence.

Locomotive torpedoes, and torpedo-vessels.

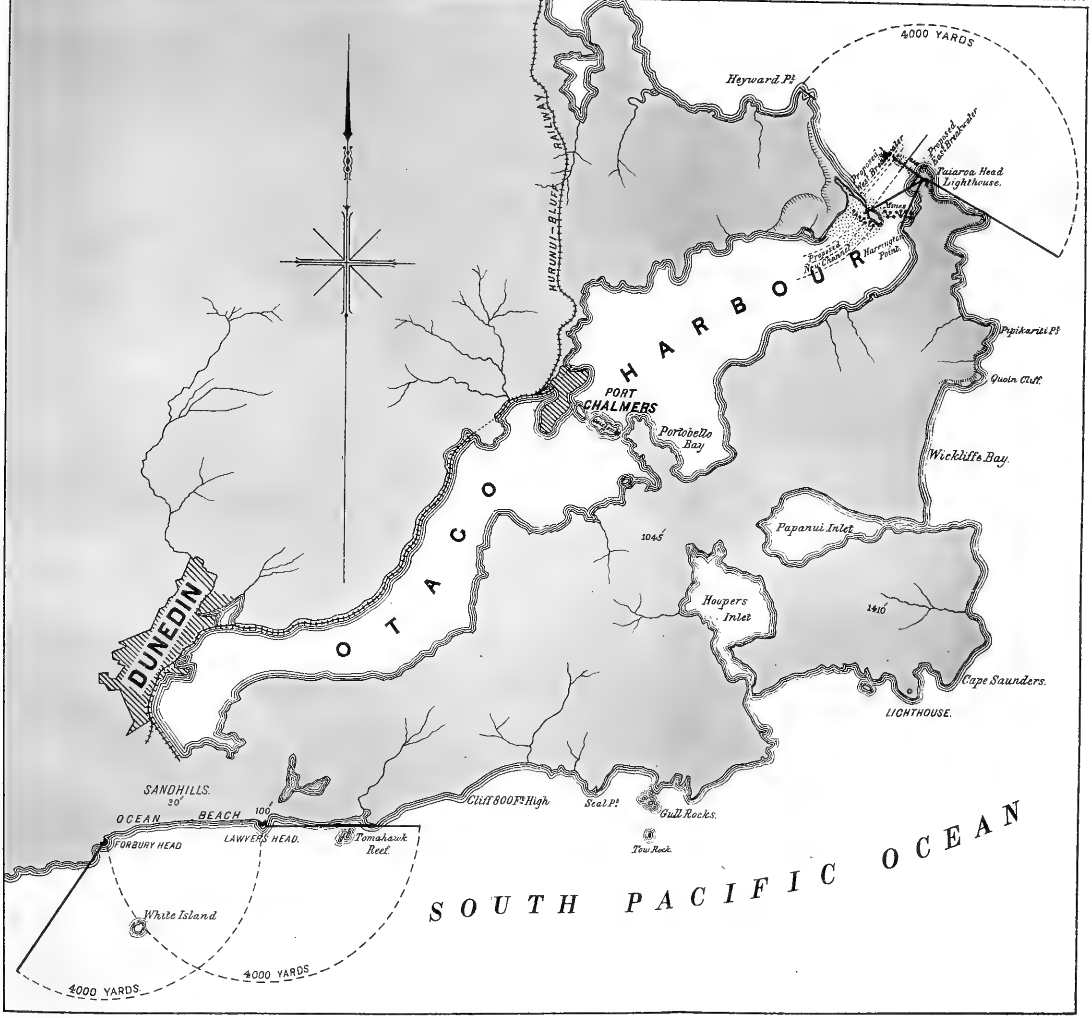
In reference to other harbours for the defence of which no special provision is proposed, I will first briefly refer to locomotive torpedoes and torpedo-vessels.

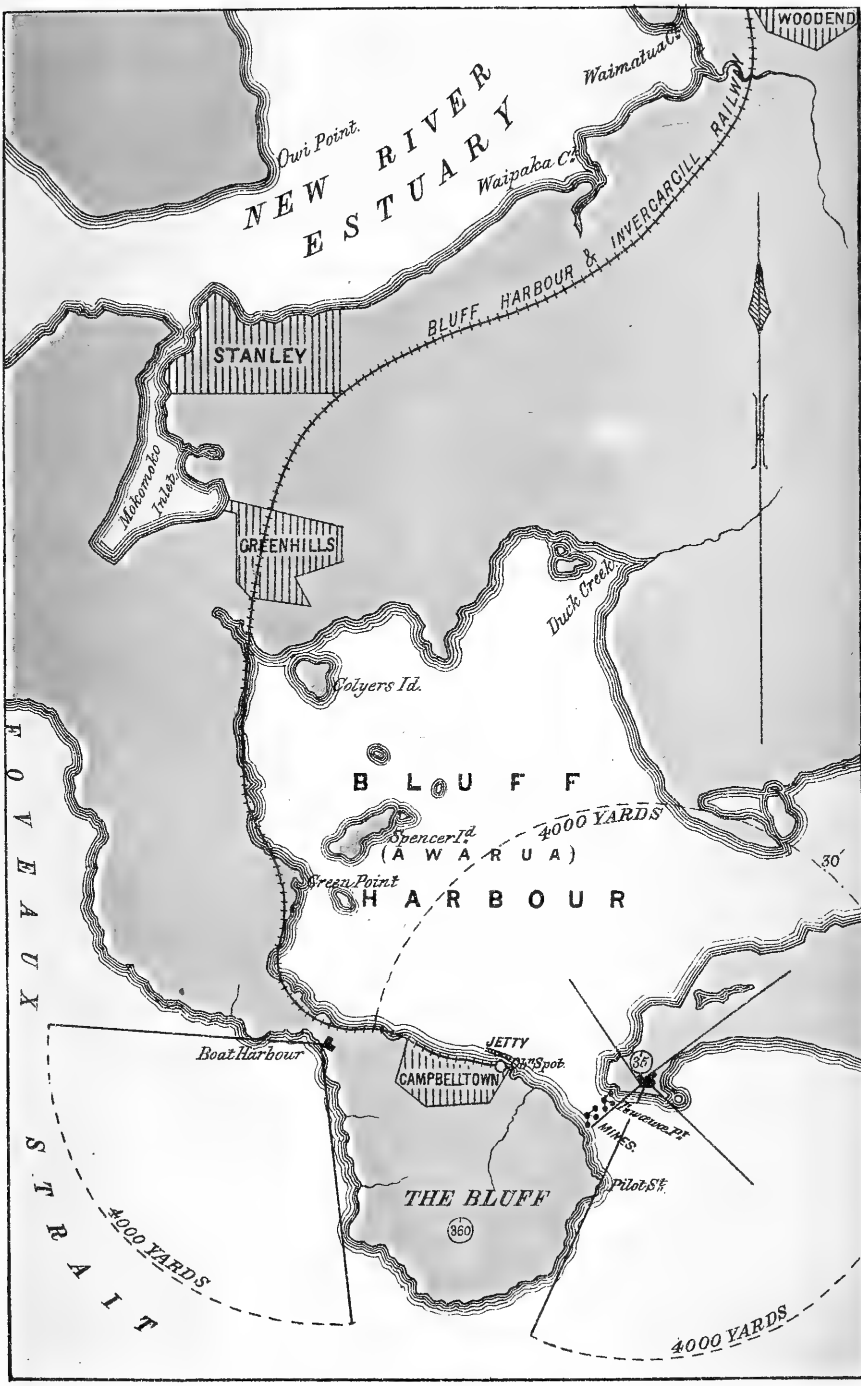

RANGITOTO
920
4000 Yds.
4000 Yds.
4000 Yds.
4000 Yds.
4000 Yds.
4000 Yds.
4000 Yds.
Takapuna Hd.
Stanley Pt.
80'
Mt. Victoria
120'
210'
120'
60'
NORTH HEAD
Bean Rock Lighthouse.
WAITEMATA HARBOUR
Stoke Point
Proposed Bridge
Sentinel Rock
Acheron Point
Queen's Wharf
MINES
Resolution Pt.
AUCKLAND
Hobsons Bay
Tamaki Head.
Whau R.
RAILWAY
RAILWAY
650
Mt. EDEN
580
One Tree Hill
Tamaki R.
ONEHUNGA
FIELDWORKS
Cape Horn
MANUKAU HARBOUR


PETONE
WELLINGTON MASTERTON RAILWAY
Hutt River
PORT
Lowry Bay
Lighthouse
SOMES Id.
Ngauranga
4000 YARDS
NICHOLSON
Kaiwara
WARD Id.
4000 YARDS
Pt. Halswell
125
190
Kau Pt.
180
Pt. Gordon
530
Mt. CRAWFORD
Pipitea Pt.
Pt. Jerningham
LAMBTON HARBOUR
EVANS BAY
Mt. Victoria
Pilot Station
Worser Bay
Mt. Alfred
Mt. Cook Barracks
4000 Yds.
Pt. Dorset.
WELLINGTON
600
Mt. Albert
LYALL BAY
Palmer Hd.
Pencarrow Hd. LIGHTHOUSE
Island Bay
Ohiro Bay


SOUTH PACIFIC
OCEAN
CHRISTCHURCH
CHRISTCHURCH LYTTELTON RAILWAY
AVON
&
HEATHCOTE ESTUARY
SUMNER
TUNNEL
LYTTELTON
650′ EVAN'S PASS
Ligthouse
Godley Head.
4000 Yds.
Adderley Head.
605′
LYTTELTON HARBOUR
4000 Yds.
Ripa Id.
62′
180′
670′
Camp Bay
1334′
PORT LEVY
Purau Bay
345′
1221′
1362″
QUAIL Id.
Charteris Bay
Head of the Bay
337′
1132′


FORBURY
4000 YARDS.


OTAGO HARBOUR
DUNEDIN
PORT CHALMERS
HURUNUI-BLUFF RAILWAY
4000 YARDS
Heyward Pt.
Proposed West Breakwater
Proposed East Breakwater
Taiaroa Head Lighthouse.
Proposed New Channel
Harrington Point.
Pipikariti Pt.
Quoin Cliff.
Portobello Bay
Wickliffe Bay.
Papanui Inlet
1045
Hoopers Inlet
1410
Cape Saunders.
LIGHTHOUSE.
SANDHILLS.
30
OCEAN BEACH
100
Cliff 800 Ft. High
Seal Pt.
Gull Rocks.
FORBURY HEAD
LAWYERS HEAD.
Tomahawk Reef.
Tow Rock.
White Island
4000 YARDS
4000 YARDS
SOUTH PACIFIC OCEAN


WOODEND
Waimatua Ck.
NEW RIVER ESTUARY
Owi Point.
Waipaka Ck.
BLUFF HARBOUR & INVERCARGILL RAILWAY
STANLEY
Mokomoko Inlet.
GREENHILLS
Duck Creek.
Colyers Id.
FOVEAUX STRAIT
BLUFF (AWARUA) HARBOUR
Spencer Id.
4000 YARDS
30'
Green Point
Boat Harbour
JETTY
Obs. Spot.
CAMPBELLTOWN
35
Tewaewae Pt.
MINES.
Pilot St.
THE BLUFF
360
4000 YARDS
4000 YARDS

Locomotive torpedoes are submarine weapons which possess within themselves the power of locomotion. Of these I will specially notice the Whitehead torpedo, the Lay torpedo, and the Brennan torpedo.

The Whitehead or "fish" torpedo is an uncontrollable weapon; *i.e.*, after it is projected from the bow or side of a vessel it cannot be controlled or directed by the will of an operator. It is made of various sizes, ranging from 14ft. long and 14in. maximum diameter, to 19ft. long by 16in. maximum diameter. The larger size carries a charge of 80lb. of gun-cotton at its bow. Its motive-power is compressed air, which, by means of small engines, drives two screw propellers. It is capable of being adjusted, by means of certain mechanical apparatus, to a certain depth, and when launched will go at a rate of about twenty-five knots an hour or more for several hundred yards. Whitehead torpedo.

Properly to use the Whitehead torpedo, however, an expert's knowledge of the weapon and special training is required. In words used by Admiral Boys, once Naval Director of Ordnance, to make it a success you must "love it." It has only been tried as yet—so far as I am aware—on three occasions in actual warfare, but on one of these it was perfectly successful. This was in 1878, when a Russian steamer fired a Whitehead torpedo against a Turkish vessel off Batoum and destroyed her.

I may mention that the Governments of Austria and Great Britain each gave Mr. Whitehead something like £20,000 for the use of his torpedo, and that nearly all the other European Governments have since purchased the secret. The Turks, however, picked up two of these torpedoes, which they found on the shore after having been unsuccessfully fired at their ships, and so obtained the use of the weapon without paying for it.

The Lay torpedo and the Brennan torpedo are shaped something like the Whitehead; and, like that weapon, are provided with charges at the bow end, which explode on contact. Unlike the Whitehead, however, they are not intended to be discharged as missiles, but are controllable whilst in motion.

The Lay torpedo, an American invention, about 25ft. long, with a maximum diameter of 24in., is a sort of torpedo-boat propelled by screws worked by machinery, the motor of which is carbonic-acid gas. It is controlled by an operator on shore or ship by an electric cable attached to it, and has an apparatus within it by means of which a rudder at the stern can be moved to port or starboard as desired. Upon it are two guide rods by which it is directed, and which can be raised or lowered at will. Each of these is pro- Lay torpedo.

vided with a disc for day and with a small oil-lamp for night. It is claimed for this torpedo that it is controllable to a distance of upwards of 2,500 yards. I understand that the Russian Government possess several of these weapons. Different accounts, however, are given as to the performances of this torpedo, and further information about it is required before it can be pronounced a success.

Brennan torpedo.

The Brennan torpedo, called after the inventor, Mr. Brennan, of Melbourne, appears to be a much simpler weapon. It is about 20ft. long with a maximum diameter of about 20in. In the body of the torpedo are placed two drums round which is wound a fine wire, and the drums are connected with the shaft of the screw propellers attached to the stern. On the wire on the drums inside the torpedo being unwound, the screw-shaft revolves and the torpedo moves ahead. Steering is effected by increasing or decreasing the velocity with which the wire on either drum is unwound. There is an apparatus within the torpedo by means of which it assumes and retains the level below water at which it is required to move. The arrangement for guiding the weapon is somewhat similar in principle to that used in the Lay. In this case, however, there is only one rod and disc attached to the top of the torpedo, which is painted red on the side towards the operator. When used at night, a funnel, which appears above water, and emits luminous chemical fumes, takes the place of the painted disc. The trials of this torpedo in the River Medway, in 1882, showed that it was effective at a range of 2,000 yards, and were deemed so successful that the Imperial Government bought the patent of it.

Torpedo-vessels.

I now wish to draw your attention to torpedo-vessels, which are now regarded by naval nations as of great importance in maritime warfare.

Steam-launches, or other craft not specially constructed for the purpose, may be fitted with outrigger-spars, at the end of which torpedoes may be placed, and directed against the side of an enemy's ship. Speed, however, being a great element in the success of torpedo-vessels, they are now constructed so as to steam with great rapidity, and to carry Whitehead torpedoes, which, as I have already stated, may be propelled against a ship at a distance of several hundred yards. As you are no doubt aware, some of these vessels of the second class have lately been provided, on the recommendation of Major-General Scratchley, to take part in the defence of your principal ports. These measure 63ft. long with a beam of 7ft. 6in., will go about seventeen knots per hour, and one of them has been fitted with gear for the Whitehead torpedo.

Torpedo-boats have, however, been constructed of much greater size and speed, and with sea-going qualities.

About four years ago one was built for the Russian Government of larger dimensions than any that had been constructed before, it being desired that she should be a sort of torpedo-cruiser, capable of going to sea in rough weather, and have coal-carrying capacity sufficient to make a run at a moderate speed of at least eight hundred miles. This vessel, called the "Batoum," is represented by the photograph herewith. She is 100ft. in length by 12ft. beam, and adapted for carrying four Whitehead torpedoes. To take her to her destination three short masts and sails were temporarily fitted to her as a precautionary measure in case the machinery broke down or the coal-supply ran short. She left England in August, 1880, having a crew on board of three officers and nine men, and steamed from London to Nicolaieff, exclusive of stoppages, in eighteen days, the distance run being 4,800 miles, including calling at Fiume on the way —being an average speed of eleven knots an hour. On trial a speed of twenty-two knots was actually obtained from her.

This vessel, which was the first torpedo-boat that made a successful voyage of any duration, has been considered by many Governments to be worthy of reproduction; for, soon after its construction, the Argentine, Greek, Brazilian, Austrian, Dutch, and Italian Governments ordered similar vessels. In fact, the "Batoum" may be said to have given rise to an altogether new type of sea-going torpedo-cruiser.

The Victorian Government have already in their possession a vessel of this class, but somewhat superior, named the "Childers." Her cost was £10,500. She is 113ft. 6in. long, with a beam of 12ft. 6in., and was brought out to Port Phillip by sea, just as the "Batoum" was from London to Nicolaieff. In order to render these vessels effective for the defence of the harbours of New Zealand, it would be necessary to have a considerable number of them, and it would be essential that they should be manned by crews specially trained for their service.

(I will for a moment ask you to look at the photographs herewith of some torpedo-vessels belonging to the English, Russian, Italian, Greek, Argentine, and other Governments.)

I have referred to locomotive torpedoes and torpedo-vessels, because these are the means by which, it is urged by some, that the defence of ports which cannot be otherwise specially protected may be provided. I confess, however, that though it appears to me probable that the Brennan torpedo may be turned to account for the defence of New Zealand harbours, I do not see my way at present to advise the adoption of other locomotive torpedoes, or to suggest that outlay should now be incurred in the direction of providing more torpedo-vessels.

Nor—though I should be glad to see a man-of-war provided as a nucleus for other naval forces—can I advise that the recommendations made by some of my naval friends for the purchase and maintenance by the colony of a considerable number of war-cruisers, gun-vessels, and torpedo-boats should be acted on.

Vessels to be used as auxiliary war-cruisers.

In the distant future New Zealand may become—I venture to foretell she will become—a considerable Naval Power; but meanwhile she must be content with what her present resources will enable her to accomplish. The most practical suggestion that I can now make with regard to the provision by the colony of vessels of war is to make arrangements for utilizing certain vessels of the Union Steamship Company as auxiliary cruisers for local defence.

More than a year ago I wrote to the authorities in England to consult them on this subject, and I find that five of these ships, viz., the "Rotomahana," the "Tarawera," the "Waihora," the "Hauroto," and the "Rotorua" can easily, by additional bulkheads or water-tight subdivisions, be rendered capable of complying with the conditions as to flotation necessary to qualify them for use as armed cruisers. Coal-bunkers can also be arranged in them so as to provide protection to the machinery against shot and shell-fire, it having been found by experiment that coal will afford a measure of such protection.

In like manner the "Aorangi," "Ruapehu," and "Tongariro," belonging to the New Zealand Shipping Company, and two ships of the Shaw, Savill, and Albion Company would be available as armed cruisers.

The diagram before you shows a vessel somewhat of the character of the five last-mentioned, fitted with armament, coal protection, and other details necessary to constitute her a war-cruiser. The ships of the Union Steamship Company would be similarly treated, on a scale suitable to their dimensions.

Probably, in case of war, the armaments, stores, and fitments required for the direct steamship lines would be put on board in England. As regards the vessels of the Union Steamship Company, however, I would recommend that everything necessary to be placed in them in order to constitute them auxiliary cruisers, including armament of breach-loading guns and machine guns, should be kept in store at one of the principal ports of New Zealand, ready to be put on board whenever war appeared imminent. I suggest also that arrangements be made with the Union Steamship Company for fitting the vessels I have named with the additional bulkheads necessary to give them the requisite degree of flotation and other fitments for war-vessels.

I shall be happy to supply, or to obtain if I cannot supply, any information that may be required with a view of carrying out this proposal.

Efficient land and sea forces essential.

It is obvious that the several measures which I have recommended will be of no avail without efficient land and sea forces. If the works for the defence of the principal ports are to fulfil their purpose, the batteries must be well manned and there must be proper garrisons for them. The discipline of the field-forces and of the forces generally, and their ability to act against an enemy, can only be acquired by proper and sufficient training. Officers commanding at each place should have a clear view as to what they would have to do in case of attack. For the handling of vessels of war and the working of their armaments, amongst other requirements, a knowledge of gunnery is essential. Again, the application of torpedoes requires skill, which can only be obtained by men who give special attention to that department of defence.

Major-General Scratchley entered into the subject of the organization of the forces in much detail, and since his visit, though not according to his suggestions, some action was taken in the matter. Generally speaking, however, the whole arrangement of the military and naval forces of the colony should be gone into with reference to the duties which each section would have to perform in case of war, and the organization which is necessary to resist foreign aggression should harmonize with that which is essential for internal defence. I may remark that this would be much facilitated by the completion of railway communication throughout the North Island.

I have not time now, and, if I had, it would be out of place for me to discuss the details of these matters. I may, however, say that it appears to me that one of the first steps to be taken here should be to obtain the services of an officer of the army as commandant, with a staff-officer under him, to manage matters relating to the land forces. Of these, one should be a Royal Artilleryman. An officer of the Navy should also be appointed to deal with naval organization and naval questions generally; and, if no better arrangement can be made, it is desirable that he should be selected with a view to his taking charge of business relating to submarine mines and locomotive torpedoes. There is abundance of military and naval spirit in this country, but efficient organization is essential, in order that it may be turned to the best account.

Recapitulation and conclusion.

To recapitulate. I recommend that the principal cities and ports of New Zealand shall be defended by land batteries and submarine mines, where applicable; that arrangements be made for utilizing for purposes of war the fine merchant-steamers which are capable of being so turned to account; and that the land and naval forces of the colony be reorganized, so as to fit them for the duties they would have to perform if called upon for actual service.

It may, however—and not unreasonably—be inquired, "But how much will all this cost?" Well, not so large a sum as many suppose. The whole thing could be done for a capital sum of £400,000. Of course, there would also be some annual expenditure, in addition to that at present incurred, for maintenance, for ammunition and stores, and for the pay of officers and men. I cannot now say what this would amount to, but it would not be large.

Now, I venture to think that, considering the interests at stake, the capital sum I have named is a moderate price to pay for the benefit it will purchase. Not to mention the amount of the local commerce of the colony, the value of the cities to be defended is probably about thirty millions sterling. The loss which would be occasioned by one attack would far exceed the outlay which would have prevented it; and the degradation to which it would subject the country is beyond my power to estimate.

New Zealand, however, at present expends scarcely anything for the purpose of resisting foreign aggression, whilst that of other States, whose revenue, and imports and exports combined, are about the same as hers, is very considerable. For instance, in 1882 the naval expenditure alone of the Argentine Republic was upwards of £120,000; that of Chili, £244,000 (peace expenditure); that of Greece, with a revenue of about £1,600,000 and a commerce of less than seven millions sterling, was £133,000. I know that the circumstances of these States are, in many respects, different from those of New Zealand, and I do not advocate that she should enter into competition with them. I *do*, however, venture to suggest that she should not rest content in her present unprotected condition. It is not only impolitic, but rash, for her to remain in a passive, defenceless state, unprepared to resist aggression, trusting to the forbearance of any Power possessing the means of attack.

The necessary measures should be taken gradually and deliberately, and should not be deferred for spasmodic action, at a time of panic, when steps would be hurriedly taken, which would surely lead to useless expenditure, and would, moreover, not effect their object. New Zealand is no longer in her infancy, but in the full vigour of youth, and I am sure that her people—vital as the question is to them—are prepared to incur the burden and the responsibility of their defence.

Some, I know, say that there is no chance of New Zealand ever being attacked, and that she is therefore under no necessity to provide for her defence. If this be so, for what purpose do Volunteer forces exist throughout the country? The very maintenance of these avows a desire to be defended against external aggression. They do not, however, effect their object. I have endeavoured to show you how New Zealand may both aim at the object and effect it too. If she is *not* liable to attack, she does too much: if she is, she does too little. Let her settle fairly and logically what her aim is, and act accordingly.

I have laid before you an outline of the principles which should guide the people in taking measures to place their country in a reasonable position for defence. New Zealand is happily united to the greatest maritime Power the world has ever seen, which, by her fleets and squadrons acting from her naval stations, protects the commerce of the empire. The old "Mother-country," as she is sometimes called, cannot, however, do everything. Australasia must do her part. The neighbouring colonies are doing their duty in the matter; and I have no doubt that this Britain of the South will profit by their experience.

Whilst money and energies are rightly employed in the development of the great internal resources of the country; whilst railway and harbour works are being constructed, and mines opened out; whilst large sums are spent—and justly spent—on the education of the youth of the country; whilst a portion of the revenue is applied to keeping peace within, it must not be forgotten that, unless proper precautions are taken, New Zealand remains open to attack from without.

I venture to urge the measures I have suggested, in order that the country itself may be secure; that it may take its share in Australasian defence; and that it may do its duty as a part of the British Empire; looking forward to the time when New Zealand may become—as I believe she is destined to become—a proud member of a mighty federation of British peoples—able to hold their own against the world.

TRANSACTIONS

TRANSACTIONS

OF THE

NEW ZEALAND INSTITUTE

1884

I.—ZOOLOGY.

Art. I.—*Notes on the Skeleton and Baleen of a Fin-whale* (Balænoptera musculus?) *recently acquired by the Otago University Museum.* By T. Jeffery Parker, B.Sc. Lond., Professor of Biology in the University of Otago.

[*Read before the Otago Institute, 14th October*, 1884.]

Plate VI.

Rather more than a year ago, a large whale's skeleton was exhibited in many parts of the colony by Captain Jackson Barry, who finally brought it to Dunedin. On visiting the shed where the bones were roughly set up, I found the animal to be a *Balænoptera*, a genus hitherto not represented in this Museum; and, as the number of bones missing was comparatively small, and the baleen was perfect, I entered into negotiations with Mr. Barry, with the ultimate result of securing the specimen as soon as it had ceased to "draw" as a show.

In one of his valuable contributions to our knowledge of the Cetacea,* Professor Flower remarks: "We have at present so little definite information upon the specific characters and geographical distribution of the Cetacea, that it is desirable that no opportunity should be lost of putting on record any facts which may contribute to the better knowledge of the natural history of even the most common species of this interesting group of Mammalia." I have, therefore, thought it advisable to communicate to the Institute a few notes on the specimen in question, with a view of furnishing a series of measurements for comparison with those already on record, and of calling attention to one or two points in which the specimen differs from hitherto described examples. It also seems desirable that an accurate account of the skeleton as it reached the Museum should be placed on record, so that any one interested in the matter may have no difficulty in finding out at once how far the specimen, as mounted, is "restored."

* "On a Lesser Fin-whale recently stranded on the Norfolk Coast." Proc. Zool. Soc., 1864, p. 252.

The whale, as I am informed by Mr. J. E. Gully, was stranded on the sands at the entrance of the Waimea River, Nelson. It was boiled down, and the skeleton and baleen passed into the possession of Captain Barry, who unfortunately was not sufficiently aware of the value of a complete whale's skeleton to give the proper amount of care to the preservation of the smaller bones. The eight (?) posterior caudal vertebræ were thrown away with the "flukes;" the anterior epiphysis of the fifth cervical vertebra is missing; many of the phalanges and some of the carpals are lost; and no trace of either pelvic bone reached Dunedin.*

The rest of the skeleton is quite perfect and in excellent condition. The small fifteenth rib is present on both sides, as well as the lacrymal and the malar. The hyoidean apparatus is complete, and the number of chevron bones (13) agrees with Van Beneden and Gervais's figure of *B. musculus*, although from the description of that species in the "Ostéographie des Cétacés" it seems probable that these were followed by three others in the cartilaginous condition.

The skeleton is in the stage defined by Flower† as "young," that is, all the epiphyses both of the vertebræ and of the arm bones are separate. The bones of the skull also shrunk away from one another a good deal in the course of drying, so that it was found impossible to bring them into contact. This is especially the case with the maxillæ and the orbital processes of the frontals, between which there is a gap of about two inches. The premaxillæ and maxillæ were both separated during the preparation of the skull, as well as the lacrymals and jugals.

The entire length of the skeleton, as mounted, is 53 feet 6 inches, measured in a straight line. This includes eight restored vertebræ at the end of the caudal region, as well as the pads of felt representing intervertebral ligaments: the latter vary from $\frac{1}{2}$ to $\frac{7}{8}$ inch in thickness in different parts of the vertebral column.

This size appears to be somewhat remarkable for so young a specimen. Flower states that whales grow to more than half the size of the adult while still in the "young" stage, but it is certainly interesting to find a length of over 54 feet attained in the young stage of a species which appears never to exceed 80 feet, and in which the fully adult condition of the skeleton may be reached in specimens of 70 and even 60 feet long.

The following measurements are taken to correspond pretty nearly with those given by Flower‡ and by Murie,|| and will help to show the close

* I am much indebted to Mr. J. E. Gully for having instituted a search for the missing bones, but unluckily his efforts met with no success.

† "Notes on the Skeletons of Whales in the Principal Museums of Holland and Belgium, etc.," Proc. Zool. Soc., 1864, p. 384.

‡ P.Z.S., 1864, p. 399, etc.

|| "On the Anatomy of a Fin-whale captured near Gravesend." Proc. Zool. Soc., 1865, p. 206.

correspondence in the proportions of the various parts of the skeleton, between the present specimen, and acknowledged examples of *Balænoptera musculus* (=*Physalus antiquorum*).

The Skull.

	Inches.
Length in a straight line	148
Breadth at the squamosals (greatest breadth of skull)	68
„ of condyles	13½
„ of exoccipitals	47½
Length of supra-occipital	30
„ of orbital process of frontal	26
Breadth of „ „ „ , at base	29½
„ „ „ „ , at outer end	15½
Length of nasal	11
Breadth of both nasals, posterior end	4½
„ „ „ anterior „	9½
Length of beak from middle of curved border of maxilla to tip of premaxilla	102½
Length of maxilla	113
Projection of premaxilla beyond maxilla..	10
Greatest width of nasal apertures..	14
Breadth of both maxillæ at posterior end	15
„ „ „ across orbital process (following the curve)..	73
„ beak at base, following the curve	54
„ „ middle „ „	26½
„ maxilla at same point „	8⅝
„ premaxilla „ „	4
Length of mandible in a straight line	144
Height of „ at coronoid process	15½
„ „ at middle	10¼
Amount of curve of mandible, *i.e.*, greatest distance of inner surface from a straight line between the ends	18¾
Length of jugal in a straight line	12½
Width of jugal at anterior end	6
„ „ posterior „	2
„ „ narrowest point	1¼
Amount of curve of jugal (measured as for mandible)	2¼
Length of lacrymal in a straight line	9½
Greatest breadth of lacrymal	3¾
Length of tympanic	5½
„ „ including external process	13
Breadth „	4¾
Thickness „	2½

The Hyoid Bone.

Extreme width in a straight line	28
Length of body from posterior edge to fork of anterior cleft	5¼
„ „ „ „ „ extremity of anterior corner or process for articulation of stylo-hyal	8
Breadth of body, about	6

	Inches.
Length of stylo-hyals	15½
Greatest breadth of stylo-hyals	3½
„ thickness of „	2
„ breadth of thyro-hyals	4
„ thickness of „	3¼
Breadth of thyro-hyals at proximal end	3¼
Thickness „ „ „	2½
Breadth „ distal „	2¾
Thickness „ „ „	1¾

The Vertebral Column.—

Vertebral Formula :—C. 7 : Th. 15 : L. 15 : C. 17 + 8 (?)=62 (?).

Dimensions in inches.	Greatest Height.	Greatest Width.	of Body. Height	of Body. Width	of Body. Thickness	of Neural Spine. Length	of Neural Spine. Greatest width	of Transverse Process. Length	of Transverse Process. Greatest width (vertical)	of Transverse Process. Greatest breadth (antero-posterior)	of Foramina of trans. process. Greatest height	of Foramina of trans. process. Greatest width	of Neural Canal. Height.	of Neural Canal. Width.	of Metapophyses. Height.	of Metapophyses. Width.	Height of Hypapophyses.
Cervical Vertebræ—																	
I.	14½	22	3	14	3	3	4	3¾	5	..	..	..	8	5	..	..	..
II.	14½	27	9½	14	3	2	4½	8	11	..	3	5¾	5½	6½	..	..	..
III.	12½	25	7½	12	1½	1	2	7½	10¾	..	7	7	5	7	..	..	..
IV.	12½	25	7½	11½	1¾	1½	1½	7	10	..	6½	6	4	8	..	..	..
V.	12¾	25	7½	11	1¾	1¾	1½	7½	10	..	6½	6½	3½	8	..	..	..
VI.	13½	26	7½	11	2½	2	1¾	8	10½	..	6½	6¾	3½	8¼	..	..	..
VII.	14	25	7½	11	3	2½	1¾	8	3	..	..	..	3½	8½	..	..	..
Thoracic Vertebræ—																	
I.	15	25	7¾	11	3	3¾	2½	7½	5	..	..	..	3½	8½	..	..	..
III.	18	25	7¼	12	5	6¼	5	9½	7	..	..	..	5	7¾	..	..	..
V.	21	31	7	11½	6¾	8½	7	11	..	6	..	..	6	6½	1¾	4	..
VII.	23	34	7½	11	7½	10	8	11½	..	7	..	..	6	5	1	4	..
IX.	23½	35	7½	11	8	10½	8	12	..	7½	..	..	5½	4½	1½	4½	..
XI.	24	36	7½	11½	8½	10¾	7½	12	..	7½	..	..	4¼	4¼	2	4¾	..
XIII.	24½	37	8	12	8½	11	7½	12	..	7	..	..	5	5¾	2	4½	..
XV.	25	34	8½	12	9	11½	7½	11½	..	5½	..	..	5¼	3½	2	4	..
Lumbar Vertebræ—																	
II.	26	34	8½	11½	9	13	7½	11	..	6	..	..	5½	3½	2¼	4½	..
IV.	26½	35	9	12	9¼	12½	7	11	..	6	..	..	4½	4	2	4½	..
VI.	27	34	9½	12½	9½	13¼	7	12	..	7	..	..	4½	4	2	4½	..
VIII.	27½	33½	9½	12½	10	14½	6	12	..	7	..	..	4	4¼	2½	4½	..
X.	27½	34	10	12½	10	14½	7	11	..	6¾	..	..	4	4	2¼	4¼	..
XII.	27	33	10½	13	10½	14½	7½	10	..	7	..	..	4	3¾	2¼	4¼	..
XIV.	27	32	10½	13	11	13	8	9½	..	6¾	..	..	4¼	3½	1½	3¾	..
Caudal Vertebræ—																	
I.	27¼	28	11½	13½	11½	12	7½	7	..	7	..	..	4¼	3¼	1¼	3½	¾
III.	27	26	11½	13½	11½	10½	6½	6½	..	6½	..	..	4	3	1¼	2¾	1
V.	22¾	24	12	13½	11½	6¾	5	5	..	5	..	..	3¼	2¼	1½	3	1¼
VII.	20¼	19	12	14	11½	5	3½	2½	..	6	..	..	2½	2	1¾	2½	1¾
IX.	17½	16	12	13	11	4	2½	2	..	6	..	..	2	1½	1½	3¼	2
XI.	16½	14	11	11¾	11	2¼	1½	Reduced to mere ridge			..	..	1¼	1¼	1½	2½	2
XIII.	12½	11	10½	10	9½	1	1	..	..	..	..	..	1	1	1¼	2½	2½
XV.	10	8½	8	8½	6½	..	..	..	..	..	..	..	..	..	..	..	..
XVII.	7	6¾	7	6¾	4¾	..	..	..	..	..	..	..	..	..	..	..	..

The Chevron Bones.—

	Greatest height (vertical).	Greatest breadth (antero-posterior).
I.	6½	3 inches.
II.	10	5½ "
III.	10½	5½ "
IV.	10½	6 "
V.	10½	7 "
VI.	10	7½ "
VII.	9½	7½ "
VIII.	9	6 "
IX.	8½	6 "
X.	7½	5 "
XI.	6½	5 "
XII.	5	5 "
XIII.	4	3½ "

The Ribs.—

(Left Side.) Dimensions in Inches.	Greatest length, following outer border of arch.	Greatest length in a straight line.	Diameter of chord.	Greatest breadth of head.	Breadth of neck.	Breadth at middle of rib.	Breadth of fin point.
I.	45	40¾	8¾	5¾	4½	4¼	6¾
II.	65	59	12½	8¾	4¾	4	4¾
III.	77	68	15	8¾	4	3½	3½
IV.	83	70	16¾	5	3½	3¼	3¼
V.	86	72½	18	4¼	2¾	2¾	3¼
VI.	87	72	19	3¾	2½	2¾	2¾
VII.	87	72	17¾	3½	2¼	3	3
VIII.	83½	69	16¼	3½	2¼	2¾	2½
IX.	78½	66½	15	3¼	2¼	2½	1¾
X.	72	63½	13½	3½	2	2¼	1¾
XI.	67	60	12	3¼	2	2	1¾
*XII.	62	57	9	2¾	2	2	1¼
*XIII.	57	55	6½	3	1¾	2¼	1¾
*XIV.	60	57½	7	2½	1¾	2¼	2
XV.	25	24½	1½	2	1½	1½	¼

* These ribs have apparently had the distal end cut off, so that the measurements are probably not strictly accurate.

The Sternum.—

	Inches.
Greatest length	16⅛
" breadth	13½

The Scapula.—

Greatest breadth in a straight line between the angles of the supra-scapular bridge	38
Length to the glenoid cavity	24
" of coracoid	3½

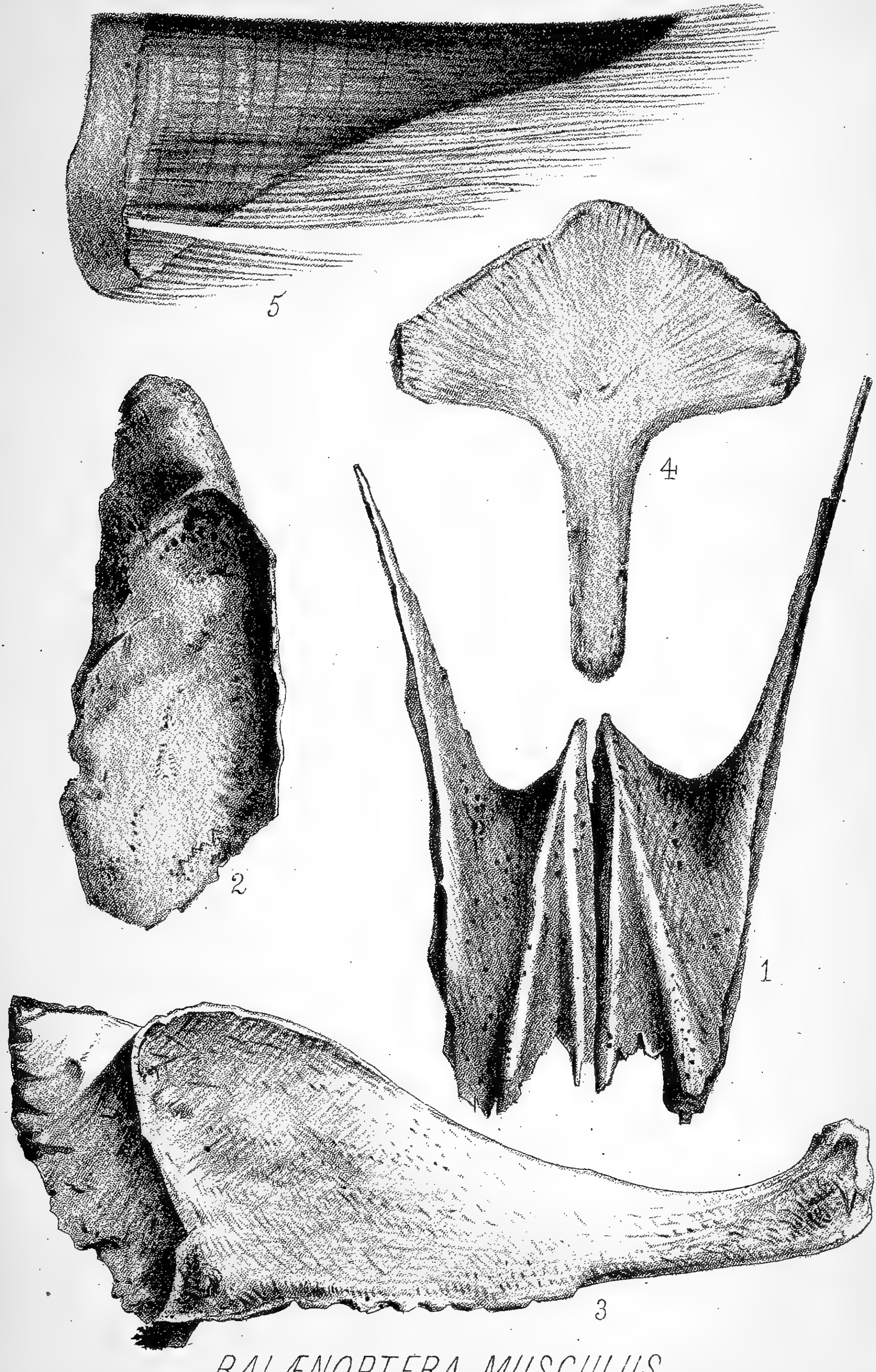
	Inches.
Breadth of coracoid at base	3
Length of acromion	8
Greatest width of acromion	3¾
Antero-posterior diameter of glenoid cavity	9¼
Transverse " " "	6¾
Circumference of glenoid cavity	25
The Humerus.—	
Greatest length	17
" breadth at head	9¼
" " " narrowest part of shaft	6¾
" " " condyles	9½
Circumference of neck	27
" " middle of shaft	18½
The Radius.—	
Greatest length	29
Breadth of head	½
Circumference of head	17
Diameter at middle of shaft	4¼
Circumference at middle of shaft	11½
Diameter of distal end of shaft	6
Circumference " " "	16
The Ulna.—	
Greatest length	29½
Length of shaft	26½
Circumference of shaft at neck	11
Diameter " " middle	3
Circumference " " "	8
Width of distal end	5
Circumference of distal end	12
Length of olecranon, taken parallel to shaft	7

It would be quite superfluous to enter into any detailed description of the skeleton, the correspondence with published accounts of *Balænoptera musculus* of the Northern Hemisphere being so close as, in most respects, to amount to identity. Indeed, with one or two trifling alterations, many of Van Beneden and Gervais's figures of that species* might have been taken from the present specimen. There are, however, one or two points in which the skeleton appears to differ from those hitherto described.

1. *The Nasals* (fig. 1).—In these the anterior processes are unusually large, and the bones are altogether larger in proportion to the skull than is usual in *B. musculus.* For instance, in the Alexandra Park skeleton,† with a skull 38 inches longer than that of the present specimen, the nasals are four inches shorter, the same width at their posterior ends, and two inches

* Ostéographie des Cétacés.

† Flower, P.Z.S., 1864, p. 411.



BALÆNOPTERA MUSCULUS.

J. H. Scott, del.

narrower at their anterior ends. Judging from published figures also, the upper surfaces of the bones seem to be unusually strongly ridged. Each has a prominent ridge along its inner border, then a somewhat triangular depression with forward apex, then a strong oblique ridge passing from about the middle of the posterior border of the bone to its antero-internal angle; from the outer edge of this ridge the bone slopes downwards, ending externally in a low ridge.

2. *The Jugals* (fig. 3).—I have not succeeded in finding any special description or figure of the jugal; but, judging from the appearance of the bone as shown in Van Beneden and Gervais's figures of the skull of *B. musculus*,* that of the present specimen appears to be broader at its anterior and narrower at its posterior end, than usual, and to be somewhat strongly curved. Owing to the absence of separate figures of this bone and of the lacrymal (fig. 2), in the works at my disposal, I have thought it advisable to give figures of both, drawn to the same scale as the nasals.

3. *Breadth of Beak.*—The proportion of the breadth of the beak to the length of the skull seems to be smaller than usual, being as 17·5 : 100. In six skeletons measured by Flower, the proportion varies from 18 : 100 to 21 : 100.

4. *Vertebral Column.*—The places at which the various dimensions of the vertebræ reach their maximum, differ slightly from those recorded by Murie in the Rosherville Gardens specimen,† and the relative dimensions of the vertebræ themselves show certain differences, but I do not consider these of sufficient importance to be recorded, except in the table of measurements.

5. *The Sternum* (fig. 4).—This differs from the corresponding bone in all the skeletons of *B. musculus* of which I have seen descriptions, in being longer than broad, like that of *B. rostrata.* The length is to the breadth as 16 : 13, while, in other specimens measured, the proportion is about 16 : 20. The antero-lateral edges and the lateral angles were, however, evidently edged with cartilage, so that the breadth was probably considerably greater in the fresh state.

Van Beneden and Gervais give the excess of breadth over length in *B. musculus* as a character of specific importance. Von Haast also figures the sternum of *B. australis*, which he seems to think is probably identical with *B. musculus*, as broader than long,‡ and the same is the case with a specimen of the same species described by Hector.||

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* *Op. cit.*, pl. xii. and xiii., figs. 11 and 12. † P.Z.S., 1865, p. 206.

‡ "Notes on a Skeleton of *Balænoptera australis*, etc.," Proc. Zool. Soc., 1883, p. 592.

|| "Notes on New Zealand Whales," Trans. N.Z. Inst., vol. vii., 1874, p. 251.

6. *The Fore-limb.*—The humerus is but slightly compressed, and cannot be said to have a sharp lower (pre-axial) edge as described by Van Beneden and Gervais, who also state that the ulna and radius are twice the length of the humerus. In the present specimen the length of the humerus is to that of the fore-arm as 3 : 5 (strictly as 17 : 29). The total length of the fore-limb, as mounted, from the head of the humerus to the tip of the second digit, is 6 feet 2 inches.

The Baleen (fig. 5).

The baleen was cut into about six pieces on each side, but the separate portions appear to be as nearly perfect as possible. The total number of blades on each side—about 350—corresponds exactly to the number found by Flower* in an entire specimen of *Balænoptera musculus* obtained near Havre. In the middle of the series I find 39 plates to a foot; Flower gives this number as 24. The length of the anterior blades is about 6 inches: the longest are 23 inches measured along the outer edge, 30 inches along the inner edge, and 10¼ inches along the base or dorsal edge. In Flower's Havre specimen the anterior blades were 7, the longest 21 inches in length, the total length of the specimen, in the flesh, being 61 feet.

The anterior blades are yellowish white, the rest slate-coloured, with irregular vertical stripes of pale horn-colour, especially numerous towards the inner edge. The whole of the fibres forming the inner surface of the baleen are nearly white; they attain a length of 11 inches in the middle of the series. There is a distinct inner fringe formed by the dorsalmost fibres, which are about six inches in length: it seems just possible that this inner fringe may be due to a uniform longitudinal splitting of the blades during drying. There is no trace of the curled fibres described by Flower in the Havre specimen† as occurring on the outer side of the hindmost plates.

It will be seen that the agreement with *Balænoptera musculus* is here very close, except in the number of blades to a foot in the middle of the series. I am disposed to wonder whether the number given by Flower (24) is not a misprint, since if the distance between the blades through the whole series were anything like uniform—as it is in my specimen—the total antero-posterior extent of the baleen would be nearly 15 feet, whereas the total distance from the end of the muzzle to the middle of the eye is given as 12 feet. If the number 24 is correct, the blades in the Havre specimen must have been much crowded at either the anterior or posterior end of the series, or both.

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* "Notes on four specimens of the common Fin-whale," Proc. Zool. Soc., 1869, p. 604.

† P.Z.S., 1869, p. 604.

The foregoing observations show that the present specimen agrees with *Balænoptera musculus* in every essential respect except the characters of the nasals and of the sternum. Without knowing anything of the external characters I think it would be extremely injudicious to consider the peculiarities of these bones as having anything more than a varietal importance. Indeed one would have no hesitation in definitely referring the Nelson skeleton to the same species as the common Rorqual of the northern hemisphere, but for the fact that considerable confusion seems to exist as to the external characters of the Southern Fin-whales.

In a recent article* Professor Flower remarks: "There are certainly four quite distinct modifications of this genus [*Balænoptera*], represented by the two just mentioned [*B. sibbaldii* and *B. rostrata*], and by *B. musculus* and *B. borealis*, all inhabitants of British seas; but the question whether almost identical forms found in the Southern or Pacific Oceans are to be regarded as specifically identical or as distinct, awaits the result of future researches."

Gray† describes a species, *Physalus? (Balænoptera) australis*, Desmoulins, distinguished by having the dorsal fin over the male organ as in *Megaptera*. The same author‡ admits a species, *Ph. antarcticus*, founded entirely upon some yellowish-white baleen imported to England from New Zealand.

Hector|| calls the Port Underwood skeleton *Physalus australis* in the text of his paper, while in the description of plates it is referred to as *Ph. antarcticus*. Taking into consideration that it is an adult skeleton, it agrees in all essential respects with the Nelson specimen, at least as far as I can judge from the brief description, except in the form of the sternum, which, as stated above, is broader than long.

It was upon the Port Underwood skeleton that Gray§ founded his new genus and species *Stenobalæna xanthogaster* "peculiar for the shortness of its pectoral fins, its plaited belly, and low recurved and pointed fin placed over the vent, and very peculiar among all whalebone-whales for the form of its bladebone." As a matter of fact, I find on referring to Hector's paper that the pectoral fin was only a little less than one-eighth the total length of the body (body 70 feet, bones of fore-limb 8 feet 6 inches), which appears to be the usual proportion for *B. musculus*: the plaited ventral surface also obtains in that species, in which, further, the dorsal fin is over the vent. As for the scapula, all Dr. Gray had to depend on was an extremely rough sketch taken from the fresh bone before the cartilage was removed, and apparently

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* Encyclopædia Britannica, 9 ed., vol. xv., art. *Mammalia*. ‡ *Loc. cit.*, p. 164.

† Catalogue of Seals and Whales, p. 161. || Trans. N.Z. Inst., vol. vii., p. 251.

§ Note to paper by Hector, Ann. and Mag. N.H., 4 ser., vol. xiv., 1874, p. 304.

very much foreshortened: as Dr. Hector remarks, it is not like the macerated bone, which has all the characters of the scapula of *B. musculus*. So that, on examination, there seem to be positively no definite characters upon which the Port Underwood whale can be separated from *B. musculus*. This is evidently Dr. Hector's opinion,* although he still adheres to the name *B. australis*.

In Haast's New Brighton† specimen the position and form of the dorsal fin were unfortunately not ascertained; in every other respect the agreement with *B. musculus* is quite close.

There seems therefore to be, as far as the information at my disposal goes, complete specific identity between at least two well-authenticated specimens of the Southern Rorqual and its northern representative. And it would further appear that in every respect in which the Nelson specimen differs from *B. musculus*, it also differs, and in the same manner, from the so-called *B. australis*.

On the whole it seems to me that one is justified in assigning the present specimen, as well as the Port Underwood and New Brighton specimens, to *Balænoptera musculus*, at least until the accurate examination of both external and internal characters in the same individual has definitely proved the existence of a distinct species of Southern Rorqual.

In the skeleton as mounted the intervertebral ligaments are represented by pads of felt, and the following missing bones by wooden models :—

The eight posterior caudal vertebræ (18th–25th).

The three posterior chevron bones (14th–16th).

Both pelvic bones (modelled from Haast's figure of the pelvis of the New Brighton specimen).

In the right manus

- The 1st phalanx of the 2nd digit.
- The 4th and 5th phalanges of the 3rd digit.
- The 1st, 3rd, and 5th phalanges of the 4th digit.
- The 2nd and 3rd phalanges of the 5th digit.

In the left manus

- The 5th phalanx of the 3rd digit.
- The 1st, 3rd, and 5th phalanges of the 4th digit.
- The 2nd and 3rd phalanges of the 5th digit.

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* "Notes on the Whales of the N.Z. Seas," Trans. N.Z. Inst., vol. x., p. 336.

† P.Z.S., 1883, p. 592.

The cartilaginous portions of the anterior cornua of the hyoid are restored, but the sternal ribs are entirely omitted, as I can find no figure of them, except one of Turner's,* showing the relations of the first sternal rib to the sternum in *Balænoptera sibbaldii.* Only one complete set of carpals could be made up. Each of these was divided tangentially, and half used for each manus by being partially imbedded in the cement used to represent the continuous carpal cartilage.

The skeleton is suspended in the centre of the Museum from girders of railway-iron passing between the capitals of the columns supporting the upper gallery. I am greatly indebted to Mr. W. N. Blair, C.E., Engineer-in-charge for the South Island, for having kindly furnished me with an extremely suitable design for these supports.

The articulation of the skeleton has been very successfully done by my second assistant, F. J. Bourne, who also designed the whole of the iron-work, with the exception of the girders.

I have to thank my friend and colleague Professor Scott, M.D., for having made the drawings from which figures 1, 2, and 3 are taken.

EXPLANATION OF PLATE VI.

Fig. 1. The nasals, dorsal aspect.
Fig. 2. The left lacrymal, postérior aspect.
Fig. 3. The left jugal, ventral aspect.
Fig. 4. The sternum, dorsal aspect.
Fig. 5. One of the longest plates of baleen.

ART II.—*Note on an Aphidian Insect infesting Pine Trees, with observations on the name* "Chermes" *or* "Kermes." By W. M. MASKELL, F.R.M.S.

[*Read before the Wellington Philosophical Society, 6th August,* 1884.]

Plate VII.

SOME four or five years ago the imported pine trees in this country began to be attacked by a "blight," (to use the popular term) which has since increased to a somewhat alarming extent throughout the colony, at least in Wellington, Nelson, and Canterbury. The trees most subject to this pest appear to be *Pinus halepensis*, *P. insignis*, and *P. silvestris*. The general appearance presented is that of a white, mealy or cottony, fluff thickly coating the twigs of the tree but not extending far along the leaf-tufts. These last, however, soon become dry and brown, as if scorched, and

* Journ. of Anat. and Phys., vol. 4, 1870, p. 273.

generally the whole tree seems to wither, until at last it presents the appearance of complete destruction. The aspect of the pest is always unpleasant, and as its ravages increase it becomes more and more repulsive, and trees formerly vigorous, full-foliaged, and handsome, become sickly, meagre and unsightly.

My attention was first called to this "blight" a few months ago at Nelson, where it was doing immense damage to *Pinus silvestris.* It appears to be very common about Wellington, *P. insignis* and *P. halepensis* in the Botanical Gardens and elsewhere being greatly infested by it. I hear also that in plantations of pines near Wanganui, Christchurch, Ashburton and Peel Forest, its ravages are extending with great rapidity and effect.

The insect causing the injuries just mentioned belongs to the family "Aphididæ," part of the order "Homoptera," an order which has as yet been by no means sufficiently studied either in New Zealand or in other countries. It belongs undoubtedly to the germs which, by Kaltenbach, Passerini, Buckton, and others, is included under the name "Chermes" or "Kermes." [As regards this name, see my observations below.] But I am not able to fix accurately its specific position at present, in the absence of certain information on some points. Its nearest allies appear to be *Chermes* (*Anisophleba*) *pini*, Koch, and *C. corticalis*, Kaltenbach, if indeed these two insects are not one and the same; but, as shown presently, there are a few characters which seem to distinguish it from both. Just now, therefore, I can only suggest for it a temporary scientific name.

It was remarked above that, after continued exposure to the attacks of this insect, the trees *present the appearance* of complete destruction. I purposely employ this somewhat vague phrase, because of the uncertainty of the thing so far. Undoubtedly, in many instances, nothing can seem more like approaching death, and often complete death, than the aspect of the infected trees. But I am informed by Mr. Buchanan, and others who have watched them for some time, that in the majority of cases the trees, after a year or two, recover and become quite green again; indeed, I understand that they have not found any tree actually killed by the insect. If this is found to be generally the case, of course the damage done will be lessened,—not that the two or three years of decay and weakness will not be harmful, but at least there will be the chance that the trees may take a fresh start afterwards. There does not appear to have been time to fully study this point in New Zealand. It may be that, like a very severe but not constitutional disease, the pest may leave no permanent injury behind it; it may be, on the other hand, that although seemingly recovering, the trees may never regain their proper vigour; or again, it may be that after an interval of relief the insect may come back as bad as ever, and the trees may simply pass through alternate periods of illness and apparent health, and never be really what they should be. At present we only know, as it were, the first stages of the malady.

I find no particular mention anywhere of *permanent* deadly injury done by *Chermes* in England; but we cannot judge with certainty from the experience at Home what might be the effects of such a parasite in a climate like ours.

As regards the methods of destroying this pest, it is not easy to suggest any certain way, on account of the mechanical difficulty of getting at the insect on branches of pine trees, covered so closely as they are with leaf tufts. But, as the Homoptera all act in the same way, by sucking through the setæ of their rostra the juices of the plants they live on, I see no reason why remedies already found useful as against the Coccidæ should not be efficacious against such an aphidian as our present insect. A great number of experiments have been made in various countries with a view to destroy Coccidæ. Some of these, which are applicable to deciduous orchard trees, where the insect is easily approached as it lies on the bark (such, for example, as the different oil mixtures, kerosene, etc.), are not available in the present instance; and, probably, the only way to attack our aphis would be by spraying over the tree some liquid remedy. There are constantly advertised in the newspapers compounds called "Scaly blight-destroyers," and the manufacturers of these claim for them all sorts of virtues. I believe, however, that in the majority of these the chief reliance is placed upon such substances as sulphur, carbolic acid, etc., which are of no real use. Sulphur, indeed, is an excellent remedy for such diseases as oidium in vines, which are fungoid; but it seems to have no sort of efficacy as against homopterous insects. Tobacco is, in itself, most useful; but probably the cost in this country would be too great. But of all remedies the best, according to the experience of American observers, appears to be common soap. I find from Professor Comstock that a solution of a quarter of a pound of soap to a gallon of water has been found to be of very great efficacy in destroying Coccidæ of all kinds, both on deciduous and evergreen trees, on the bark and on the leaves. This being so, probably it would be also very useful against the pine insect, and is well worth trying. Of course any common soap would do if the solution is made strong enough.

In some papers lately forwarded to the New Zealand Government by the Colonial Office in London, I find a suggestion by a French gentleman for destroying *Phylloxera vastatrix* (also a homopterous insect) by driving copper nails into the wood of the infested vines. The idea seems to be that the insects would imbibe some salts of copper, and so be poisoned. Whether such a course would answer with pine trees and their aphidian pest I cannot say.

In cases where the trees attacked are accessible to applications of a remedy, I should say therefore that a strong solution of common soap, applied by a syringe in dry weather, might be found to be the best. Doubtless, in large plantations of tall trees say of many acres, especially if the insect is well established, it would be difficult to apply any remedy at all.

General Description of the Insect.

Suggested name—*Kermaphis pini*, Koch, var. *lævis.*

Anisophleba pini, Koch.

Plate VII , figs. 1–11.

Occurs in colonies surrounded by masses of white cottony secretion, clothing the twigs of pine trees. This secretion contains great numbers of apterous oviparous females, with ova and young larvæ.

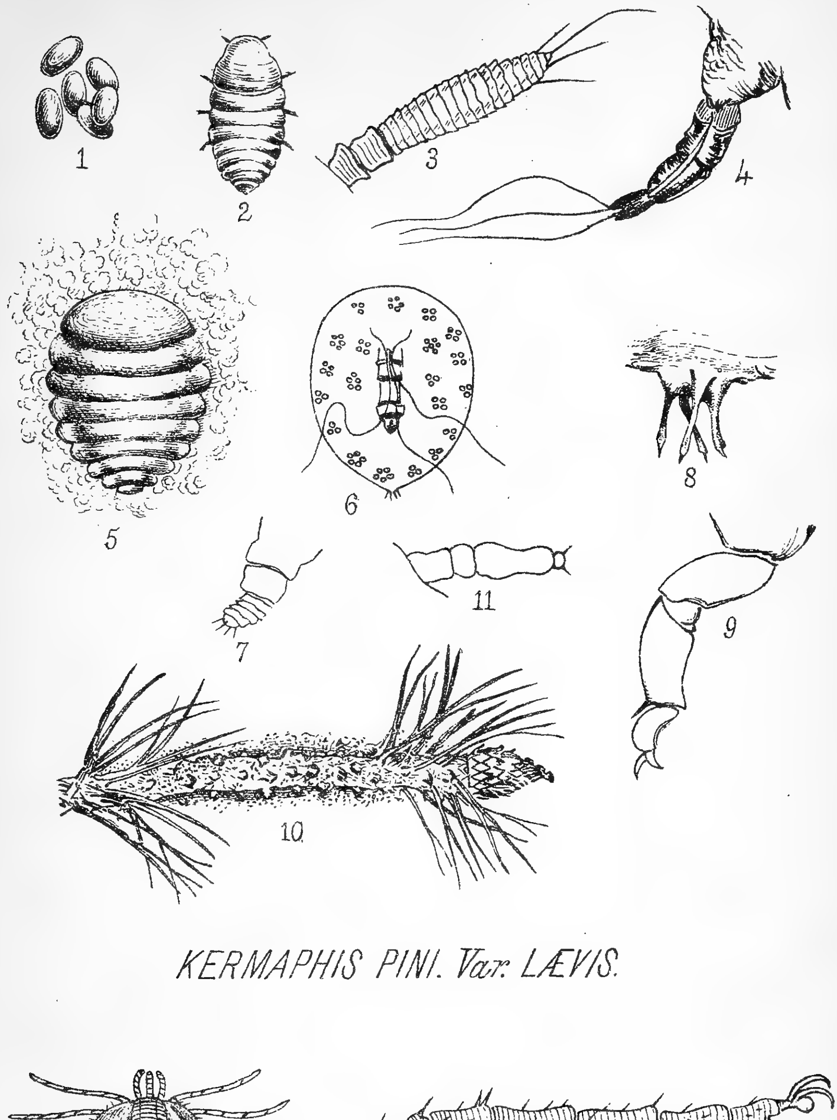
Eggs oval, yellow or brown, length about $\frac{1}{80}$ inch, not pedunculated (fig. 1).

Young larva just hatched, yellow, elongated oval, flattish: body segmented, the segments diminishing to the anal extremity (fig. 2): eyes brown, conspicuous. Antenna (fig. 3) of three joints, each numerously ringed, the third joint being longer than the other two together; foot normal of Aphididæ: rostrum not longer than the body; a few short spines on the segments. The larva is somewhat active.

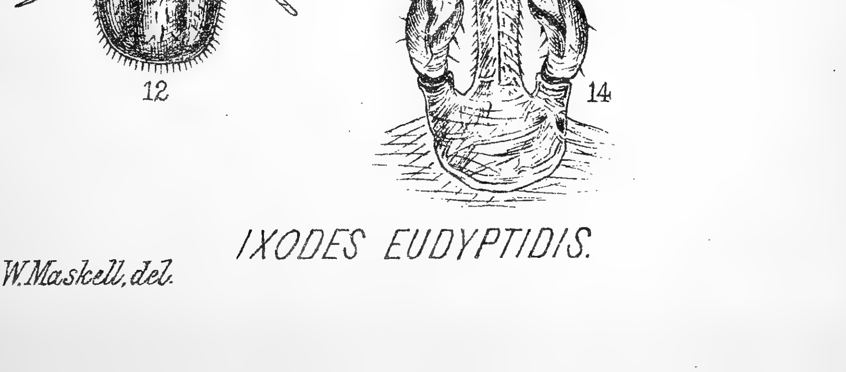
Apterous oviparous female dark brown in colour, semiglobular, convex above, flat beneath, resembling somewhat the Coccid insect *Rhizococcus* (fig. 5). Length from $\frac{1}{20}$ to $\frac{1}{30}$ inch, breadth and height rather less. Body segmented, but without spots on the dorsum and sides. Antenna (fig. 7) very small, of three (?) atrophied joints, the last bearing some hairs. Foot (fig. 9) normal of Aphididæ. Abdomen ending in four minute but somewhat strong spines (fig. 8). Cornicles (honey tubes), none, unless the spines just mentioned may answer to them. When the insect has been macerated in potash and the interior substance expelled, the skin is found to be covered with numerous small circular orifices arranged in groups, whence is secreted the white cotton.

I am not acquainted as yet with the male, nor with the winged state of the female. According to Buckton (British Aphides, vol. iv., p. 41), the winged forms of *Chermes pini* are also not exactly known.

This insect differs from *C.* (*Anisophleba*) *pini* in the absence of peduncles in the eggs, and from both that and *C. corticalis* in the absence of spots on the dorsum and sides, and in the form of the female antenna. I give for comparison (fig. 11) a copy of Buckton's figure of the antenna of *C. corticalis.* Probably also the spines at the extremity of the abdomen may be distinctive.



KERMAPHIS PINI. Var: LÆVIS.



IXODES EUDYPTIDIS.

W. Maskell, del.

Observations on the name "Chermes" *or* "Kermes."

Much confusion has grown round this name, which has been made by different writers to do duty in various distinct directions. Linnæus and Fabricius included under it Coccidæ, Aphididæ, and Psyllidæ; Passerini restricts it to the Aphididæ; Kaltenbach, Buckton, and others seem to include in it Aphididæ and Coccidæ; Geoffroy, Targioni-Tozzetti, Signoret, and others restrict it to the Coccidæ.

Now, there is so marked a distinction between the families just mentioned that it seems simply absurd to confound them under one name. A number of characters which can only be well made out under the microscope distinguish them completely; but, apart from these, the fact that in the Coccidæ the females are always, without any exception, apterous, whilst in the Aphididæ the females in certain stages have four wings, is a perfectly sufficient cause for separation. Attempts have been made at various times to introduce a clearer classification, but, amongst at least English writers, with little or no success. This appears to me to be due in a great measure to the very small knowledge possessed by English naturalists of the family Coccidæ, a family which is apparently not abundant in England except upon exotic plants. In point of fact, most of these writers seem not to be aware of anything more than the single genus "Coccus," to which, although in reality it contains only the single species *C. cacti* (cochineal), they relegate every insect of the family.* It is from some such want of knowledge that the name of "Chermes" or "Kermes" has been given to many quite distinct insects, even in some cases to Psyllidæ.

I am quite well aware that names are not an end, but a means to an end, and that a rigid and precise purism may be often absurd; yet I see no reason why accuracy should not be aimed at in the case of minute insects as in the case of larger animals; and I can fancy the chorus of indignant and contemptuous expostulation which would greet an ornithologist combining under one genus a hawk and a magpie, or a geologist including a trilobite amongst the saurians.

The name "Chermes" or "Kermes" is, so to speak, as old as the hills. It appears to have been originally given by the Persians either to the insect itself which produced for them a red dye (not cochineal), or to the dye thus produced. Linnæus applied the name to an insect which he termed *Kermes ilicis*, and unfortunately began the confusion to which I am referring, as he

* Thus, for example, Mr. Beck, in the Journal of the Roy. Microsc. Society, describes at some length what he calls a "Coccus" of the apple tree, which is, of course, *Mytilaspis pomorum;* and Mr. Buckton (British Aphides), who mentions constantly "Coccus," refers to an insect as "now *Coccus ilicis*," which is not a *Coccus* at all, but a combination long ago abandoned of *Kermes bauhinii* and *Kermes vermilio.*

included under it insects of several distinct species and even families. Gustave Planchon, in distinguishing these species, defined the one producing the red dye as *Kermes vermilio* and denominated another *K. bauhinii*. Both of these are true Coccidæ, and the Coccid genus *Kermes* may now be said to include the following European species :—

K. ballotæ, Lichtenstein.
K. bauhinii, Planchon.
K. gibbosus, Signoret.
K. pallidus, Réaumur.
K. reniformis, Réaumur.
K. variegatus, Gmélin.
K. vermilio, Planchon.

From America a species, *K. galliformis*, Riley, has been described, and some others are reported, but without description, by Professor Comstock.

From South Australia I have received from F. S. Crawford, Esq., of Adelaide, a *Kermes*, which is undoubtedly a true Coccid, but I have not sufficient material for its full description.

All the above insects are entirely distinct from the Aphididæ in the apterous condition of the female in all stages of her existence and in almost every other character, with possibly a slight doubt as to *K. variegatus*.

It would seem to be only correct that, whatever might happen with regard to insects discovered or described in later times, the generic name ought to follow, and to be included in, the family of the insect which originally received the name, whether scientifically or popularly. As therefore, the above-mentioned *Kermes vermilio* is the undoubted representative of the old dye-producing Kermes of the Persians and Arabs, and as it is also undoubtedly a true Coccid and not Aphidian, it is right that the generic name of *Kermes* should be attached to the Coccid family, and that some other should be found for those Aphidians at present included under it.

Mr. Buckton (British Aphides, vol. iv., p. 22) affirms himself convinced by the arguments of Passerini, and adds, "As regard should be paid to priority, I follow Kaltenbach, Koch, and many other authors in retaining the name *Chermes* amongst the Aphididæ." The same reasoning would of course lead us to extend it also to the Psyllidæ, with Fabricius, Strobelberger and Marsili two centuries ago ; and this would be absurd. But, in truth, the point to be noted is that, whilst it makes no difference perhaps to which family the name is given, it is quite clear that it ought not to belong to both ; and looking at the position of *Kermes vermilio* as stated just now, it seems most proper that this name should be restricted to the Coccidæ alone, and that some other should be found for the Aphididæ.

I venture to suggest for this purpose the name *Kermaphis*. It is not so far removed from the other as to be strange, and it would relieve entomology of an absurd confusion whilst still indicating something of the old relationship. On this idea, the insect above described would be *Kermaphis pini* var., unless the differences noted in my description should be sufficient to raise it to distinct specific rank.

EXPLANATION OF PLATE VII., Figs. 1–11.

Fig. 1. Eggs × 20.
Fig. 2. Young larva.
Fig. 3. Antenna of larva × 350.
Fig. 4. Rostrum of larva.
Fig. 5. Oviparous female, dorsal view.
Fig. 6. The same, after maceration in potash. The legs are not shown in this figure.
Fig. 7. Antenna of oviparous female × 400.
Fig. 8. Abdominal spines of oviparous female × 400.
Fig. 9. Foot of oviparous female.
Fig. 10. Pine twig infested; the leaf-tufts are cut away on the centre portion.
Fig. 11. Antenna of *C. corticalis*, after Buckton.

Art. III.—*On a Parasite of the Penguin.* By W. M. Maskell, F.R.M.S.

[*Read before the Wellington Philosophical Society, 13th February*, 1885.]

Plate VII., figs. 12–14.

Mr. A. Reischek has collected at Dusky Sound a parasite of which the following description may be sufficient.

Order. ARACHNOIDEA.

Fam. Gamasinæ.

Genus **Ixodes.**

Ixodes eudyptidis, sp. nov.

Body almost ¼ inch in length, of a light brown colour, elliptical, somewhat convex, with a tough, leathery skin, covered with numbers of short fine hairs which are longest and most numerous on the abdominal region. Eyes absent. On the back, at the cephalic end, is a small shield exhibiting no hairs, smooth, shining, and marked with numerous minute circular shallow pits. Skin also finely striated with minute transverse wavy wrinkles. On the dorsum are two longitudinal shallow grooves, and on the under side the median portion is a broad longitudinal depression, the anal orifice placed near the extremity. Legs somewhat long and strong, seven jointed, each joint having a few spiny hairs: claw double, with a small thick caruncle or pad. Rostrum protruded in front, thick and cylindrical, with many recurved spines and eight little tubular short processes at the tip, with a small lobe or pad. Mandibles of the length of the rostrum or a little longer, the end recurved and terminating in a sharpish point.

Hab. In the gape of the penguin.

This is evidently a true tick, having the characteristic rostrum and dorsal shield of the genus. I have found no species described exactly resembling it.

It may be supposed that so large a parasite must be greatly inconvenient to the penguin, but its position would seem also to offer easy opportunities for getting rid of it if the bird chose to do so.

EXPLANATION OF PLATE VII., FIGS 12-14.

Fig. 12. *Ixodes*, dorsal view, about 4 times nat. size.
Fig. 13. „ foot.
Fig. 14. „ rostrum and mandibles.

ART. IV.—*Further Notes on* Coccidæ *in New Zealand.*

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

[*Read before the Wellington Philosophical Society, 13th February,* 1885.]

Plate VIII.

A PARAGRAPH in "Nature" of September, 1884, referring to my last paper on New Zealand Coccids, recommends me to try the application of kerosene to infested trees. This recommendation is more particularly directed to the case of *Icerya purchasi.* In another part of the same journal, I find a notice of some papers by Professor C. V. Riley, of Washington, in which the use of kerosene is also urged; and the remedy is characterized by "Nature" as "new." Considering that ever since 1878 I have been constantly preaching the employment of kerosene against scale insects, often against adverse criticism, it is not a little amusing to me to receive advice to try the very thing which, in my first paper in these Transactions, I originally proposed. "Nature" perhaps also overlooks, in connection with *Icerya purchasi*, that there is some difference between treating garden plants, or even orange-trees, and perhaps several acres of forest, or trees fifty feet high, or many chains of gorse fences.

In the same paragraph exception is taken to the "extreme roughness" of the plates attached to my paper. *Non cuivis homini contingit adire Corinthum.* We are not all artists, nor have we always in this country engravers who are able to improve the "roughness" of our original drawings.

Group.—DIASPIDÆ.

Genus, **Aspidiotus**, Bouché.

1. *Aspidiotus camelliæ*, Boisduval.

In my paper of 1878 (Trans. vol. xi., p. 200), I reported this insect as attacking camellias in greenhouses. I find that it has since spread out of doors, and that it is common about Wellington on *Euonymus*, weeping willow, and other garden trees and shrubs. Its whitish or grey scales cover the bark in great numbers.

Aspidiotus carpodeti, sp. nov.

Figs. 1, 2.

Female puparium usually light-brown, but varying a little with the colour of the tree; convex; circular, the pellicles in the centre: some specimens are slightly elongated. Average diameter $\frac{1}{16}$ inch.

Male puparium narrow, with parallel sides; not carinated; dirty-white or brownish colour; length about $\frac{1}{16}$ inch.

Adult female of the normal peg-top shape, the abdomen not so much overlapped as usual. Abdomen ending in two median, somewhat prominent, lobes, with two others much smaller not in close proximity; edge of the body jagged with curvilinear incisions, amongst which and between the lobes are a number of serrated pointed hairs as in *A. nerii.* Four groups of spinnerets: lower pair with 4–6 orifices, upper with 6–10. These groups seem surrounded by a narrow line as if enclosed in a chamber: the same appearance is presented (according to a figure of Mr. Comstock's) in *A. nerii.* There are many single spinnerets.

The adult male is of normal form, with antennæ of ten joints of which the seventh, eighth, and ninth are the longest. The haltere (fig. 2) has a somewhat long peduncle. The abdominal spike is rather long, and springs from a large tubercle.

On *Carpodetus serratus* and *Vitex littoralis* (puriri), but I think my specimens on the latter tree had only spread from the former. The puparia are so like in colour to the bark that it is difficult to detect them.

This insect is evidently closely allied to *A. nerii*, but seems to differ in the abdominal lobes of the female and in the antennæ of the male; its male puparium is also much longer, and that of the female more convex than in that species.

Genus, **Mytilaspis**, Targioni-Tozzetti.

1. *Mytilaspis epiphytidis*, sp. nov.

Fig. 3.

Female puparium flat, pyriform, brown in colour, thin; length about $\frac{1}{11}$ inch.

Male puparium narrower than that of the female, and a good deal darker, being sometimes almost black; length about $\frac{1}{20}$ inch: not carinated.

Adult female of normal form of *Mytilaspis.* Abdomen ending in two median lobes: along the edge several deepish curvilinear incisions between which are some strong spines. Five groups of spinnerets: lower pair with 14–16 orifices, upper pair 12–16: uppermost group 4–6.

I have not seen the adult male: the pupa exhibits apparently a very long abdominal spike.

This insect is closely allied to *M. pyriformis*, mihi, but differs in the lobes of the abdomen in the female, and in the very dark puparium of the male. However, I cannot consider it with certainty a new species. It is undoubtedly not a *Chionaspis.*

Hab. On *Astelia cunninghamii*, an epiphyte on numbers of our forest trees.

2. *Mytilaspis pyriformis*, mihi.

(Trans., vol. xi., p. 194; vol. xii., p. 121.)

This insect occurs abundantly near Wellington on *Dysoxylon spectabile*, in company with *Chionaspis dysoxyli* and *Fiorinia asteliæ.* It may be easily distinguished from the latter, of course, by the second pellicle of the female; from the former it differs by the puparium of the male, which in the *Mytilaspis* is brown and not carinated, and by the generally much larger size and brown colour of the female puparium. The abdominal segment of the female is also a clear distinction.

Some of my specimens attain a length of $\frac{1}{8}$ inch for the female puparium.

Genus **Chionaspis,** Signoret.

1. *Chionaspis dysoxyli*, sp. nov.

Figs. 4–6.

Female puparium thin, flattish, pyriform, white in colour with a faint pink tinge when the egg-mass beneath shows through it. Length about $\frac{1}{12}$ inch. The second pellicle is comparatively large.

Male puparium white, narrow, carinated; length about $\frac{1}{36}$ inch.

The insect affects principally the leaves of the plant, and the puparia are usually clustered thickly along the midrib.

Adult female of general form of *Mytilaspis*, not very deeply corrugated; colour, yellowish red. Abdomen ending in a broken curve with many curvilinear incisions. There are fourteen lobes, of which the two median are the largest; separated from them by a spine on each side are two others rather smaller; then another spine and a short open space; and then three smaller lobes and another spine; another space, and then a single small lobe followed by a spine. Five groups of spinnerets: lower pair with 12–14 orifices; upper pair with 7–10; uppermost group, 4–6. A few spiny hairs are on the edge of the abdomen.

I have not been able to hatch out an adult male, though the male puparia are very numerous.

Very abundant on *Dysoxylon spectabile*, often in company with *Mytilaspis pyriformis*. It seems to differ from all described species in the abdominal lobes of the female.

2. *Chionaspis citri*, Comstock.

(Second Report of Entomol., Cornell University, U.S.A., 1883.)

An insect which occurs here sparingly on oranges imported from Sydney belongs, I think, certainly to this species.

3. *Chionaspis minor*, sp. nov.

Female puparium white, small, not more than $\frac{1}{15}$ inch in length, usually less; it is narrower and less pyriform than is usual in the genus, and is often bent in the middle; pellicles yellow.

Male puparium white, narrow, elongated, carinated, about $\frac{1}{30}$ inch in length.

Adult female not deeply corrugated, with general form of *Mytilaspis;* colour dark brown. Abdomen ending in six small lobes, of which the two median, the largest, are closely contiguous. Between them and the next pair is a spine; then beyond the second pair another spine, a space, and a third pair of very small lobes; after a long space there is another spine. Five groups of spinnerets—uppermost group with 12–14 orifices; upper pair, 14–17; lower pair, 18–24; many single spinnerets.

I have not seen the adult male.

Abundant sometimes on *Parsonsia*; also frequently on *Rhipogonum* (supplejack).

The smallness of this species and the contiguous median lobes of the female abdomen sufficiently distinguish it.

Genus **Diaspis**, Costa.

1. *Diaspis boisduvalii*, Signoret.

In my paper of 1878 I reported this insect as occurring in hothouses. I find that, like *Asp. camelliæ*, it has spread out of doors, and is common on several garden shrubs. I have found it abundant on the wattle.

2. *Diaspis santali*, mihi.

(Trans., vol. xvi., p. 122.)

I have received from G. E. Alderton, Esq., of Whangarei, specimens clearly belonging to this species, which in that locality seems to have spread from the native trees to the orchards, and is infesting in great numbers pear, plum and other fruit trees.

Genus **Fiorinia**, Targioni.

Uhleria, Comstock, *loc. cit.*, p. 110.

1. *Fiorinia stricta*, mihi.

(Trans., vol. xvi., p. 124.)

I find that this insect is more common than I had supposed. It occurs on several native plants, *Astelia*, *Muhlenbeckia*, *Cordyline*, etc.; and on the last-named tree, in the Hutt Valley, I have seen it covering the leaves in countless thousands, as also on *Phormium*. I find also that in some specimens four very minute lobes may be detected between the sharp comb-like teeth of the abdomen.

2. *Fiorinia asteliæ*, mihi.

(Trans., vol. xiv., p. 217; vol. xi., p. 201.)

Figs. 7–9.

There are some modifications in the second female pellicle of this insect on different plants which do not seem to be sufficient for the establishment of new species, as I cannot detect in the adult stage or the general habit any clear differences. The normal pellicle exhibits, as described in Trans., vol. xi., p. 202, two prominent lobes just before the abdominal segment, and that segment itself terminates in a number of small blunt serrations. Sometimes, however, I have found specimens (on *Cyathodes acerosa*) where the two lateral lobes were absent, and others (on *Astelia cunninghamii*) where the abdomen ends, as shown in the figure, in large, peculiar, tusk-like lobes. The normal form I have found most frequently on *Atherosperma novæ-zealandiæ*. I am not prepared to consider the differences mentioned as amounting to more than variety.

Group.—LECANIDÆ.

Subsection I.—Lecanio-diaspidæ.

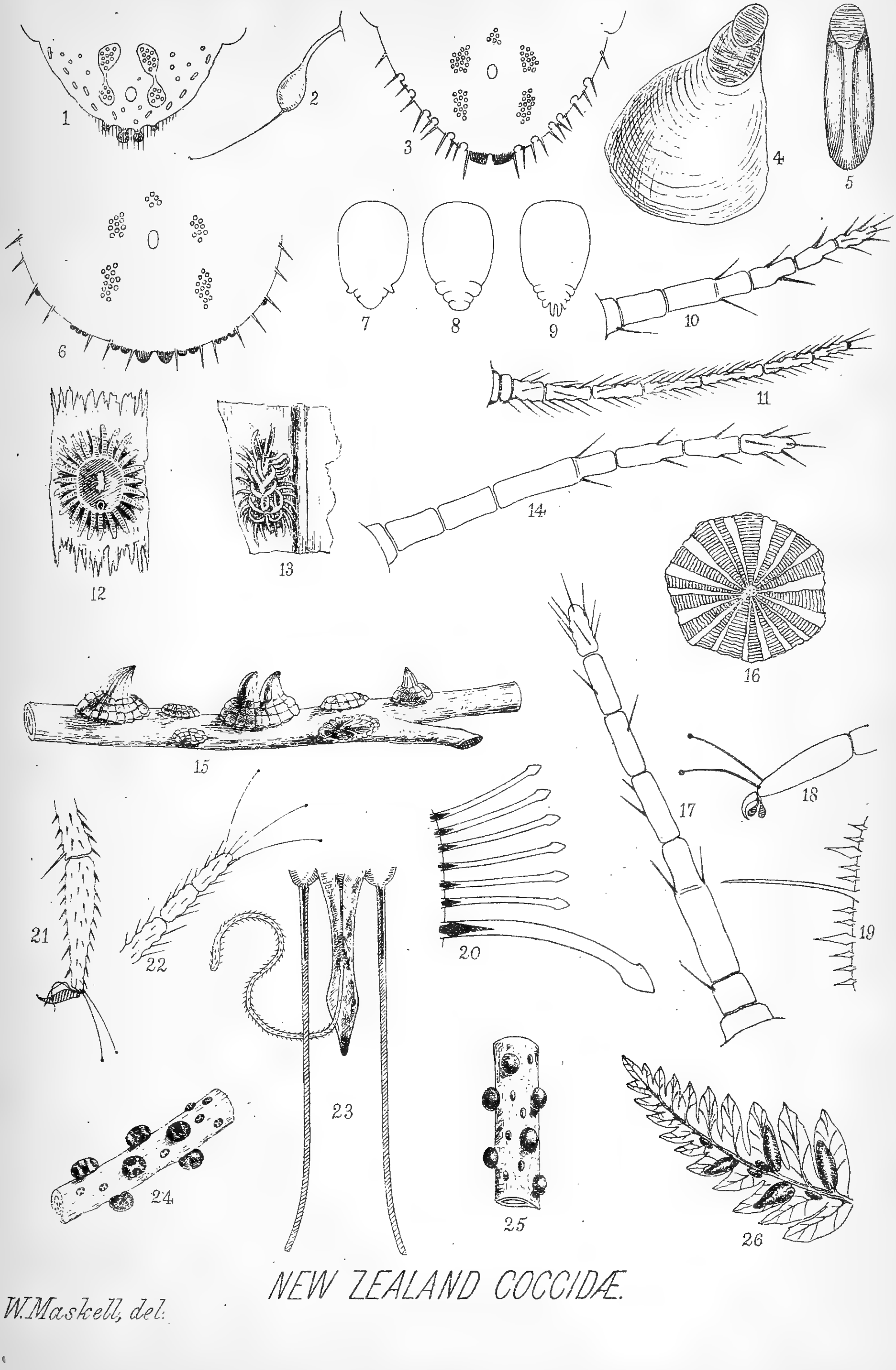
Genus **Ctenochiton**, mihi.

1. *Ctenochiton viridis*, mihi.

(Trans., vol. xi., p. 211.)

The male of this species, of which I have hatched out some half dozen specimens in the last year, presents no striking features. The test is white, glassy, oval, and slightly convex, about $\frac{1}{6}$ inch long, divided into hexagonal segments marked with radiating lines like that of the female, and with a somewhat large fringe. Towards the posterior end it is cut across by a dividing line, and the insect when emerging lifts up the last segments of the test on this line as on a hinge.

The perfect insect has antennæ of nine joints, feet normal (but I cannot make out any digitules), thoracic band small and inconspicuous. There is a spine at the extremity of the tibia.



NEW ZEALAND COCCIDÆ.

W. Maskell, del.

The only means of distinguishing this from the male of *C. perforatus* seem to be in the test, where the rows of perforated air-cells characteristic of that species are absent.

2. *Ctenochiton spinosus*, mihi.

(Trans., vol. xi., p. 212; vol. xiv., p. 218.)

I have to add to the habitat of this species the bark of *Muhlenbeckia* and of *Melicope ternata*. The insect is very difficult to detect, as it is usually of almost the same colour as the bark.

3. *Ctenochiton hymenantheræ*, sp. nov.

Figs. 10, 11.

Test of female waxy, circular, convex, dirty white, yellow, or brownish, formed of a number of hexagonal or octagonal segments, which are also convex, giving it a rough appearance. Fringe not very conspicuous. Diameter of test about $\frac{1}{12}$ inch.

Test of male glassy, white, oval, segmented, slightly convex, segments of fringe small. Length about $\frac{1}{16}$ inch.

Adult female yellowish brown, fitting the test. Antennæ (fig. 10) of six joints, of which both the second and third seem sometimes double. Foot normal; upper digitules long fine hairs, lower pair broad. The spiracular spines are strong and conspicuous. The skin is divided into segments corresponding to those of the test, the divisions being marked by lines of spinneret orifices which are small and simple.

In the second stage the usual wavy edge of the genus is not generally apparent.

Adult male somewhat thick and short. Antennæ (fig. 11) of nine joints, the first short and thick, the remainder long and nearly equal: each joint after the first has many nodosities from which spring longish hairs. Foot long and slender, especially the tibia. Digitules fine hairs. Thoracic band inconspicuous. Abdominal spike short and blunt.

This species is usually accompanied by a great quantity of very black fungus covering and rendering unsightly the whole plant on which it lives.

From *Hymenanthera crassifolia*.

This insect seems to be intermediate between *C. piperis* and *C. depressus*, differing from both in the rugose female test and the distribution of the spinneret orifices.

4. *Ctenochiton piperis*, mihi.

(Trans., vol. xiv., p. 218.)

The male test of this species is more oval than that of the female, and somewhat smaller, averaging about $\frac{1}{20}$ inch in length. It is otherwise so similar in its divisions, colour, and general appearance, that it cannot be mistaken for that of any other species.

The adult male has nine-jointed antennæ, all the joints except the first long and hairy. Foot not so slender or long as in the last species, the tarsus being a good deal thicker. Digitules fine hairs. The penis, in some of my specimens, which as usual protrudes from the abdominal spike as a long white soft tube with minute hairs, seems to end in a somewhat large round knob, which I have not noticed in any other species.

5. *Ctenochiton elæocarpi*, sp. nov.

Figs. 12–14.

Test of adult female oval, nearly circular, black in colour, divided into hexagonal and pentagonal segments which are not conspicuous, and of which the median series forms a very slightly elevated ridge somewhat lighter in colour. The test is only slightly convex. The fringe is very long and conspicuous, the segments toothlike. Diameter of test, exclusive of the fringe, reaches $\frac{1}{6}$ inch.

The adult female fills the test, as usual. Colour black: antennæ somewhat long (fig. 14), of seven joints (I think, otherwise the third joint is abnormally long), a few hairs on the last joint. Foot normal; upper digitules strong and thick, lower pair very broad. On the skin are a number of large oval spots which appear to be the orifices of spinneret tubes.

In the second stage this insect has a somewhat remarkable test of white wax, which is not, as usual, almost homogeneous, but is made up (fig. 13) of a number of detached plates somewhat resembling those of the genus *Orthezia*. The fringe is here even longer than in the adult, and its long white teeth curl in different ways, so that the whole test presents a rather elegant appearance. The insect beneath has the normal Lecanid shape, but wants the usual wavy outline of *Ctenochiton*. All round the edge is a row of sharp conical spines set pretty closely together. Feet normal; antennæ of six somewhat confused joints. Extreme length of test, including fringe, sometimes $\frac{1}{8}$ inch.

I do not know the male.

From *Elæocarpus dentatus* (hinau) in the neighbourhood of Wellington.

This species is, in some respects, similar to *C. fuscus*, mihi (Trans., vol. xvi., p. 131), but differs in the much more flattened adult test, the longer antennæ, the presence of the oval spots, and also in the peculiar test of the second stage.

Ctenochiton flavus, mihi.

(Trans., vol. xvi., p. 130.)

The tests of the second stage of this species, which resemble somewhat *Ceroplastes rusci*, Linn., occur not uncommonly on *Elæocarpus* and *Leptospermum*, near Wellington.

Genus **Inglisia**, mihi.

(Trans., vol. xi., p. 213.)

1. *Inglisia leptospermi*, mihi.

(Trans., vol. xiv., p. 220.)

The test of the male is white, elongated, convex, not unlike that of the female, but with a longer fringe ; it has also its posterior segment divided from the rest by a transverse slit or hinge ; average length about $\frac{1}{15}$ inch.

The male is yellowish green in colour, the body slender and tapering. From the abdomen spring two very long white cottony setæ, one on each side of the spike, which is straight and short. Antennæ of ten joints ; the first two short, the rest long, thin, and hairy. Of these the seventh, eighth, and ninth are the shortest ; on the last joint three long knobbed hairs. Feet slender, hairy; digitules normal. Thoracic band inconspicuous. Four pairs of eyes.

I only once found specimens, from which I hatched four males, on *Leptospermum*, the favourite tree of this species.

2. *Inglisia ornata*, sp. nov.

Figs. 15–23.

Test of adult female reddish brown, the base more or less oval, the rest elevated in a cone and ending in a prominence standing up like a more or less sharp horn ; sometimes there are two of these horns. The test is formed of a number of polygonal segments, each slightly elevated, and all are marked with the radiating striæ peculiar to the genus. There is a fringe of sharply triangular segments, also striated. Average length of test about $\frac{1}{6}$ inch, but specimens attain a length of $\frac{1}{4}$ inch ; height about $\frac{1}{10}$ inch.

Test of second stage generally resembling that of the adult, but smaller and less conical, and more tinged with green ; and at the edge a number of short spinneret tubes may be seen protruding.

Test of the male elongated oval, convex, but wanting the prominent horn of the female, glassy, white tinged with yellowish brown, composed of segments marked with conspicuous striæ. Length, $\frac{1}{12}$ inch. Fringe often present, but irregular ; often absent.

The adult female fills the test, shrivelling after gestation. It exhibits the horn, or two horns, as in the test. Antennæ of seven joints (fig. 17) : the third joint showing the false division noted in other species of Lecaniodiaspidæ. Feet normal : upper digitules strong and thick, lower pair rather broad. Along the edge of the body is a row of sharp lanceolate spines (fig. 19), set closely together : and the spiracular spines are long and conspicuous. A double or triple row of minute circular spinnerets marks the divisions corresponding to the segments of the test. Colour of the insect greenish, turning brown after gestation. The abdominal lobes are brown.

In the second stage the female resembles generally the adult; but the antennæ have six joints, and amongst the marginal spines are some very much larger than the rest.

The young larva is flat and oval, and at the margin shows a fringe of long glassy pointed tubes (fig. 20), springing from the marginal spines.

The adult male is about $\frac{1}{20}$ inch in length (exclusive of the wings), brownish or reddish yellow in colour, the wings hyaline and iridescent, with red nervures. Antennæ (fig. 22) of ten joints, on the last of which are, amongst others, three long knobbed hairs. Foot with a spine at the extremity of the tibia; digitules fine hairs (fig. 21). At each side of the abdominal spike springs a strong seta, from which extends a white cottony pencil, as long as the body of the insect. The penis is as usual a long soft cylindrical tube covered with minute recurved spines. Thoracic band short and narrow.

From *Elæocarpus* (hinau) and *Leptospermum* (manuka), but apparently the former is the principal habitat. I have only found it as yet in the North Island, sometimes on twigs in great numbers.

This is a peculiarly elegant insect, the beautifully coloured and striated tests both of males and females forming an interesting object under a lens or the microscope. It cannot be mistaken for any other species that I know of, and the curious horn of the test, especially when double, is quite characteristic.

Subsection II.—Lecanieæ.

Genus **Lecanium**, Illiger.

1. *Lecanium oleæ*, Bernard.

Fig. 24.

I find that this insect is becoming very common throughout this country, especially in the North Island. I have specimens from several plants in gardens and orchards; it is abundant on *Cassinia leptophylla*, the useless and noxious shrub which is covering the hills near Wellington; and Mr. Alderton informs me that it is spreading on the native trees near Whangarei. It may be readily recognized by the large size and black colour of the semi-globular adult females, and the one longitudinal and two transverse keels on the young insects. It is usually known in California and elsewhere as the "black scale."

2. *Lecanium hemisphæricum*, Targioni.

Fig. 25.

Not unlike the last species to the naked eye, but wanting the keels mentioned under *L. oleæ*. It does not seem to be, as yet, common in this country, but occurs on some garden plants—e.g. Camellia, etc.

3. *Lecanium mori*, Signoret.

Fig. 26.

An insect which I cannot identify as any but this species occurs on *Alsophila* and other plants in the Botanical Gardens, Wellington. It is evidently an introduced insect, and as evidently belongs to the series of *Lecanium* of which the type is *L. persicæ*, Réaumur, where the body is oval and slightly convex, reddish in colour, but without keels. The present insect is about $\frac{1}{9}$ inch long, smooth, naked, with antennæ of seven joints. The skin exhibits no tessellations or markings.

I have not seen the adult male, but there is a white and glassy male test.

Group.—COCCIDÆ.

Genus **Acanthococcus**, Signoret.

1. *Acanthococcus multispinus*, mihi.

(Trans., vol. xi., p. 217.)

Occurs near Wellington on *Knightia excelsa* and *Cyathodes acerosa*.

Genus **Eriococcus**, Targioni.

1. *Eriococcus pallidus*, sp. nov.

Female enclosed in an elliptical sac of felted secretion, which is yellowish white in colour, and about $\frac{1}{9}$ inch in length. This sac completely envelopes the insect, being closed in at both ends.

Female insect greenish grey in colour, turning brown after gestation; at first filling the sac, but shrivelling as the sac becomes full of eggs. Antennæ of six joints, of which the third is twice as long as any other. Tibia and tarsus slender; upper digitules fine hairs, lower pair narrow and somewhat long. Anal tubercles rather large; anal ring with eight hairs (sometimes only six). The body is segmented, but without deep corrugations, and along the middle of each segment runs a line of conical spines, not set very close together and somewhat slender. There are very many small oval spinneret orifices all over the dorsal surface.

Not uncommon throughout the islands on several plants, *e.g.*, *Myoporum lætum* (ngaio), *Elæocarpus* (hinau), etc. It may be readily recognized by the yellowish-white elliptical felted sac.

The genera *Eriococcus*, *Rhizococcus*, *Acanthococcus* require revision. The present insect resembles *E. buxi*, Signoret, in its sac, but differs in its paler colour and in the form of the antennæ; also *A. multispinus*, mihi, in some particulars, but wants the large and numerous conical spines of that species, and is also a good deal larger, and the sac is whiter.

Genus **Dactylopius**, Costa.

1. *Dactylopius glaucus*, mihi.

(Trans., vol. xi., p. 219.)

The male of this species undergoes its last metamorphosis in a narrow cylindrical sac of pure white cotton, about $\frac{1}{8}$ inch in length, and open at the end. Sometimes twenty or more of these sacs may be seen on a leaf, with the females and young crawling about amongst them.

The male insect is about $\frac{1}{20}$ inch long, brown in colour, and when newly hatched covered with white meal. Form normal; the body is rather thick, the anal spike very short. Antennæ of ten joints, hairy; the last eight joints equal to each other. Feet slender, hairy; the upper digitules long fine hairs, lower pair very short. The seta of the haltere is short. Wings rather large.

Genus **Icerya**, Signoret.

1. *Icerya purchasi*, mihi.

(Trans., vol. xi., p. 221.)

In the fourteenth annual report of the Colonial Botanical Garden, 1883, p. 20, I find it stated that this insect perhaps derives the differences which it exhibits when compared with the Mauritian *I. sacchari*, from change of food or climate. The natural food of *Icerya* in Mauritius is the sugar-cane; it was first found in New Zealand on Acacia: and it is suggested that the "violent change" from "sweet juice to tannic acid" might account for some change of form. This statement appears to me to rest on a misapprehension. As pointed out in my paper of 1883 (Trans., vol. xvi., p. 140), *Icerya purchasi* possesses organs and performs operations which are not observed in *I. sacchari*. Whatever modifications might, after lapse of ages, be produced by change of food or climate, it is scarcely likely that in a year or two they would include the elaboration of special spinning organs and the power of constructing a peculiar and complicated ovisac. I am aware that nobody has yet settled the vexed question of the true basis and limits for differentiation of species; but surely the absence or presence of important organs and a marked difference in the mode of propagation may be taken, at present, as sufficient for the purpose.

The number of New Zealand scale insects might be indefinitely extended if mere colour, or minute features referrible to varying food or other conditions, were taken to constitute new species; and I have carefully avoided taking them as such. Yet, perhaps we might also fall into error and confusion by attempting too much in the other direction.

EXPLANATION OF PLATE VIII.

Fig. 1. *Aspidiotus carpodeti*, abdomen of female.
Fig. 2. „ „ haltere of male.
Fig. 3. *Mytilaspis epiphytidis*, abdomen of female.
Fig. 4. *Chionaspis dysoxyli*, puparium of female.
Fig. 5. „ „ puparium of male.
Fig. 6. „ „ abdomen of female.
Fig. 7. }
Fig. 8. } *Fiorinia asteliæ*, various forms of 2nd pellicle.
Fig. 9. }
Fig. 10. *Ctenochiton hymenantheræ*, antenna of female.
Fig. 11. „ „ antenna of male.
Fig. 12. „ *elæocarpi*, female on twig.
Fig. 13. „ „ female, 2nd stage, on leaf.
Fig. 14. „ „ antenna of female.
Fig. 15. *Inglisia ornata*, tests, male and female, on twig.
Fig. 16. „ „ segment of test.
Fig. 17. „ „ antenna of female.
Fig. 18. „ „ foot of female.
Fig. 19. „ „ marginal spines, adult female.
Fig. 20. „ „ spines and tubes, young insect.
Fig. 21. „ „ foot of male.
Fig. 22. „ „ extremity of antenna of male.
Fig. 23. „ „ spike, penis, and setæ of male.
Fig. 24. *Lecanium oleæ*, females on twig.
Fig. 25. „ *hemisphæricum*, females on twig.
Fig. 26. „ *mori*, females on frond of fern.

ART. V.—*On the Spiders of New Zealand.* By A. T. URQUHART.

[*Read before the Auckland Institute, 27th October*, 1884.]

Plates IX.–XI.

OWING to our not possessing in the library of this Institute Koch's great work "Die Arachniden Australiens" and Walckenaer's "His. Nat. des Insectes Aptéres," I was obliged to refer home for detailed descriptions of, as far as I have been able to ascertain, rather more than one-half of the described species of New Zealand spiders. As the greater portion of the New Zealand species described by Koch were omitted in the transcript—recently received,—I have struck out from this preliminary paper all doubtful species that may have been described before, and trust that the few retained will prove new to science. The family *Thomisidæ*, represented by two genera *Philodromus* and *Sparassus*, and the genera *Arachnura* and *Sphasus* I believe have not been previously recorded as occurring in New Zealand.

Fam. EPEIRIDÆ.

Genus **Epeira,** Walck.

Epeira brounii, sp. n. Pl. x., fig. 5.

Length of an adult female 18 mm., and of an adult male 11 mm.

The *cephalothorax* of the female is moderately convex, compressed before, rounded on the sides, medial indentation and normal grooves moderate ; it has a reddish-brown hue, and is clothed with silky whitish hairs. The height of the *clypeus* equals the facial space.

The four intermediate *eyes* are placed on a prominence and nearly form a square ; the tubercles of the lateral eyes arch over the anterior pair.

Relative length of *legs* 1, 4, 2, 3, first and fourth nearly equal (30 mm.) ; they have a red chestnut tint, and are sparingly furnished with fine light hairs ; the armature consists of spines and sustentacula.

The *palpi* are moderately slender and resemble the legs in colour.

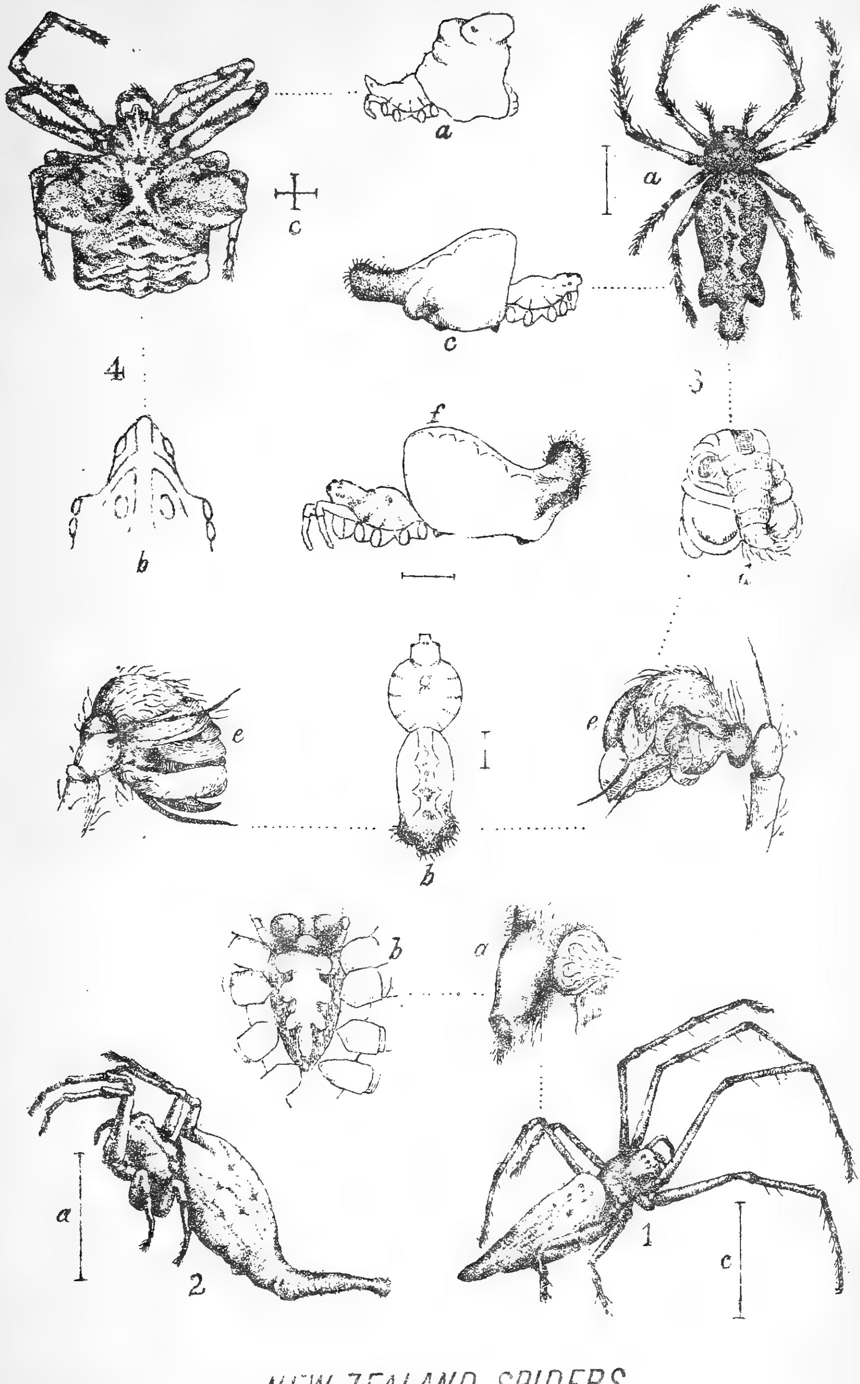
The *falces* are strong, vertical, and have a dark amber hue.

The *maxillæ* are as broad as long, slightly pointed, and inclined towards the *lip*, which is somewhat oval ; these parts have a greenish-brown tint.

The *sternum* is heart-shaped, has eminences opposite the legs ; is brown in colour, and clothed with light hairs.

The *abdomen* is a broad oval, depressed above, projects over the base of the cephalothorax ; the ground colour is brown, and the specific markings have a pale ochraceous hue ; the fore-pair of impressed spots form a transverse line with the anterior tubercles ; these brown spots are intersected by the broad medial band, forming a cross-like pattern, margined with the paler tints ; the fore-margins have a somewhat crescent-shape, and the hind converge into a double loop above the posterior tubercle ; between this conical protuberance and the two anterior tubercles there are four hook-shaped marks ; on the lateral margins there are a series of oblique lines converging towards the spinners. On the ventral surface there is a shield-like mark with light margins, and a double row of four pits in the centre. The *vulva* consists of a long, curved, dark amber-coloured, wrinkled, taper, membraneous process, directed backwards ; beneath it are black protuberances.

The male is about two-thirds the length of the female. The *cephalothorax* is oval, nearly as broad as long ; medial fovea deep ; the anterior prominence of the caput is more pointed, and the tubercles of the lateral eyes more prominent than in the female ; it has a brownish-amber hue. The legs are long, moderately stout, and resemble the cephalothorax in colour ; there is a curved process on the coxæ of the first pair ; the tibiæ of the second pair are tumid, and have four irregular rows of spines on the inferior surface ; the general armature consists of numerous long spines.



NEW ZEALAND SPIDERS.

A. T. U. del.

The *palpi* are short and stout, yellowish-brown; the cubital and radial joints are short, the former has at its extremity, in front, a long bristle directed forwards, and the latter joins in closely with the digital joint, which is well developed, and somewhat globose; the convex sides are hairy, and directed towards each other; the palpal organs are complex, and compact, the most remarkable being a strong curved process at the base. The *abdomen* is ovate; it has the same tints, and the specific pattern much the same form, as the female.

I have much pleasure in connecting this fine species with the name of Captain Broun, M.E.S., to whom I am indebted for an interesting collection of spiders. Several examples were captured by him at Tairua and Whangarei Harbour. I have taken it near Auckland.

Epeira indistincta, var. n.

This handsome variety only differs from *E. brounii* in colour, and as a rule in the specific pattern being less distinct; the *cephalothorax* and *legs* have a rather dark amber colour, and the *abdomen* has a pale yellowish-brown hue faintly tinged with green; the specific marks are buff, picked out with red.

Numerous specimens. Tairua, Whangarei Harbour, *T. Broun*; Karaka, Auckland, *A.T.U.*

Epeira (?) *attenuata*, sp. n. Pl. ix., fig. 1.

Length of an adult female, 15–17 mm.

The *cephalothorax* is oval, depressed above; the lateral constrictions at the caput, which is rather convex and roundly truncate, are moderate; there is a deep transverse fovea, and the furrows at the junction of the caput are well marked; it has a yellow amber hue, suffused with brown; sparingly clothed with pale grey silky hairs. The profile line ascends with a slight curve from the thoracic junction, running in an undulating line to the ocular area, which is only moderately prominent; projecting slightly over the *clypeus*, whose height is more than the diameter of one of the fore-central eyes.

The area of the four intermediate *eyes* is nearly twice as long as broad in front, this interval being rather more than the diameter of one of these eyes; the space between the hind-centrals is slightly in excess of the latter interval; the laterals are nearly contiguous, and placed on tubercles; the fore-pair are the smallest of the eight. The eyes, which are seated on small black tubercular spots, when viewed from above form two transverse rows; the anterior row includes the laterals, and is slightly procurved.

The *legs* are long and slender, relative length 1, 2, 4, 3, the second pair nearly equals the first in length; they are like the cephalothorax in colour, and are moderately furnished with dark hairs and long fine spines.

The *palpi* resemble the legs in colour, and are clothed with hairs and bristles.

The *falces* are strong, conical, vertical, divergent at their extremities; armed with a short double row of teeth.

The *maxillæ* are a broad oval, slightly inclined towards the *lip*, which is pointed, broader than long; these parts have a duller yellow hue than the falces.

The *sternum* is cordate, brown, and stamped with a yellow seven-lobed embossed mark.

The *abdomen* is ovate-lanceolate, of a slightly mottled creamy brown colour, margined—as far as the base of the tail-like extremity—with two broad bands of soft light silky hairs; beneath these bands there are a series of longitudinal undulating wrinkles; a narrow irregular brown medial line runs between the eight impressed spots. From the posterior pair of spots a series of four creamy brown longitudinal streaks extend along the superior surface of the tail; this part, measured from the posterior pair of spinners, is 5 mm. in length; it is shaded with brown and yellow-brown tints, furnished with fine erect hairs, and encircled with closely-set wrinkles; devoid of terminal tubercles. The ventral surface has a dark brownish hue; two creamy-coloured bands extend from the branchial opercula as far as the posterior spinnerets. The *vulva* consists of a long, thick, pendulous yellow-brown process, directed backwards, with an orifice at its extremity.

This species—which I have placed provisionally amongst the *Epeira*—appears to be intermediate between that genus and *Arachnura*; resembling the former in having spines on the 3–4 pairs of legs, and showing its affinities to the latter genus by its cross-ringed tail; which is stouter and less flexible than that of the type form.

It affects shrubs, and the lower parts of furze hedges.

Tairua, *T. Broun*; Karaka, Auckland, *A.T.U.*

Genus **Arachnura**, Vinson.

Arachnura longicauda, sp. n. Pl. ix., fig. 2.

Length of mature female—body extended, 11–16 mm.; length of cephalothorax, 2½ mm.; breadth, 2 mm.; breadth of abdomen, 3 mm.; length of tail from posterior pair of spinners, 5–7 mm. Length of adult male, 1¾–2 mm.

Female.—The *cephalothorax* is oval, moderately convex, constricted anteriorly, a glossy dark straw colour, finely rugulose, furnished with a few white hairs; the margins are edged and speckled with dark olive-green, and two narrow—sometimes blending into one—stripes of a similar shade extend along the medial line; a large pale straw-coloured, semi-oval, convex lobe, with a faint longitudinal sulcus, extends from the base to the centre of the thorax.

This lobe forms a somewhat rounded prominence in the profile line, which otherwise ascends gradually in nearly an even line to the ocular area; the fore-part of this area, containing the four intermediate eyes, is prominent; the height of the *clypeus* is rather more than twice the diameter of a fore-central eye.

The *eyes* are placed on small black tubercular prominences; the fore-centrals, which are about one eye's breadth apart, are the largest, the rest about equal; the space between the hind-centrals is less than one eye's diameter, and they are further from the fore-centrals than these eyes are from each other; the laterals are about half an eye's breadth apart, and seated obliquely on tubercles.

The *legs* are short, relative length, 1, 2, 4, 3; the first, second, and fourth about equal (6 mm.); they resembly the cephalothorax in colour, and are speckled with dark spots; the femoral, genual, and tibial joints of the 2, 3, 4 pairs have two greenish stripes on the upper surface; the armature consists of erect hairs, and a few long fine spine-like bristles on the 1–2 pairs—one or two weak ones on the 3–4.

The *palpi* resemble the legs in colour and armature.

The *maxillæ* are broad, somewhat obliquely truncate; brownish-yellow.

The *labium* is semicircular, pointed, brownish, light apex.

The *falces* are strong, conical, vertical, armed with a double row of teeth; same hue as the legs.

The *sternum* is heart-shaped, brown; in the centre there is a seven-lobed embossed mark of a yellowish colour, and speckled with brown spots; resembles fig. *b*, pl. ix.

The *abdomen* is triangular-lanceolate in form, projects over the cephalothorax; at the fore-extremity there are two conical protuberances, directed forwards, formed by a deep cleft in the abdomen; posteriorly it tapers off to a long transversely wrinkled tail-like process. This portion of the abdomen is tinted with yellowish and dark brown hues, more thickly clothed with short erect hairs; on the ventral surface there is a light-coloured band with four transverse bars, extending from the spinners to the apex; on this somewhat conical extremity are seated five small reddish tubercles.

The colouring of this species is very variable; but in most examples the fore-part of the abdomen has a creamy hue more or less mottled with violet; from the base of each conical projection a violet, yellow, or red line runs through each pair of impressed spots; between them there is a narrow medial streak, with short oblique bars. The lateral margins from the fore-part of the tubercles to the base of the tail, have a broad band of close-set longitudinal undulated wrinkles; this part and the ventral surface have a greenish-brown hue. The *vulva* consists of a broad lip-like process.

The male is much smaller than the female, being hardly 2 mm. in length. The *cephalothorax* does not differ much from that of the latter, but the *abdomen* is remarkable as it bears a somewhat close resemblance to the undeveloped form of a very young female; it is short, broad, and almost squarely truncated at either end; the depression at the base is slightly concave, and the prominences on either side are rounded and abortive. At the posterior end there are six wide, deep, transverse wrinkles extending over about one-third of the abdomen, which terminates with prominent, obtuse tubercles; the lateral marginal wrinkles are also well developed. In colour the abdomen is a yellowish-brown, mottled with a darker tint. The *legs* have a bright yellow colour, tinged with reddish-brown; they are furnished with hairs, and a very few fine hair-like bristles. The *palpi* are short, resemble the legs in colour, and have a few fine hairs. The femoral joint does not greatly exceed the cubital in length; at the base and outer side of the latter there is a rather prominent semi-bulb; the radial joint is darker, shorter, and projects on the outer side a short curved apophysis; immediately above it the base of the hairy convexity is produced into a similar but more curved bright reddish-brown apophysis; the digital joint is oval, convex, and hairy externally, the convex sides directed towards each other; concave within, comprising the palpal organs, which are not very complex; on the outer side, projecting from beneath the upper folds, there is a broad, flattish, twin apophysis directed downwards, the extremities are truncated, dark, and serrated; projecting forwards from beneath this apophysis is a finely-pointed dark process; partially in front of this one is a stronger dark serrated process, directed downwards.

Although this interesting species, from the relative length of the legs and the lesser interval between the lateral eyes, appears to be more closely allied to Koch's *Epeira higginsii* and *E. feredayi* than to Vinson's *A. scorpionoides*, I have thought it preferable to follow Vinson. In reference to its long flexible tail he says it is "susceptible d'abaissement et d'élévation, et se recourbe également vers le dos ou vers le ventre;" this power obtains in the N.Z. species. It generally affects shady places, usually spinning its small vertical web beneath the boughs of trees. I have observed the females constructing cocoons from October to August; they are composed of light-brown silk of a loose felty texture. The female, when fabricating the somewhat cylindroid cocoons, spins a strong horizontal line across the upper surface of the web, to which she suspends a thin pedicle 10 mm. or more in length; this rope-like structure is then enlarged into the first cocoon, about 8 mm. in length and $3\frac{1}{2}$ mm. in diameter; between this cocoon and the next there is a short node; this process is repeated until there are sometimes as many as nine cocoons, the entire length being about

12 mètres. Comprised within each cocoon are about 20–32 pale stone-coloured unagglutinated eggs. In the first cocoon of a nidus examined on the 14th June the young were little more than 1 mm. in length, and had attained to some extent their normal tints; the abdomen was a broadish oval, convex, with only a slight longitudinal indentation on the fore-part, the tail being represented by a small convex lobe; in the second cocoon the tints were not so dark, and the young in the third had only a slight tinge on the abdomen; fig. 10, pl. x., respresents a young translucent spider from the fourth cocoon; the fifth and sixth only contained eggs. The female invariably rests in the centre of the web.

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

Arachnura nigritia, var. n.

Length of an adult female, 10 mm.

The *cephalothorax* of this handsome variety is hyaloid, pale stone-colour, tinged with olive-green, normal markings dark chocolate. The *palpi* and *legs* have a reddish-chocolate hue, suffused and streaked with dark brown; at the articulation of the joints and apices of the tarsi there are bright yellow annuli. The *falces* have a dark olive tint, and the *maxillæ* and *labium* a chocolate hue, margined with yellow. The fore-part of the *abdomen* from the spinners, is finely mottled with pale and blackish olive-green; the tubercular prominences and medial band are shaded with bright orange and orange-red; the wrinkled lateral margins are a bright velvety brown; the ventral surface has a black velvety appearance; and the tail a blackish olive-brown hue; the close set wrinkles well defined.

Apparently rare. Karaka, Auckland, *A.T.U.*

Arachnura obtusa, sp. n.

Length of a mature female, 6 mm.

This species may be distinguished from *A. longicauda* not only by its smaller size, but by the almost entire absence of the longitudinal cleft in the abdomen, and the more vertical position of the tubercles, which are obtuse, and of an orange-red colour with buff tips. The *cephalothorax* is of an olive-tinged yellow colour, suffused with chocolate-brown, medial band same hue. *Legs* and *palpi* yellowish-brown, suffused with chocolate and marked with a few olivaceous streaks. The *falces* have the yellowish hue of the legs, and the *maxillæ* and *lip* are chocolate, with olive-yellow margins. The *abdomen* is of an olivaceous-brown colour mottled with a lighter tint; the medial band is brown margined with orange-red; the tail is distinctly wrinkled and has the same dark hue, its five small tubercles resemble the anterior ones in colour.

Karaka, *A.T.U.*

Arachnura trilobata, sp. n. Pl. ix., fig. 3.

Length of an adult female 9½ mm., and of an adult male 5 mm.

The *cephalothorax* is oval, convex, glossy black; constricted laterally forwards; medial fovea deep; the caput is strongly convex, and its normal grooves well defined; the profile line forms a double arch, the highest part being at the occiput; the fore-part of this area is prominent, projecting over the *clypeus*, whose height equals the depth of the ocular area.

The four intermediate *eyes* form a trapezoid, whose length is greater than the interval between the fore-central eyes; the hind-centrals are about one-quarter of an eye's breadth apart; the laterals are placed obliquely on strong tubercles, the space between them is about one-half their diameter. The eyes are moderately large and have a pearly lustre.

The *legs* are moderately long and strong, 1, 2, 4, 3, the second pair nearly equals the first in length (9 mm.); they have a yellowish hue and well-defined brown annuli; the armature consists of strong hairs.

The *palpi* are not very long, and are indistinctly annulated with brown and black tints.

The *falces* are prominent, conical, and nearly vertical, glossy dark brown.

The *maxillæ* are convex, and somewhat obliquely truncated, they are glossy dark brown; the *labium* has the same hue, is semicircular, pointed.

The *sternum* is heart-shaped, dull brownish-black, stamped with the seven-lobed mark. The *abdomen* is a long oval, convex, and rises almost perpendicularly from the thoracic junction; posteriorly it terminates in three blunt transversely wrinkled protuberances, the central one is much the longest; it is of a very glossy dark green—in some examples nearly black hue, almost devoid of hairs, except on the tail-like extremity and lateral lobes which are a dull black, faintly streaked with yellowish-brown, furnished with short erect hairs; a broad irregular silver band with lake-coloured marks extends along the medial line to the base of the central protuberance, where it ends in a more or less defined silver crescent; the lateral margins are devoid of the longitudinal wrinkles, have a dull black hue, and are mottled and streaked with pale brownish-yellow; ventral surface dull black. The *vulva* consists of black oval protuberances, over which hangs a broad, curved, wrinkled, membraneous process, directed backwards.

The male is much smaller than the female, being only 5 mm. in length. The *cephalothorax*, which equals the abdomen in length, is a broad oval, dull brownish-black, finely rugulose. The *legs* are somewhat like those of the female in colour; the armature consists of strong spines and a few fine dark hairs. The *palpi* are short, the three first joints have a yellowish-brown colour; at the apex of the cubital joint there is a strong bristle; the radial joint is short, brownish-black, with a tuft of strong hairs on the upper side; the digital joint is large, dark brown, convex and hairy externally, concave within, reddish-brown; the palpal organs are prominent, complex, directed outwards; the most remarkable are two long bristle-like processes, and a claw-like process at the base of the outer side. The *abdomen* somewhat resembles that of the female both in colour and form, but it is comparatively broader at the posterior end, and the central protuberance is shorter, devoid of the yellowish streaks, and the wrinkles more defined.

Var. a., nov. Pl. ix., fig. f.

Length of mature female 7mm.

The posterior portion of the *abdomen* bears a resemblance to that of the male, the central lobe is short and stout, strongly wrinkled, coloured markings absent; the crescent-like termination of the medial band well-defined. This example is figured with the tail curled up. This species pairs in February–March, possibly earlier; the female fabricates, generally on the ends of manuka twigs, a conical pale copper-coloured cocoon of a soft silky texture, 9 mm. in height, and about the same in diameter, comprised within is a cocoon 3 mm. in diameter, containing about 49 spherical straw-coloured agglutinated eggs.

Tairua, *T. Broun*; Karaka, Auckland, *A.T.U.*

Fam. THLAOSOMIDES.

Genus **Thlaosoma**, Cambr.

Thlaosoma olivacea, sp. n. Pl. ix., fig. 4.

Adult female, length 5 mm., breadth of abdomen at the widest part 5½ mm.

The *cephalothorax* is broad, rounded at the sides, constricted anteriorly, it is of a dull greenish-yellow colour, sparingly clothed with silky whitish hairs, the sides are marked with dark olive, a broad whitish medial band extends from the ocular area to the region of the thoracic junction, which is a little raised and divided into two subconical points by a longitudinal cleft. The fore part of the caput, which is of a red-chestnut colour, is upturned, ending in a subconical point, on its face are placed the four minute central eyes, which are divided by a broad yellow cross; the laterals are seated on small tubercles.

Relative length of *legs* 1, 2, 4, 3, those of the first and second pair are much the longest (9 mm.), and about equal in length; the femoral joints are rather stout and armed along the outer side with several rows of minute spinous tubercles, the outer rows being the strongest; the femoral joint of the third, and the tibiæ of the first and second pairs, are similarly armed, but to a less extent; the femoral and genual joints have a yellowish-brown colour suffused with red-chestnut, the other joints are yellowish with brown annulations. The tarsi terminate with three claws all differing from the rest in strength and curvature.

The *palpi* are short, with annulations of three shades.

The *falces* are vertical, dull black, finely rugulose.

The *maxillæ* are somewhat quadrate, blackish-brown, reddish margins.

The *labium* is triangular, about twice as long as high, resembles the maxillæ in colour.

The *sternum* is blackish-brown, heart-shaped.

The *abdomen* is large, on the fore part, which projects over the base of the cephalothorax, there is an oblong brown mark, margined with a smooth space of a pinkish colour clothed with whitish hairs; on either side the surface of the anterior part of the abdomen is deeply wrinkled; four prominent humps form a transverse row across the centre, the exterior ones are somewhat conical, divergent, and directed slightly backwards; the upper and anterior face has an olive hue, the ridges tinted with brownish-pink; the posterior extremity is somewhat pointed with five transverse wrinkles; the hind parts are tinted with light shades. The ventral surface has deep transverse wrinkles, is of a yellowish-brown colour, sparingly furnished with light hairs. The *vulva* is black with a large reddish lip-like protuberance.

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

Fam. THERIDIIDÆ.

Genus **Argyrodes**, Simon.

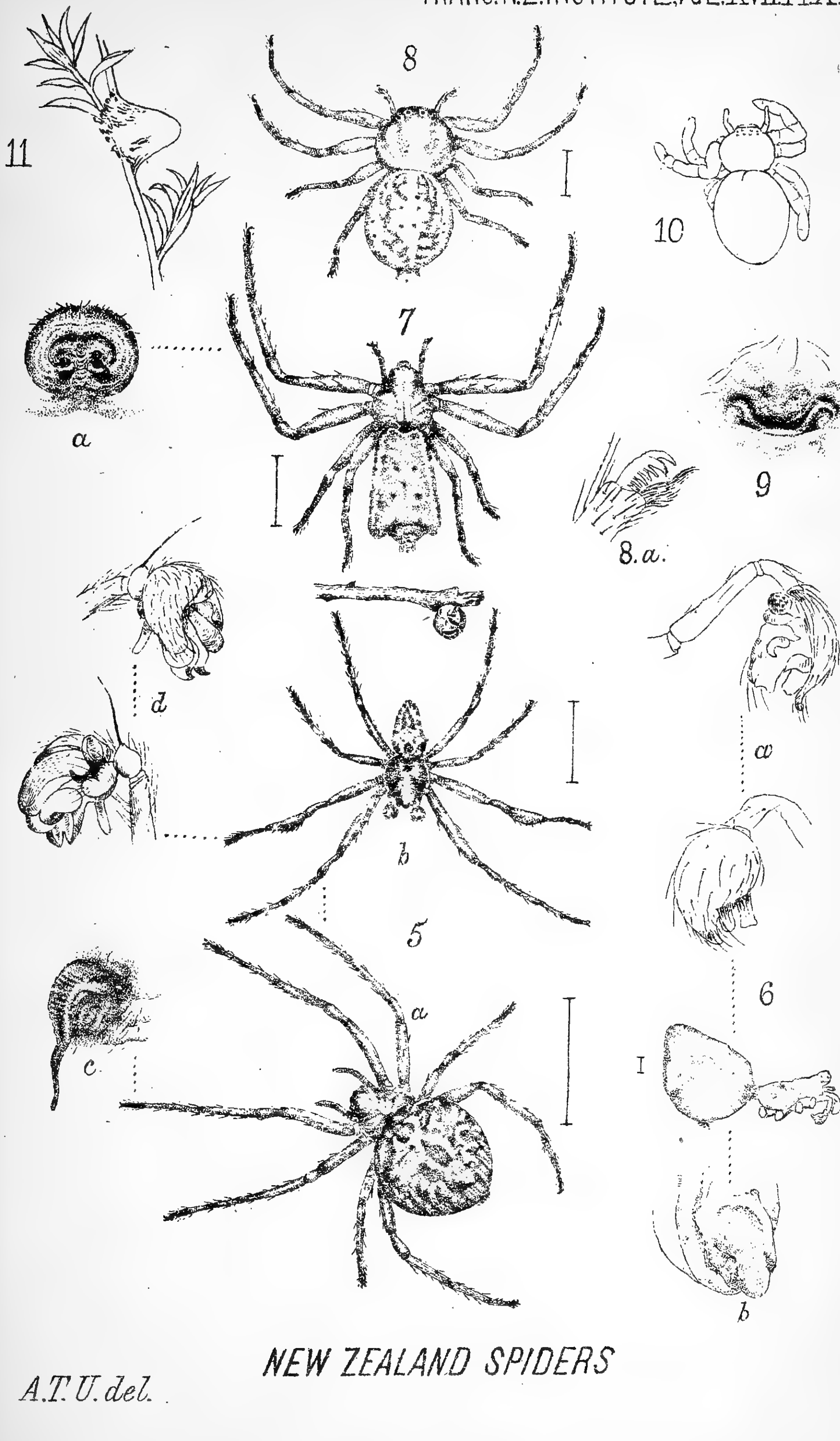
Argyrodes conus, sp. n. Pl. x., fig. 6.

Length of a mature female $2\frac{1}{2}$ mm., and of an adult male 2 mm.

The *cephalothorax* is oval, moderately convex, glossy black; nearly glabrous; the profile line ascends gradually from the thoracic junction in an undulating line, caused by the transverse indentation, to the ocular area; the forepart of this area is very prominent, forming a deep indentation in the profile of the *clypeus*, whose height otherwise is rather more than the length of the ocular area; lateral marginal constrictions at the caput moderate, normal grooves deep.

The *eyes* are about equal in size, and have a pearly lustre; the four central eyes form a square, and the hind-centrals are rather further apart from each other than each is from the posterior lateral eyes, which are seated obliquely on strong tubercles and nearly contiguous to the anterior laterals.

The *legs* are long and slender, the first pair is the longest (6 mm.), second and fourth about equal; they have yellowish-brown tints, and with the exception of the first pair, only faintly annulated with a darker hue;



NEW ZEALAND SPIDERS

A.T.U. del.

they are furnished only with fine erect hairs. The superior tarsal claws of the first pair differ from each other in size, the outer claw being the largest, and are provided with two teeth of unequal size pointing obliquely forwards; the inferior claw is as large as the greater of the superior claws, more powerful, and furnished with a long pointed tooth.

The *palpi* are slender, darker than the legs; the claw is long, fine, slightly curved, with two teeth of different size, pointing obliquely forwards.

The *falces* are long, vertical, tapering, divergent at the extremities, brownish.

The *maxillæ* are oblong, sides nearly straight, roundly-pointed at the extremities, parallel. *Labium* short and broad; has the dark brown shade of the maxillæ.

The *sternum* is somewhat cordate, convex, black.

The *abdomen* is large, conical; the dorsal portion is of a dull silver, with faint pinkish reflections; from the petiolum a black toothed band faintly margined with yellow ascends to the apex, and converges from the thoracic junction to the spinnerets; the sides and ventral surface are black. The spinners are surrounded by a sheath-like band, formed by a deep circular groove; the outer margin of this groove, viewed laterally, forms a protuberance on which there is a circular fovea; between this depression and the vulva, on the side of the abdomen there is a larger one of an oval form. The *vulva* consists of a somewhat square, moderately raised black protuberance, to which is attached a broad crimson process, directed backwards.

The male is rather shorter than the female and resembles her in colour and markings; the *cephalothorax* is comparatively narrower, and the ocular area more prominent; projecting from the clypeus is a long, strong dark brown process, its tumid conical point has hairs directed backwards. The humeral and radial joints of the *palpi* are long and resemble the legs in colour; the digital joint is unusually developed, convex and moderately hairy externally, black; concave within, brownish; the palpal organs are complex, the most remarkable are two strong processes directed downwards. The *abdomen* is similar in form to that of the female, but it is smaller, slopes backwards, exposing the petiolum. These interesting little spiders are quasi-parasitic on the webs of the larger *Epeirids*, they are also to be found under the eaves of low buildings on the webs of the *Theridiidæ*, etc., When resting on webs the abdomen is always below, the legs being drawn together and extended upwards. The females commence constructing their cocoons towards the end of December; most of the young are hatched in March. Occasionally cocoons are fabricated as late as April; the female commences this work by spinning a short strong horizontal line, to which she suspends by a short pedicle,—and sometimes braces with a few fine lines,—a somewhat globular whitish cocoon of compact texture, 5 mm. in length, and 3 mm. in diameter; the base contracts into a narrow funnel-shaped outlet 2 mm. in length, through which the young escape. In this cocoon the female deposits about 36 unagglutinated spherical straw-coloured eggs.

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

Fam. THOMISIDÆ.

Genus **Sparassus**, Walck.

Sparassus angulatus, sp. n.

Length of an adult female 7 mm.

The *cephalothorax* is a broad oval, constricted laterally forwards, and roundly truncated in front; the profile ascends abruptly from the hinder extremity, then slopes gradually, ascending slightly at the ocular area; the caput is depressed, and its converging grooves—in some examples forming a brown medial band—extend nearly to the base of the cephalothorax, which is of a yellow-ochreous hue, sparingly furnished with short papillæform hairs. Height of *clypeus* about half the depth of the facial space.

The *eyes* constitute a segment of a circle, with its convexity directed forwards; the lateral eyes of the anterior row are the largest, and the intermediate ones of the same row are the smallest of the eight.

Relative length of *legs* 1, 2, 4, 3, the first and second pairs (9–7 mm.) are much the stoutest and longest; they are a shade lighter than the cephalothorax, and furnished with papillæform hairs; the femoral joints of the first pair have an oblique row of three or four spines on the outer surface, the socket of the inner spine is remarkably developed; the femora of the second pair have only one spine; the tibiæ and metatarsi of the first and second pairs have each six spines on the inner, and four on the outer side of the inferior surface; the two hind-pairs are sparingly armed with spines; the tarsi are clothed with dark hairs, and terminate with two curved claws furnished with three coarse teeth, beneath them there is a small scopula.

The *palpi* resemble the legs in colour, and are armed with a minute claw.

The *falces* are vertical, tapering.

The *maxillæ* are straight, rounded at the extremity, inclined towards the lip which is oval.

The *sternum* is a broad oval, and has the uniform yellow-ochreous tint.

The fore-part of the *abdomen* rises abruptly from the pedicle, is truncate, with a slight cleft in the centre; the posterior extremity is the widest and somewhat square; at each angle there is a conical prominence directed backwards; the impressed spots form a square; it is of a dull ochreous colour, and clothed with papillæform hairs; the ventral surface has the same hue. The *vulva* is formed by a nearly circular narrow wrinkled membraneous hood, in the centre there are two crimson-brown fovea.

Tairua, Whangarei Harbour, *T. Broun*; Karaka, Auckland, *A.T.U.*

Sparassus angularis, sp. n. Pl. x., fig. 7.

Length of an adult female 10 mm.

The *cephalothorax* of this species is comparatively longer than that of *S. angulatus*, being nearly as long as the abdomen, and the anterior constrictions are rather sharper; it is margined by a raised band; the caput bifurcates into two parallel medial ridges, ending at the thoracic slope (viewed laterally) in two conical prominences; it is of a reddish-amber colour, sparingly furnished with hair-like papillæ.

Relative length of *legs* 1, 2, 4, 3, the first and second (16–13 mm.) are much the strongest and longest; the armature differs from the former species in there being six spines irregularly seated along the outer surface of the femoral joint of the first pair.

The *maxillæ*, *labium*, and *falces* have a dark hue.

The *sternum* is a broad oval, with slight prominences opposite the coxæ.

The *abdomen* has an earthy-brown colour, clothed with fine light hairs; the under surface has two pits below the vulva, not well marked in the former species. The genital organ differs slightly from that of *S. angulatus*.

There was only one example of this species in *Captain Broun's* Tairua collection.

Genus **Philodromus**, Walck.

Philodromus ambarus, sp. n. Pl. x., fig. 8.

Length of an adult female 6 mm.

The *cephalothorax* is of a reddish-amber colour, glossy, furnished with a few black bristle-like hairs; about as broad as long, rounded on the sides; anterior extremity broad and truncated, lateral marginal constrictions at the caput very slight, slopes abruptly posteriorly; height of *clypeus* about the depth of the ocular area.

The *eyes* describe a crescent on the anterior part of the caput, those of each lateral pair are larger than the intermediate ones, and are seated on yellowish cup-shaped tubercles; the four central eyes nearly form a square, and are placed on small yellowish tubercular prominences.

Relative length of *legs* 1, 2, 4, 3, the first and second are much the longest (6½ mm.) and strongest; they have a yellow-ochreous hue, and furnished, especially the femoral joints, with spine-like bristles; the tibiæ and metatarsi are armed with strong spines; the tarsi terminate with two curved pectinated claws, beneath which there is a small scopula.

The *palpi* have the same tint as the legs, armed with a few bristles, and small curved claw.

The *falces* are strong, convex, somewhat cuneiform, slightly inclined outwards.

The *maxillæ* are rather pointed, inclined towards the *lip*, which is oval, and obtuse at the apex; these parts are a yellow-ochreous, provided with a few strong black hairs.

Sternum heart-shaped.

The *abdomen* is oval, broadest towards the posterior end, somewhat globose, rises rather abruptly from the thoracic junction; it has a pale brown hue, two dark lake-coloured lines converge towards the hind extremity, forming a semi-oval and square space, in the centre of each space are four dark impressed spots; between the base of each of these lines and the spinners are a series of four oblique marks; the lateral margins have a band of creamy-white embossed small leaf-like marks. *Vulva* simple.

Tairua, Whangarei Harbour, *T. Broun.*

Philodromus sphæroides, sp. n.

Length of an adult female 6 mm.

The colour of the *cephalothorax* is a pale amber, faintly tinged with pea-green; almost glabrous; it is oval, almost as broad as long; the caput is large, roundly truncated, anterior constrictions slight; the profile line rises abruptly, then runs in a straight line to the ocular area, forming an obtuse angle; the height of the *clypeus* equals the depth of the facial space.

The *eyes* are disposed on the anterior part of the cephalothorax in two transverse curved rows, in the form of a crescent whose convexity is before; they are seated on prominent orange-coloured tubercles, the lateral eyes are the largest of the eight, and their tubercular prominences conjoin.

The first and second pairs of *legs* are moderately robust, and of about equal length, the fourth and third are much the slightest and shortest; palish-amber, suffused, especially the first pair, with brownish-purple; the armature consists of about the normal number of spines and a few fine hairs and bristles; the tarsi terminate with the usual pair of claws and a scopula.

The *palpi* are furnished with hairs and bristles, and are like the legs in colour.

The *falces* are conical, short, broad at the base.

The *maxillæ* are straight, rounded at the extremities.

The *labium* is oval, slightly pointed.

Sternum heart-shaped; these parts have the amber hue of the legs.

The *abdomen* is a broad oval, the diameter equalling the length, convex; nearly glabrous, and of a pale yellowish pea-green, five distinct impressed spots form an acute triangle, which has its vertex directed forwards. The ventral surface has an amber colour, sparingly clothed with a few fine hairs. The *vulva* is formed by a semicircular narrow wrinkled hood, of a pale amber hue, between it and the spinners there is a double row of six shallow foveæ.

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

Fam. SALTICIDÆ.

Genus **Salticus**, Latr.

Salticus zanthofrontalis, sp. n. Pl. xi., fig. 12.

Length of an adult male 5 mm.

The *cephalothorax* is somewhat quadrilateral, of a dull black hue, finely rugulose; irregularly clothed with yellowish hairs, lateral margins convex, edged with fine hairs; the profile line ascends abruptly from the thoracic junction, then runs with a slight slope to the occiput which projects a little over the falces. The height of the *clypeus* equals the diameter of a fore-lateral eye.

The ocular area is large, the hind-lateral *eyes*, which are the furthest apart, are placed near the verge of the posterior slope, and form with the faint fovea a transverse line; the small intermediate laterals are nearest to the anterior laterals; a rim of yellow lanceolate hairs curves over each of the fore-central eyes, and under the fore-laterals; the lower margins of the fore-centrals have white hairs of a similar form, and a few are scattered over the clypeus.

Relative length of legs, 1, 4, 2, 3, the first pair is longest and most robust; the femoral joints have a dark mahogany hue, the genual and tibial joints, especially of the first pair, have a crimson tinge; the metatarsi and tarsi are brownish; black and white hairs; armature normal, spines strong; the tarsi terminate with a pair of weak claws and scopula.

The *palpi* are furnished with hairs only, and are similar in colour to the legs; the humeral joint is rather long, the cubital and radial joints short, the latter is black, somewhat globose, and projects an apophysis near its articulation with the digital joint, which is long and narrow, convex, hairy and black above; beneath it is moderately convex, reddish-brown, with a large pad-like protuberance.

The *falces* are vertical, broad, flat, finely rugulose, black; furnished with long white hairs, and strong teeth.

The *maxillæ* are strong, broad, somewhat obliquely truncated, inclined towards the lip, which is nearly triangular; these parts are dark brown with light apices.

Sternum oval, black, few white hairs.

The *abdomen* is oviform, and resembles the cephalothorax in colour and clothing; ventral surface black, yellowish hairs.

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

Salticus tabinus, sp. nov. Pl. xi., fig. 13.

Length of a mature female 5 mm.

The *cephalothorax* is somewhat quadrilateral, rounded posteriorly; it is thickly clothed with short fulvous and brown hair, forming a tabby pattern; the profile line rises rather abruptly from the base of the cephalothorax, then runs with a very slight curve to the ocular area, which projects over the falces; the *clypeus* in height equals the diameter of a fore-lateral eye, and is thickly furnished with light hairs.

Eyes normal.

Legs moderate, 4, 1, 2, 3, they do not differ much in length; pale stone-colour, hyaline, with dark grey and brown annulations; the armature consists of strong spines, hairs, and a few bristles; the tarsi are provided with the normal claws and scopula.

The *palpi* resemble the legs in colour, but are devoid of annuli.

The *falces* are short, broad at the base, vertical, divergent, black.

Maxillæ broad, and rounded at the extremity, divergent.

Labium oval, these parts are brownish yellow.

Sternum oval, convex, glossy, brownish yellow, few light hairs.

Abdomen oval, slightly pointed posteriorly, resembles the cephalothorax in colour and clothing; the ventral surface has a yellowish-brown hue. The *vulva* is formed by a narrow, somewhat angular membraneous hood; the central parts are somewhat convex, with two dark foveæ.

Scoria walls, North Shore, Auckland, *A.T.U.*

Salticus curvus, sp. n. Pl. xi., fig. 14.

Length of an adult male 5 mm.

The *cephalothorax* is nearly quadrilateral, rounded posteriorly; it is of a glossy brown black, finely rugulose, with a few light hairs about the margins, which are abrupt, medial indentation T-shaped; the profile line ascends with a moderate curve from the thoracic junction, is horizontal as far as the hind lateral eyes, then slopes off to the anterior extremity of the caput, which projects over the falces; the *clypeus* is sparingly furnished with long light hairs, and in height nearly equals the diameter of one of the fore-lateral eyes.

The fore- and hind-lateral *eyes* form a square, the intermediate laterals are equidistant between them; the anterior row are prominent.

The *legs* are moderate, and do not vary much in strength or length, 4, 3, 2, 1, the two hind and two fore pairs are about equal; in colour they are a dark brownish black, lightest at the extremities; the armature consists of a few brownish hairs and long strong spines; each tarsus terminates with two strongly-toothed claws, beneath which there is the usual scopula.

The *palpi* resemble the legs in colour, the humeral joint is moderately long, the cubital and radial short, the digital joint is oval, light brown, convex and hairy externally, reddish chocolate beneath; the palpal organs are prominent, projecting at the base in a convexity directed backwards; at the anterior extremity there are two small horn-like processes directed forwards and upwards.

The *falces* have a reddish-chocolate hue, shading off to an orange-red tint at their rounded extremities, strongly rugulose, moderately convex, and inclined towards the lip, curving outwardly (bandy) in the centre, armed with strong teeth.

The *maxillæ* are nearly as broad as long, somewhat rounded, brown in colour, with a brassy appearance about the margins.

The *labium* is semicircular, dark brown.

Sternum oval, glossy brownish-black, clothed with a few hairs.

The *abdomen* is oval, moderately convex, glossy brown-black, thinly clothed with short dark hairs.

Whangarei Harbour, *T. Broun.*

Salticus furvus, sp. n. Pl. xi., fig. 15.

Length of a mature female 5 mm.

The *cephalothorax* is somewhat quadrilateral, rounded and sloping rather abruptly posteriorly, prominent in front, fovea moderately deep, placed on verge of slope; it is a dark brown-black, finely rugulose, sparingly furnished with bright fulvous hair; two faint lines converge from the lateral eyes to the thoracic junction, and the lateral margins are fringed with hairs of a similar hue. The *clypeus* is about equal to the diameter of a fore-lateral eye. The hind-lateral *eyes* are nearer to the anterior laterals than they are to each other.

Relative length of *legs*, 1, 4, 2, 3; in the first pair, which are the stoutest, the femoral joints have a reddish-brown tint, the four last joints have a crimson-brown tinge, the latter joints in the second pair have a similar hue, and the femoral joints have the brownish-yellow colour of the third and fourth pair, these have brown annulations. The armature consists of strong spines, a few bristles and fine hairs; the tarsi terminate with the usual claws and scopula.

The *palpi* have a light brownish hue.

The *falces* are vertical, somewhat flat, divergent, rugulose, reddish, armed with sharp teeth.

The *maxillæ* are broad, and rounded at their extremity, moderately inclined towards the lip, bright brownish-amber colour.

The *labium* is somewhat oval, darker than the maxillæ, with a light recurved apex.

The *sternum* is oval, nearly black.

The *abdomen* is oval, finely rugulose, transversely marked with indistinct brown and black streaks, thinly clothed with hairs of a similar shade to those of the cephalothorax; the sides and ventral surface are darker; two broad yellowish bands converge from above the branchial opercular round to the spinners, which are pale brown. The *vulva* consists of a prominent, short, broadly-tapering, wrinkled, reddish process, with a large orifice at the extremity.

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

Salticus alpinus, sp. n. Pl. xi., fig. 16.

Length of an adult female 6 mm., and of an adult male 7 mm.

The *cephalothorax* is somewhat quadrilateral, rounded posteriorly; moderately depressed above; it is a dull black; sparingly clothed with pale yellow, coppery-yellow, and black hairs, forming a tabby-like pattern; the profile line ascends with a moderate curve from the thoracic junction, sloping off anteriorly at the caput; medial fovea shallow. The *clypeus* is furnished with long white hairs, and its height is about half the diameter of the fore-lateral eyes.

The ocular area is nearly as long as broad; fore- and hind-lateral *eyes* equal; small intermediate eyes equidistant between them.

The *legs* are moderately robust, relative length, 4, 1, 2, 3, fourth and first nearly equal; they are tinted with light brown and black annuli, clothed with black and white hairs; the armature of the first and second pairs consists of the usual double row of six spines on the inferior surface of the tibiæ, and of four on the metatarsi; the femoral joints of the third and fourth pair have two long bristle-like spines on the superior surface; one spine on the tibiæ, six at the end of the metatarsi; claws strong, curved, pectinated.

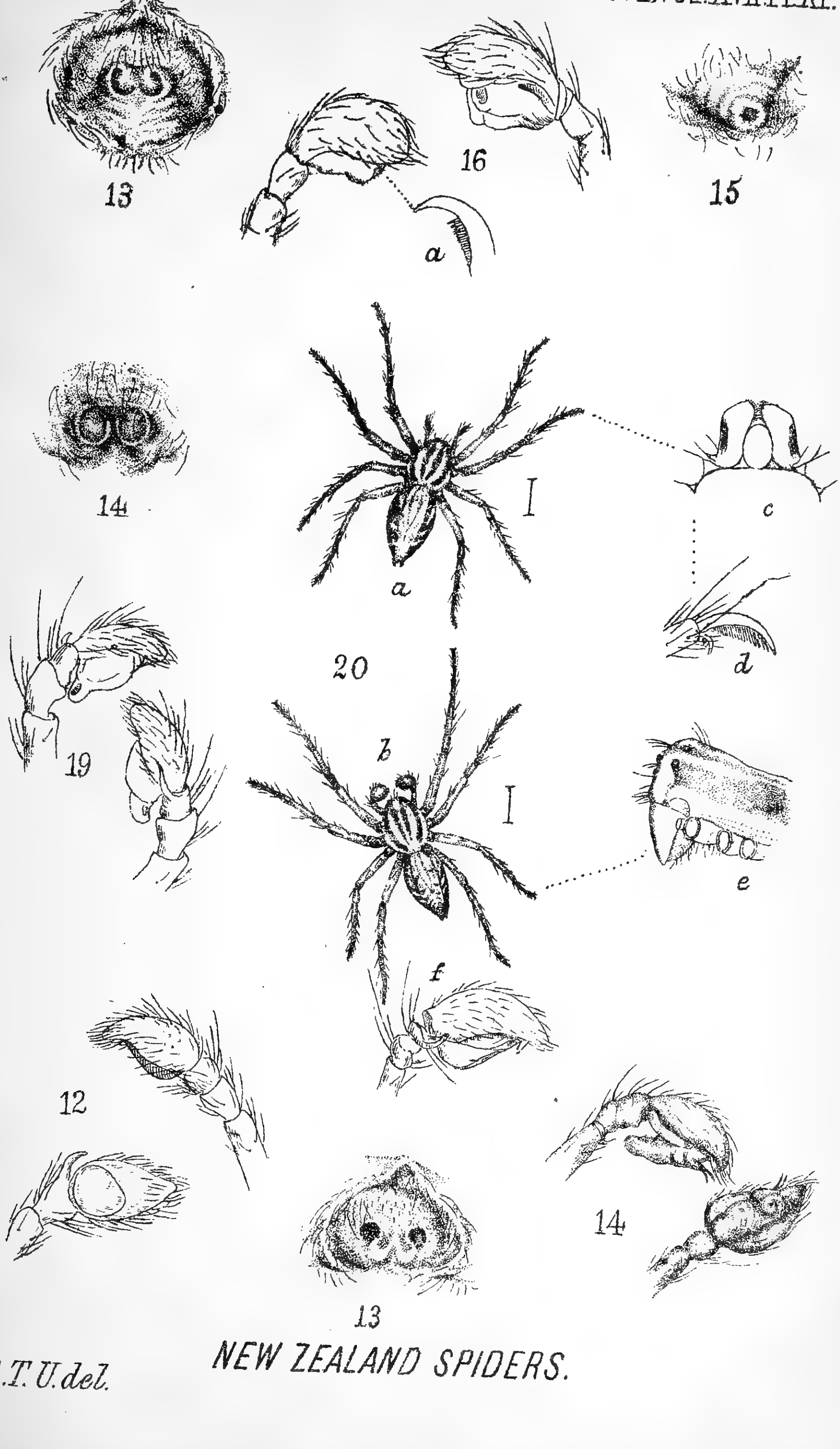
The *palpi* have a fulvous tinge, and are clothed with white hairs.

The *falces* are vertical, convex, moderately broad, pale brown.

The *maxillæ* are broad, obliquely truncated, inclined towards the *lip*, which is semicircular, pointed; these parts have a light brown colour.

The *sternum* is oval, black.

The *abdomen* is oval, rises with an inward curve from the pedicle, is pointed posteriorly; in colour and markings it resembles the cephalothorax, but it is more thickly clothed with hair; the under side is light brown, sparingly furnished with short light hairs; a prominent medial ridge extends from the genital organ to the spinnerets, which are moderately long. The *vulva* is a simple hood-like, greenish-brown prominence, concave within.



NEW ZEALAND SPIDERS.

A.T.U. del.

The male appears to be larger than the female, but does not differ much from it in form or colouring; the armature of the *legs* is similar.

The *palpi* are moderately long and slender, brownish-black, furnished with whitish hairs; the humeral joint is about twice the length of the cubital and radial joints together, the latter is the shortest; the digital joint is oval, convex and hairy externally; beneath there are black convex lobes; at the base of the outer side there is a short, pointed, concave, membraneous process.

This species is common on the mountains of Canterbury and Westland, it affects the solid rocks, and in colour bears a close resemblance to its surroundings. *A.T.U.*

Salticus albopalpis, sp. n. Pl. xi., fig. 17.

Length of a mature female 9 mm.

The *cephalothorax* is somewhat quadrilateral, depressed; black, thickly clothed with grey, black, and yellowish-hairs, forming the common tabby pattern; thoracic fovea oblong; the profile line forms a slight curve to the ocular area, the depth of which is about one-third of the cephalothorax; the fore-part of this area is furnished with erect black hairs.

The *clypeus* is thickly clothed with long white hairs, and in height is less than the diameter of one of the fore-lateral eyes.

The two intermediate *eyes* of the anterior row are seated on collar-like prominences; the transverse diameter of this row exceeds that of the hind-row; the intermediate laterals are equidistant from the fore- and hind-laterals.

The first and second pairs of *legs* are moderately strong; relative length 4, 1, 2, 3; they are marked with black and brown annuli, and clothed with long, mostly erect, black and white hairs; the armature consists of the normal spines; the tarsi terminate with long curved claws; the inner claw of the fourth pair has about twenty fine comb-teeth gradually increasing in length and strength; the outer about fifteen; on the first pair the inner claws have about twelve fine teeth, the outer four coarse teeth.

The *palpi* are long and strong, resemble the legs in colour, and are furnished with remarkably long white hairs.

The *falces* are moderately strong, vertical, of a light amber colour, rugulose; armed with three acute teeth, two on the inner, and one on the outer row.

The *maxillæ* are straight, rounded, and slightly pointed at the apex, light brown-umber.

The *labium* is somewhat oval, brown, with a pale slightly recurved margin.

Sternum oval, dark brown, few white hairs.

The *abdomen* is ovoid, pointed posteriorly, resembles the cephalothorax in colour and pattern; the ventral surface is black, sparingly clothed with short white hairs. The *vulva* consists of a large, narrow, somewhat circular yellowish-brown hood, clothed with hairs, in the centre there is a somewhat quadrate protuberance, of the same hue, with dark foveæ at the anterior extremity.

Mountains above the Otira Gorge, Westland, *A.T.U.*

Salticus compactus, sp. n. Pl. xi., fig. 18.

Length of a mature female 4 mm.

The *cephalothorax* has a dull brownish-black colour, finely rugulose, furnished with a few light hairs; it is rounded posteriorly as far as the hind-lateral eyes, from whence it is moderately constricted forwards; truncate in front; the lateral margins are abrupt, slightly inclined inwards; the profile line ascends abruptly from the thoracic junction, then slopes across the caput, forming a somewhat obtuse angle, with the hind-lateral eye placed on the anterior side of the apex. The *clypeus* is clothed with strong white hairs directed centrally, in height it equals the diameter of one of the fore-lateral eyes.

The ocular area is remarkably large, extending over the greater portion of the cepahlothorax, whose greatest diameter is between the hind-lateral *eyes*, intersecting the faint medial fovea; the small intermediate eyes are placed nearest to the fore-laterals; the anterior row are fringed with orange-coloured hairs on the lower side.

The *legs* are moderately long, 1, 4, 2, 3; the first pair is the most robust, and does not differ much from the fourth in length; the femoral joints have a dark mahogany hue, the other joints a reddish amber colour, palest at the extremities; the armature consists of a few lightish hairs, fine bristles, and spines, which are normal.

The *palpi* have the lighter tints of the legs, and are furnished with bristles and hairs.

The *falces* are vertical, flat, rounded at the apices, armed with strong teeth, bright chocolate brown, rugulose.

The *maxillæ* are broad, rounded, inclined towards the *lip*, which is semi-circular; these parts are dark brown, with light slightly recurved apices.

Sternum ovate, posterior end broadest, black, furnished with a few coarse light hairs.

The *abdomen* is a broad oval, convex, projects over the cephalothorax; dull black, finely rugulose, obscurely marked with oblique brown streaks, very sparingly furnished with light hairs. The ventral surface has a lightish hue, and is more thickly clothed. The *vulva* consists of a reddish brown, moderately wide, nearly circular hood, the ends on the posterior side curved inwardly, nearly dividing the crimson brown concave portions.

Frequents shingle slopes. Mountains near Lake Tekapo, Canterbury, *A.T.U.*

Salticus tenebricus, sp. n. Pl. xi., fig. 19.

Length of an adult male 4 mm.

The *cephalothorax* is brownish black, nearly glabrous; the thorax is rounded posteriorly and about one-third longer than the caput; the profile line rises with a moderately abrupt curve from the thoracic junction, then runs in a nearly even line, sloping slightly at the fore-part of the caput, which is prominent; medial fovea moderately deep. The *clypeus* is directed inwardly, and in height hardly equals the diameter of one of the fore-lateral eyes.

The lateral *eyes* nearly form a square, the transverse diameter being the greatest; the intermediate laterals are equidistant between them.

The *legs* are moderately long and stout, and do not differ much in their relative proportions, 1, 4, 2, 3; glossy brown, suffused with black, sparingly furnished with light hairs, spines moderately strong.

The *palpi* are not very long, have a lighter shade than the legs, and are sparingly clothed with white hairs; the cubital joint is rather stronger than the radial, the latter projects a large apophysis from its extremity, on the outer side; the digital joint is oval, convex and hairy externally, black; beneath it is reddish-brown, prominent, projecting at the base in a convexity extending upwards to the articulation of the cubital and radial joints; at the anterior extremity there is a small black corneous process directed outwards.

The *falces* are broad, bowed outwardly in the centre, inclined inwardly; they are rugulose, and have a bright reddish-brown colour.

The *maxillæ* are straight, broad, rounded, bright brownish-yellow.

The *labium* is broader than long, pointed, brown, yellowish apex.

The *sternum* oval, brownish-black.

The *abdomen* is oviform, shorter than the cephalothorax, blackish-brown, finely rugulose, sparingly clothed with whitish hairs.

Captured on shingle slopes. Mountains near Lake Tekapo, Canterbury, *A.T.U.*

As there is no very satisfactory natural arrangement of this large family, I have thought it advisable for the present to follow the example of many arachnologists, including Blackwall, and to group all the species in the Latreillean genus *Salticus*.

Fam. LYCOSIDÆ.

Genus **Sphasus**, Walck.

Sphasus gregarius, sp. n. Pl. xi., fig. 20.

Length of an adult female 5–6 mm., and of an adult male 5 mm.

The *cephalothorax* is oval, sides abrupt, roundly truncated in front; lateral marginal constrictions at the caput slight; it is of a light yellowish-brown colour, sparingly clothed with light and dark hairs; from the hind-central eyes a lanceolate brown mark, with a light medial streak, extends to the base of the cephalothorax; on either side there are broad brown marginal bands. The profile line rises abruptly from the thoracic junction, then runs in a nearly even line to the ocular area. The height of the *clypeus* exceeds the space between the eyes of the second row, and its direction nearly vertical.

The four posterior *eyes* are equal in size, and form a moderately re-curved transverse row; the other four form a trapezoid whose shortest side is before, the posterior pair of the trapezoid are the largest, and the anterior pair much the smallest of the eight.

The *legs* are moderately long and slender, and do not differ greatly in length, 1, 2, 4, 3, second and fourth nearly equal; they are like the cephalothorax in colour, and are marked with longitudinal streaks; the armature consists of hairs and long black spines.

The *palpi* resemble the legs in colour and armature.

The *falces* are subcylindrical, slightly inclined towards the lip, glossy, clear pale brown; dark brown streaks, apparently a continuation of those on the frontal margin, extend along their entire length.

The *maxillæ* are long, somewhat enlarged and incurved at their extremity; a shade darker than the falces, tinged on the outer side with brown.

The *labium* is a long oval, dark brown.

Sternum broad, cordate, convex, reddish brown.

The *abdomen* is oviform, rises abruptly from the petiolum, which is rather exposed; its colour and markings resemble the cephalothorax; a light, broad, tapering mark extends from the base to the spinnerets, in the centre there is an acute mark, formed by two dark streaks—in many examples, both male and female, the lanceolate marks are partly obliterated by whitish hairs—the lateral margins are dark brown, with a few light oblique streaks. Ventral surface light brown.

The *vulva* is a simple greenish-brown lobe, with two brownish spots at the orifice.

The male nearly equals the female in length, and does not differ essentially from her in form or colour. The superior claws of the tarsi are finely curved, and have about 18–20 parallel comb-teeth; the inferior claw terminates in a long fine, rather straight point, and has three long curved teeth.

The *palpi* are moderately long, the radial joint is blackish brown, rather stouter than the cubital, and projects a concave apophysis on the outer side; the digital joint is oviform, blackish, convex and hairy externally; the palpal organs are not very complex, there is a prominent lobe near the base, and a tooth-like projection at the anterior extremity.

In December the females commence fabricating their cocoons; they are of a plano-convex figure, 8 mm. in diameter; composed of a fine but very compact texture; white when newly constructed, containing about eighty spherical eggs, not agglutinated together. They are attached by their plane surface to bark, etc. The female usually remains upon or near the cocoon.

These active little spiders are numerous about low herbage growing on sunny banks; they spring actively from leaf to leaf, and appear sociable in their habits.

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

EXPLANATION OF PLATES IX.—XI.

PLATE IX.

Fig. 1. *Epeira attenuata*, sp. n., female; *a*, profile of vulva; *b*, sternum; *c*, natural length of spider.

Fig. 2. *Arachnura longicauda*, sp. n., female; *a*, natural length.

Fig. 3. *Arachnura trilobata*, sp. n.; *a*, female; *b*, male; *c*, profile of female with legs and palpi truncated; *d*, vulva; *e*, palpus of male in two positions; *f*, *var. a.*, nov., drawn with tail curled up.

Fig. 4. *Thlaosoma olivacea*, sp. n., female; *a*, profile of female with legs truncated; *b*, eyes in front and rather beneath; *c*, natural length and breadth.

PLATE X.

Fig. 5. *Epeira brounii*, sp. n.; *a*, female; *b*, male; *c*, profile of vulva; *d*, palpus of male in two positions. The second pair of male legs are drawn a little out of their natural position to show the tumid tibiæ; *e*, natural length.

Fig. 6. *Argyrodes conus*, sp. n., male; *a*, palpus in two positions; *b*, vulva of female, profile view.

Fig. 7. *Sparassus angularis*, sp. n., female; *a*, vulva.

Fig. 8. *Philodromus ambarus*, sp. n., female; 8*a*, outer fore-claw.

Fig. 9. Vulva of *Arachnura trilobata.*

Fig. 10. Young of *Arachnura longicauda*, recently hatched; drawn with the camera-lucida.

Fig. 11. Cocoon of *Arachnura trilobata*, natural size, *in sitû.*

PLATE XI.

Fig. 12. *Salticus zanthofrontalis*, sp. n.; palpus of male in two positions.

Fig. 13. *Salticus tabinus*, sp. n.; vulva of female.

Fig. 14. *Salticus curvus*, sp. n.; palpus of male in two positions.

Fig. 15. *Salticus furvus*, sp. n.; vulva of female.

Fig. 16. *Salticus alpinus*, sp. n.; palpus of male in two positions; *a*, fore inner claw.

Fig. 17. *Salticus albopalpis*, sp. n.; vulva of female.

Fig. 18. *Salticus compactus*, sp. n.; vulva of female.

Fig. 19. *Salticus tenebricus*, sp. n.; palpus of male in two positions.

Fig. 20. *Sphasus gregarius*, sp. n.; *a*, female; *b*, male; *c*, maxillæ and labium of female; *d*, claw; *e*, profile of male cephalothorax, with legs and palpi truncated; *f*, palpus.

Art. VI.—*The Freshwater Shells of New Zealand belonging to the Family* Limnæidæ. By Professor F. W. Hutton.

[*Read before the Philosophical Institute of Canterbury, 5th June,* 1884.]

Plate XII.

The New Zealand *Limnæidæ* are not very numerous in species although they are usually very variable. *Limnæa* is rare, or abundant only in a few localities. *Aplexa* is far more common, but not nearly so abundant as *Potamopyrgus.* Our single species of *Planorbis* is so small it may easily be overlooked, but it does not appear to be common. I have to thank Mr. H. M. Gwatkin for sending me odontophores of the British *Limnæidæ* without which I should have hesitated to name some of our species.

Limnæa (Amphipeplea) arguta, sp. nov. Pl. xii., fig. 1.

Shell globosely ovate, glossy horn brown when dry, dark olive green when alive; rather strongly longitudinally striated, and without any spiral lines. Whorls 3 or 3½, the last inflated, spire very short, slightly acute, usually eroded at the apex, suture moderate, simple. Aperture large, ovate, occupying three quarters of the entire length of the shell; columella arcuate, with a well-marked spiral fold; inner lip reflexed over the umbilical region, and connected with the lip above by a thin white callosity. Length ·3; diameter ·18; aperture, long ·24, broad ·17 inch.

Hab. River Avon, Christchurch.

Animal olive brown sparingly speckled with yellowish white. Edge of the mantle simple, slightly reflected over the shell. Foot broad and rounded behind; tentacles short, flat, triangular, with the eyes at the inner bases.

Dentition (pl. xii., fig. 10), 23–1–23, of which about 9 are laterals. Central tooth slightly broader behind, the length rather more than twice the greatest breadth; the reflexed portion short, with a minute cutting point. Laterals with the reflexed portion nearly as long as the base, triangular, slightly sinuated on the inner and notched on the outer side. Cutting points two, the inner one large, the outer small. The large cutting point is simple in the inner laterals, but carries a small denticle in the outer ones. Marginal teeth from three to many dentate, getting longer and narrower outwards. Length of the radula rather more than twice its breadth. Transverse rows of teeth nearly straight.

Ova attached to stones or water plants in gelatinous lumps of 10–20 together.

This species much resembles *L. glutinosa* of Europe, but in that species the mantle is represented as covering nearly the whole of the shell. I have not been able to compare the dentition.

LIMNÆA (AMPHIPEPLEA ?) AMPULLA, sp. nov. Pl. xii., fig. 2.

Shell ovate, very thin and fragile, semi-transparent, slightly longitudinally plaited, without any spiral lines, yellowish horn-colour or greenish, rarely with a white spiral band on the centre of the body whorl. Whorls 3½, the last swollen; spire acute, short, about one-fifth of the length of the whole shell; suture rather deep. Aperture oval, the outer lip thin, not reflected; inner lip broadly reflected and thickened on the columella, but not covering the umbilicus; columella plait well marked. Length ·4; breadth ·27; aperture, long ·28, broad ·17 inch.

Hab. Arthur's Pass (Mr. Dominick Brown and Mr. Cheeseman); Lake Lyndon (Mr. J. D. Enys).

Dentition (pl. xii., fig. 8), 28–1–28, of which about 9 are laterals. Central tooth broader behind, the sides concave; reflexed portion moderate with a well marked point. Laterals with the reflexed portion oval, nearly as large as the base, with a trifid cutting point projecting over the next row of teeth; marginals normal.

This species appears to be near *L. huonensis* (Tenison-Woods) from Tasmania, but the dentition of that species is not known. From *L. peregra* (Müll.) it differs in wanting the spiral striæ on the shell, and considerably in the dentition.

LIMNÆA LEPTOSOMA, sp. nov. Pl. xii., fig. 3.

Shell ovate, acuminate above, glossy, rather strongly longitudinally striated, and with four or five obsolete distant spiral ridges on the body whorl: pale horny white with indications of darker spiral bands near the mouth. Whorls 4, rather flattened; suture deep. Aperture ovate, occupying two-thirds of the length of the shell; outer lip thin and straight, inner lip callously reflexed over the body whorl, and completely covering the umbilicus. Columella plait not very distinct. Length ·47; breadth ·27; aperture, long ·34, broad ·20 inch.

Hab. Wellington.

I have two specimens only. The animal and dentition are unknown.

LIMNÆA TOMENTOSA, Pfeiffer. Pro. Zool. Soc. of London, 1854, p. 297 (*Succinea*); Reeve, Conch. Icon., *Succinea*, f. 81.

Hab. Auckland (Mr. Justice Gillies).

Dentition (pl. xii., fig. 9). Central tooth broader behind, length nearly three times the breadth, the reflexed portion small. Laterals rather broad, the reflexed portion not half the length of the base, hollowed on the outer side, bicuspid, with two nearly equal cutting points.

LIMNÆA TENELLA, sp. nov. Pl. xii., fig. 4.

Shell small, oblong, not glossy, longitudinally striated, olive horny. Whorls 4, rather flattened, apex blunt. Aperture ovate, less than half the entire length of the shell; peristome simple, the inner lip slightly reflexed, not covering the umbilicus; columella plait small. Length ·18; diameter ·07; aperture, long ·07, broad ·05 inch.

Hab. River Heathcote, Christchurch.

Animal yellowish white, semi-transparent, the head between the eyes and the centre of the rostrum yellowish brown. Foot emarginate in front; tentacles triangular, flattish, very short. Eyes triangular.

Dentition 20–1–20, of which about 6 or 8 are laterals. Pl. xii., fig. 11.

Central tooth quadrate, the length more than twice the breadth; reflected portion about two-fifths of the base. Inner laterals with the reflected portion deeply excavated on the outer side, bicuspid, the inner cusp with its point being the larger; cutting points not reaching to the posterior margin of the base. Outer laterals with the reflected portion not excavated, the outer point small; the inner large, projecting beyond the base, often bidenticulate. Marginals normal.

This species has the habit of leaving the water like *L. truncatula*, but from that species it differs in the shell, in the animal, and in the dentition.

LIMNÆA PUCILLA, sp. nov. Pl. xii., fig. 5.

Shell small, oblong, glossy, translucent, finely longitudinally striated. Whorls 4, rounded, aperture oval, half the length of the shell; peristome simple, the inner lip reflexed, covering the umbilicus; columellar plait obsolete. Length ·16; diameter ·10; aperture ·08 inch.

Hab. Auckland.

I have only seen two dead specimens of this species, and have not been able to examine the dentition. The shell somewhat resembles that of *L. truncatula*, but is, I think, quite distinct; and this is also the opinion of Professor A. P. Thomas, to whom I showed the specimens before venturing to describe them.

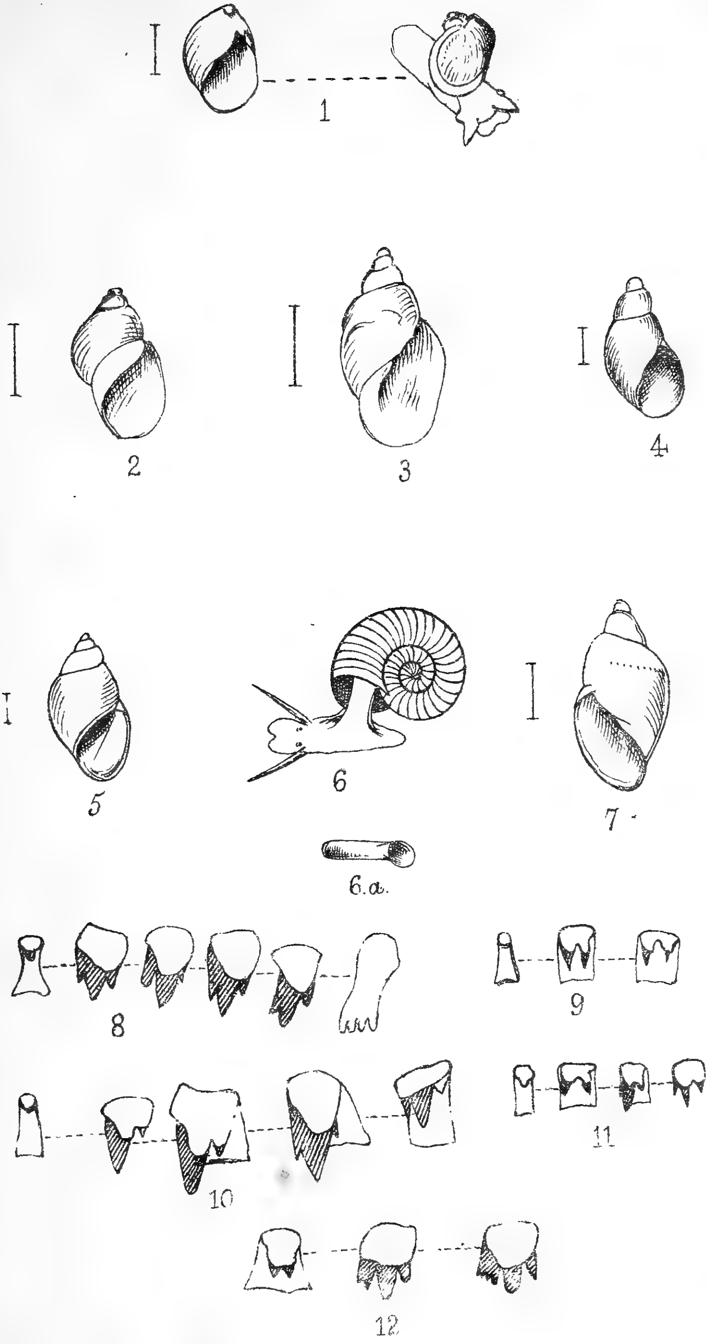
BULINUS ANTIPODEUS, Sowerby in Reeve's Conch. Icon., Physa, f. 37 (1873).

Hab. In lakes from Auckland to Otago. This is our largest species; the whorls are never keeled. The animal and dentition are unknown. Apparently allied to *P. auriculata*, Gassies, from New Caledonia.

BULINUS VARIABILIS, Gray in Dieffenbach's New Zealand, ii., p. 248 (1843). *Bulinus gibbosus*, Hutton, Trans. N.Z. Inst., xiv., p. 155, pl. iv., f. c., Q. and v. (not of Gould). *Physa novæ-zealandiæ*, Sowb. Conch. Icon., f. 29 (1884). *Physa guyonensis*, Tenison-Woods, Pro. Lin. Soc. of N.S.W., iii., p. 138, pl. 13, f. 4. (1878).

Hab. Throughout New Zealand.

This species is smaller than the last. The whorls are rounded, but sometimes show traces of a keel. The shell is figured in pl. xii., f. 7, the dentition in Trans. N.Z. Inst., vol. xiv., pl. 4.



NEW ZEALAND LIMNÆIDÆ.

Bulinus tabulatus, Gould, U.S. Explo. Expedition, xii., p. 116, f. 130 (1848); Sow. Conch. Icon., Physa, f. 17.

Hab. Bay of Islands in mountain streams. Whorls flattened above, but the angle rounded. I have not seen this species, unless it is the same as the last. The dentition is unknown.

Bulinus mæsta, Adams, Pro. Zool. Soc., 1861, p. 144; Sowb. Conch. Icon., Physa, f. 32. *Physa lirata*, Tenison-Woods, Pro. Lin. Soc. of N.S.W., iii., p. 138, pl. 13, f. 6 (1878), not of Tristram.

Hab. Throughout New Zealand.

Distinguished by the angular shoulder to the shell.

Dentition, 30–1–30, of which 6 or 8 are laterals. Pl. xii., f. 12.

Central tooth broader behind, the length about the same as the breadth; reflected portion covering more than half the base, and carrying two small cutting points. Inner laterals with three moderately large cutting points, the inner one of which is bidenticulate at the point; outer laterals with the inner cutting point broad and with three denticles at the apex. Marginals normal.

Planorbis corinna, Gray (1849). Pl. xii., fig. 6. Reeve, Conch. Icon., Planorbis, f. 122.

Hab. Auckland, Christchurch, Lake Wakatipu.

Animal semitransparent; greyish, minutely speckled with smoke brown. Foot short, tapering posteriorly, rounded behind and in front. Rostrum emarginate. Tentacles cylindrical, rounded at the tip, widely separated at the base. Eyes large, round, situated at the inner bases of the tentacles.

The teeth are arranged in broken transverse bands, but they are too minute to be made out with a $\frac{1}{16}$th objective. There appear to be eleven laterals and a large number of marginals on each side, the difference between the two being well marked.

The following species has been introduced:—

Limnæa stagnalis, Linné.

Hab. River Avon, Christchurch.

Introduced intentionally as food for trout.

The following are omitted as not really inhabiting New Zealand:—

Limnæa wilsoni, Tryon (1866).

Like *Physa pyramidata*, Sowb., from Australia.

Physa gibbosa, Gould (1847).

Inhabits New South Wales.

Physa cumingi, Adams (1861).

Inhabits Queensland.

EXPLANATION OF PLATE XII.

Fig. 1. *Limnæa arguta.* Shell and animal.
Fig. 2. ,, *ampulla.* Shell.
Fig. 3. ,, *leptosoma.* Shell.
Fig. 4. ,, *tenella.* Shell.
Fig. 5. ,, *pucilla.* Shell.
Fig. 6. *Planorbis corinna.* Shell and animal.
Fig. 7. *Bulinus variabilis.* Shell.
Fig. 8. *Limnæa ampulla.* Dentition × 470.
Fig. 9. ,, *tomentosa.* Dentition × 740.
Fig. 10. ,, *arguta.* Dentition × 470.
Fig. 11. ,, *tenella.* Dentition × 740.
Fig. 12. *Bulinus mæsta.* Dentition × 470.

Art. VII.—*Description of a new Species of Paper Nautilus* (Argonauta gracilis). By T. W. Kirk.

[*Read before the Wellington Philosophical Society, 9th July,* 1884.]

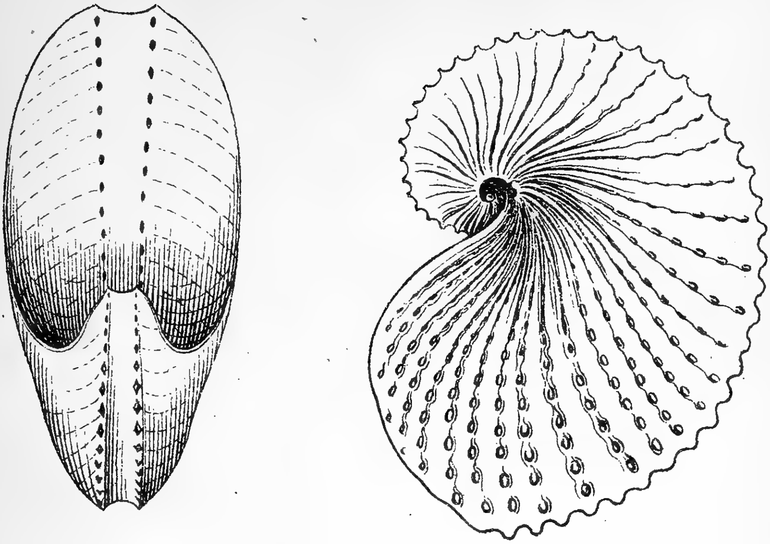
Plate XIII.

That we have in New Zealand two species of the beautiful "Paper Nautilus," so called on account of the extreme delicacy of its shell, I have for some years felt sure; but although I have examined numerous specimens, I have not until lately been able to obtain a sufficiently good series of each form to justify the creation of a new species, and am now indebted to Mr. C. H. Robson of Te Mahia, who had himself noticed the difference, for the loan of several examples which supply the links required to render the evidence complete.

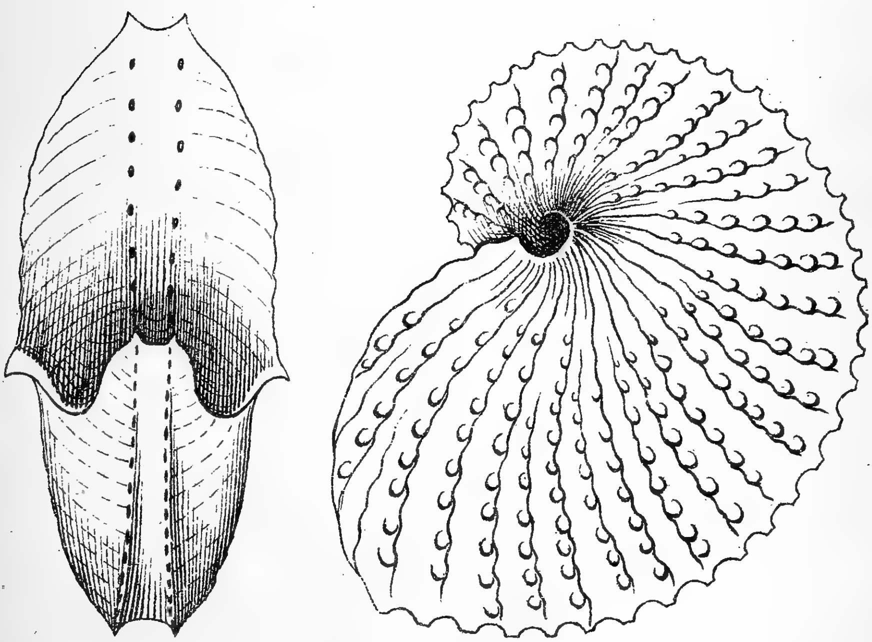
The larger series examined, the individuals of which range from $1\frac{1}{4}$–9 inches across, undoubtedly belong to *A. tuberculata*, Shaw. The description given is defective, yet a comparison of the shell with drawings by Chenu, Reeve, and other authors, is conclusive.

I propose to amend the description as follows :—" Shell compressed, sides with transverse plications which are longitudinally tuberculiferous." Aperture nearly square posteriorly, margin much thickened, and the angles produced outwards so as to form pointed wing-like processes, projecting beyond the sides of the shell. Keels two, with compressed tubercles, white, brown on the spire, where also the keel tubercles are blackish-brown.

What I now consider to be a new species is distinguishable from the foregoing at a glance. The whole shell has a more graceful and regular outline, and is much more fragile looking, the aperture is narrower and rounded, especially posteriorly, there is no sign whatever of wing-like expansions, indeed the sides have a graceful sweep where the angle occurs



ARGONAUTA GRACILIS, *n. sp.*



ARGONAUTA TUBERCULATA, *Shaw.*

n *A. tuberculata.* The transverse processes are finer and more numerous, consequently the tubercles forming the keels are smaller, the space between the keels is much less.

Some of these differences have been noticed before, but were thought to be probably due to age; that such is not the case will be apparent to all who examine the specimens on the table.

A shell containing the animal having been sent to the Canterbury Museum by Mr. Robson, Dr. von. Haast very kindly granted the loan of them, and at once forwarded them for my examination.

The animal proves to belong to the same species as a specimen from the Chatham Islands, described by Professor Hutton on p. 2 of the Catalogue of Marine Mollusca (1873), under the name of *A. tuberculata.*

The specimen now under consideration was procured at Portland Island, is somewhat larger than the Chatham Island one, and shows some slight differences, but only such as are frequently found between members of the same species. Such being the case, I cannot do better than quote Professor Hutton's description.

"*Animal.*—Body oblong, rounded behind, smooth, spotted with violet: eyes large, prominent; siphuncle united to the base of the arms by a lateral membrane; arms tapering, except the dorsal pair, which are palmate at the end, these are the shortest, the next pair to them the longest, and the others graduated; the lowest pair are keeled on the outside; membrane small, all the arms equally webbed; cups large, less than their own diameter apart, in two rows, with a single row of rather small cups round the mouth."

To which he adds the following remark:—"As the shell of this animal was not obtained, I refer it doubtfully to this species, as it differs from Dr. Gray's description."

It is satisfactory that conclusive evidence is now forthcoming, and that this animal with its exquisitely beautiful shell is to enjoy specific distinction. I would therefore suggest for this latest addition to the fleet, the name of *Argonauta gracilis.*

Art. VIII.—*Notice of the Occurrence of the Eastern Golden Plover* (Charadrius fulvus, *Gml.*) *near Wellington.* By T. W. Kirk.

[*Read before the Wellington Philosophical Society, 9th July,* 1884.]

This handsome little bird, although possessing one of the widest geographical ranges of any known species, was until recently included in the New Zealand Fauna solely upon the authority of a single specimen in the British

Museum. It is true there is another in the Bremen Museum which was stated to have been received from New Zealand, but it now appears that there is considerable doubt as to the correctness of the statement.

In the Transactions of the New Zealand Institute, vol. xiv., p. 264, Mr. T. F. Cheeseman records the occurrence of a small flock of them on the Manukau Harbour. Mr. E. A. Plumby being fortunate enough to secure two specimens for the Auckland Museum.

Two years later Dr. Buller recorded the capture of another pair on Portland Island near Napier, and also communicated a notice by Mr. C. H. Robson on the breeding habits of this rare species.

The point of interest in connection with the specimen now exhibited is the occurrence of this beautiful little wader in the Wellington district.

In November last a specimen in splendid plumage was shot at the Pilot Station in Worser Bay, and procured for the Museum. Subsequently a pair was seen at Island Bay; these also were shot, and I am informed by the taxidermist who prepared them, are now in the possession of a resident of this city.

It is very curious that its right to a place in the Avifauna of this country should for so many years have rested on a single specimen, and that during the last three years upwards of fifteen examples have been noted, in three different and widely separate localities.

Art. IX.—*Notes on some New Zealand Birds, exhibiting curious Variations of Colour.* By T. W. Kirk.

[*Read before the Wellington Philosophical Society, 9th July,* 1884.]

1. *Glaucopis wilsoni*, Bp. Blue-wattled crow, Kokako.

Several instances of abnormal colouring in this genus have already been recorded. The first specimen showing a leaning towards albinism belongs to the South Island species or orange-wattled crow (*Glaucopis cinerea*). It is of the usual dark bluish-grey, with the exception of a few white feathers scattered indiscriminately over the whole body; a description will be found on page 154 of Dr. Buller's "Birds of New Zealand."

All the specimens subsequently obtained belong to the North Island species or blue-wattled crow.

In 1877 a pure albino having bright pink eyes and very small pink wattles was captured in the Rimutaka mountains, and kept alive for several months by Mr. Elliott of Pakuratahi, during which time it became sufficiently domesticated to feed from the hand of its owner.

Five years later two specimens almost identical, having the body, head, and neck of a pale slaty-grey, but the wings and tail white, were shot in the mountains near Featherston, and secured for the Museum.*

I have now to note the capture of two additional examples further illustrating the tendency which this bird shows to depart from the typical colour ; both specimens, like those above-mentioned, were procured in the Wairarapa district, which locality appears from some cause or other to afford peculiar facilities for the production of these "freaks of nature." (Trans. N.Z. Inst., vol. xii., 248 ; xiii., 235 ; xiv., 544.)

The first of these additional specimens is a pure albino shot near Greytown by Mr. W. C. Creff.

The next may be regarded as the second step in the progress towards albinism. This species is an uniform bluish-slate colour, with the exception of the wings and tail which are lighter, the shafts of the quills being quite white. It was obtained on the Dry River, Wairarapa, by Mr. Sinclair Liardet.

2. *Ardea pœciloptila*, Wagl. Bittern, Matuku.

A specimen of this bird lately procured at Foxton was shown to me a few days ago. It had a large white patch on each shoulder and on the back of the neck, the remainder of the plumage was of the usual colour, though somewhat dimmed. I do not remember the record of any similar description in this species.

3. *Anas chlorotis*, Gray. Brown Duck, Pateke.

In 1878 Dr. Buller described an albino of this species which was shot on the Horowhenua Lake.

The capture of a partial albino on the Wairarapa Lake was recorded by myself in vol. xiii., Trans. N.Z. Inst.

The specimen to which I have now to direct attention also comes from the Wairarapa, and is more remarkable than either of those before mentioned. The head and neck are pure white, with the exception of a few feathers of the normal colour near the base of the bill. A band of white, with a few coloured feathers interspersed, runs across both wing coverts, primaries and tail with numerous patches of white. The white head and neck, together with the band of the same colour on the wings, give it somewhat the appearance of a paradise duck (*Casarca variegata*), and suggest the possibility of its being the result of a cross with that species.

4. *Ossifraga gigantea*, Gml. Nelly, Giant Petrel.

On page 84 of the "Manual of New Zealand Birds" issued by the Geological Survey Department, appears the following remark by the author: "A variety with white plumage is not uncommon, a fine specimen captured

* Trans. N.Z. Inst., vol. xiv., p. 544.

by Dr. Hector in Foveaux Straits being in the Colonial Museum." The specimen referred to has, however, a number of black feathers; but the Museum has lately received another, presented by Dr. Buller, which has not a trace of colour about it.

There is now on view in the window of Mr. Liardet, furrier, of this city, a third specimen, in beautiful plumage, which may be taken as intermediate between the normal black and the specimen described in the "Manual." The whole of the ground colour is white, but pure black feathers are plentifully scattered all over the bird.

5. *Nestor meridionalis.* Brown Parrot, Kaka.

This specimen is very similar to that described by Dr. Buller on page 40 of his well-known book. The one there mentioned was originally the type of his *N. superbus*, from which it differs only in having the head and upper part of the face of a delicate slaty grey, and all the bright parts much more gorgeous. It seems almost a pity that circumstances should have necessitated the reduction of this rightly-named superb bird to the rank of a variety.

The example now exhibited was procured near Waikanae, and is I am informed the property of the chief Wi Parata. I am indebted to the taxidermist to whose tender mercies it had been committed for the temporary loan of the skin.

Art. X.—*Supplement to a Monograph of the New Zealand* Geometrina.

By E. Meyrick, B.A.

[*Read before the Philosophical Institute of Canterbury, 7th August,* 1884.]

Since the preparation of my paper on this group, published in the Transactions for 1883, I have revisited England, and been enabled to examine all the types of New Zealand *Micro-Lepidoptera* existing in the British Museum. The results of this examination with reference to the *Bombycina* and *Noctuina* I hope to embody in future papers; meanwhile I give here the corrections and additions to my list of *Geometrina* which I find to be necessary. It will be remembered that I anticipated the necessity of this revision.

I have also been enabled to obtain Lederer's paper on the classification of the group, forming the basis of the system now adopted in Europe; by its aid I have been able to rectify my use of some generic names. I may mention, however, that whilst fully concurring in his general views on classification, I dissent from many of his results, and especially from his limitation of the genus *Cidaria*, which requires subdivision; I am still of opinion that the genera allied to this, but distinguished by me, will be found to be natural and tenable. Also, I do not agree that the group is incapable of division into families, though, as previously mentioned, I may very probably see cause hereafter to modify the limits of my families, when I have concluded the investigation of the Australian species.

Two or three corrections on other points are also included.

The five family names employed I desire to stand as follows:—(1) *Acidaliadæ,* (2) *Larentiadæ,* (3) *Boletobiadæ,* (4) *Lyrceidæ,* (5) *Boarmiadæ.* The alterations in form, which I have here made, I believe to be correct orthographically, and have adopted them as alone justifiable; I need not here enter into the technical question. The fifth name is altered on the ground of priority, the alteration being also convenient and just.

I proceed to go through the species in the order given; where no mention is made of a species, it will be understood that the synonymy and nomenclature has been verified as correct.

2. *Acidalia rubraria,* Dbld.

Additional synonyms of this species are *Acidalia repletaria,* Walk., 778; and *Acidalia attributa,* Walk., 779.

4. *Hippolyte rubropunctaria,* Dbld.

This species is *Acidalia pulchraria,* Walk., 780, as well as of Butler, both authors having mistaken it for *Asthena pulchraria,* Dbld., of which the description is notwithstanding quite clear.

9. *Eurydice rufescens,* Butl.

(*Larentia* (?) *rufescens.* Butl., Cist. Ent., ii., 502; *Eurydice cymosema,* Meyr., Trans. N.Z. Inst., 1883, 63.)

Should stand corrected as above, according to type.

10. *Harpalyce megaspilata,* Walk.

The reference to *Larentia rufescens,* Butl., as a synonym, should be struck out.

11. *Harpalyce parora,* n. sp.

(*Harpalyce humeraria,* Meyr. (nec. Walk.), Trans. N.Z. Inst., 1883, 64.)

As I had apprehended, none of Walker's names quoted for this species are really applicable, all being referable to No. 85. I also agree with Mr. A. Purdie (N.Z. Journ. Sc., ii., 88), that *Itama cinerascens,* Feld., is not this species, but No. 86. The present insect is therefore left without a name; I name it as above.

12. *Stratonice euclidiata,* Gn.

(*Coremia euclidiata,* Gn., x., 420; *Coremia glyphicata,* ib., 420; *Fidonia catapyrrha,* Butl., Proc. Zool. Soc. Lond., 1877, 392, pl. xliii., 2; *Stratonice catapyrrha,* Meyr., Trans. N.Z. Inst., 1883, 64.)

I recently discovered that this was identical with the Australian species described twice as above by Guenée, having obtained Australian specimens for comparison. The species occurs in Victoria; I think that, as in the case of all other *Geometrina* common to both regions, Australia is its original home.

14. *Pasiphila bilineolata*, Walk.

The following are all additional synonyms of this species: *Coremia inductata*, Walk., 1322; *Scotosia denotata*, ib. 1361; *Scotosia subitata*, ib., 1362; *Scotosia humerata*, ib., 1362; *Phibalapteryx eupitheciata*, ib., 1720; *Phibalapteryx parvulata*, ib., 1721; *Coremia cristata*, ib., Suppl., 1683.

I find that this species also occurs in Australia, being common in Victoria and New South Wales.

16. *Tatosoma agrionata*, Walk.

(*Cidaria agrionata*, Walk., 1417; *Cidaria tipulata*, ib., 1417; *Cidaria inclinataria*, ib., 1418; *Cidaria transitaria*, ib., 1419; *Cidaria collectaria*, ib., 1419; *Sauris mistata*, Feld., cxxxi., 12.)

All these synonyms refer to this species, and not to the following, as supposed.

17. *Tatosoma timora*, n. sp.

(*Tatosoma agrionata*, Meyr. (nec. Walk.), Trans. N.Z. Inst., 1883, 68.)

It becomes necessary now to rename this species, as above.

26. *Arsinoë subochraria*, Dbld.

Aspilates euboliaria, Walk., 1684, is an additional synonym of this.

33. *Cidaria arida*, Butl.

(*Melanthia arida*, Butl., Cist. Ent., ii., 505; *Cidaria chaotica*, Meyr., Trans. N.Z. Inst., 1883, 76.)

Identified as above; Butler's type is a very poor specimen, which may partially account for the incomprehensibility of his description.

42. *Larentia lucidata*, Walk.

(*Larentia lucidata*, Walk., 1200; *Coremia plurimata*, ib. 1321; *Panagra venipunctata*, ib., 1666; *Larentia psamathodes*, Meyr., Trans. N.Z. Inst., 1883, 81.)

The synonymy will stand as above.

47. *Larentia subobscurata*, Walk.

(*Scotosia subobscurata*, Walk., 1358; *Larentia petropola*, Meyr., Trans. N.Z. Inst., 1883, 82.)

Type rather worn, but clearly identifiable.

48. *Larentia cinerearia*, Dbld.

An additional synonym is *Larentia diffusaria*, Walk., 1201. In the synonymy of this species *similisata*, Walk., is wrongly printed as *semilisata*.

62. *Pasithea brephos*, Walk.

The reference to *Fidonia enysii*, Butl., as a synonym, should be struck out; vid. infr.

64. *Statira enysii*, Butl.

(*Fidonia enysii*, Butl., Proc. Zool. Soc. Lond., 1877, 391, pl. xlii., 9; *Statira homomorpha*, Meyr., Trans. N.Z. Inst., 1883, 91.)

Butler's type is certainly this species; but I should add that neither the description nor figure are strictly recognizable, and my identification of the name with *Pasithea brephos* was founded on an undoubted specimen of that species received by Mr. Enys from Mr. Butler himself as his *enysii*.

Genus 25. SAMANA, Walk.

Having investigated many of the Australian species of *Panagra*, Gn., I find it necessary to separate the present genus from it on the ground of the ciliated antennæ; these in *Panagra* are unipectinated. It will, therefore, be desirable to retain for this genus Walker's name.

71. *Lyrcea alectoraria*, Walk.

An additional synonym of this species is *Ennomos ustaria*, Walk., 1519. On the other hand, I could not find the types of *Aspilates primata*, Walk., and *Endropia mixtaria*, Walk., and am of opinion that Walker's descriptions do not apply to this species, whilst the localities are not given at all; I therefore think these names should be left out of the synonymy, and rejected altogether for the present.

76. *Pseudocoremia melinata*, Feld.

An additional synonym is *Pseudocoremia confusa*, Butl., Cist. Ent., ii., 496 (I am not sure whether this reference to text is correct).

Genus 31. GELONIA, n. g.

On comparing Lederer's definitions of the genera *Boarmia* and *Gnophos*, it appears that the present genus differs from them notably in neuration, as well as in other points; I have therefore renamed it as above.

Genus 32. BOARMIA, Tr.

This genus agrees well with Lederer's definition of *Boarmia*, which, however, he makes rather more comprehensive than I do, as I limit the genus to his subdivision A, to which our species belongs. The name *Barsine* must therefore be abandoned. To the generic characters given should be added: *male* with a bare indented spot near base of forewings beneath submedian vein.

81. *Declana floccosa*, Walk.

The reference to *Chlenias verrucosa*, Feld., should be struck out; vid. infr.

82. *Declana junctilinea*, Walk.

Politeia junctilinea, Walk. Suppl., 643; *Chlenias verrucosa*, Feld., cxxxi., 22; *Declana crassitibia*, Meyr., Trans. N.Z. Inst., 1883, 103, male.)

I believe that the insects described by me as sexes of *Crassitibia*, Feld., are really specifically distinct, as I have seen now several specimens of the form described as the female with what I believe to be the male belonging to it, having simple antennæ, and therefore generically separable from *Declana*. The present species is that described as the male, for which I have found a name in Walker, and to which I also now refer *verrucosa*, Feld., instead of to the preceding species. The other species described as the female will stand as follows:—

Ipana leptomera, Walk. Noct., 1662.

(*Ipana leptomera*, Walk., ; *Amphitape crassitibia*, Feld., cix., 10; *Declana crassitibia*, Meyr., Trans. N.Z. Inst., 1883, 103, female.)

The simple antennæ distinguish this genus from *Declana* and *Detunda*, and the separate origin of veins 10 and 11 of the forewings remove it from *Atossa*. Further investigation of this peculiar group, in which I think some specific variation in neuration may occur, is desirable; the genera may eventually require to be remodelled.

85. *Amastris humeraria*, Walk.

(*Macaria humeraria*, Walk., 940; *Lozogramma obtusaria*, ib., 985; *Cidaria flexata*, ib., 1421; *Cidaria obtruncata*, ib., 1421; *Sestra fusiplagiata*, ib., 1751; *Amastris encausta*, Meyr., Trans. N.Z. Inst., 1883, 105.)

I rather anticipated this identification, but was afraid to make it until I had seen the types.

87. *Chalastra pelurgata*, Walk.

(*Chalastra pelurgata*, Walk., 1430; *Itama cinerascens*, Feld., cxxxi., 1; *Stratocleis streptophora*, Meyr., Trans. N.Z. Inst., 1883, 106.)

I was not acquainted with the male when publishing my description; it has bipectinated antennæ, and the species therefore cannot remain in *Stratocleis;* I have retained for it accordingly Walker's generic name. Excepting the pectination of the antennæ, the characters of *Chalastra* are those of *Stratocleis*. The specific name is misprinted *pellurgata;* but I think there can be no doubt that Walker meant to write *pelurgata*, deriving it from the generic name *Pelurga*, Hb., which is itself correctly formed from the Greek.

APPENDIX.

91. Identified with 71.

92. No type found; description not recognizable; may be dropped.

93, 94. Single specimens of these Australian species are labelled from New Zealand; I have no doubt this is an error; they may be omitted until recaptured.

95. Identified with 42.

96. Identified with 26.

97. *Larentia subductata*, Walk., 1198. I think this may be a distinct species from any described, but cannot speak positively until specimens are obtained for examination; it is probably a *Larentia*, and rather resembles large forms of *L. cinerearia*, Dbld., but is distinctly tinged with yellow-greenish.

98. Wholly unidentifiable; may be dropped.

99. Identified with 42.

100. *Larentia quadristrigata*, Walk., 1200 ; *Larentia interclusa*, ib., 1202. Distinct from any species described ; recalls *Microdes* in appearance ; rather small, oblong-winged ; white, with irregular curved dentate fuscous-grey lines ; three forming a stronger curved band at $\frac{1}{3}$, and three others a straight band at $\frac{2}{3}$, first preceded and second followed by a dark shade. I should like to obtain specimens of this for investigation ; I think it may be a *Microdes*, and identical with an Australian species.

101. Unidentifiable, but possibly a synonym of 42.

102. Identified with 42.

103. Identified with 14.

104. A common Australian species, doubtless recorded from New Zealand in error.

105. *Phibalapteryx suppressaria*, Walk., 1721. Distinct from any species described ; perhaps a *Larentia* ; moderate ; costa sinuate ; fuscous-grey, with oblique, dentate, slightly curved darker lines, a narrow central band obscurely whitish, margins darker. Said to be from Auckland.

106. Identified with 14.

107. Identified with 47.

108. Identified with 14.

109. Unidentifiable, but possibly a worn specimen of 75.

110. Identified with 87.

115. *Larentia falcata*, Butl., Cist. Ent., ii., 501. Apparently a distinct species ; recalls *Eurydice rufescens*, Butl., but greyer and darker ; cf. descr.

117. Identified with 33.

118. This is a tolerably common Australian species, also described more than once by Walker ; it is doubtless recorded from New Zealand in error, and may be dropped.

The following is an additional species which was overlooked previously.

Samana acutata, Butl.

(*Samana acutata*, Butl., P.Z.S.L., 1877, 401.)

I have not been able to critically examine this, of which I saw the type ; I noted that it was very like *S. falcatella*, Walk,, but with first dark line running from inner margin near base to below costa before middle, lower extremity of second connected with anal angle by an oblique streak.

I also made the following notes on exotic species, which struck me as nearly approaching New Zealand species, and as throwing light on questions of geographical distribution.

Fidonia edmondsii, Butl., from Chili, is very closely allied to *Cephalissa siria*, Meyr., and is doubtless also a *Cephalissa* (*Geometrina*, with orange hindwings, are usually classed by Mr. Butler under *Fidonia*, irrespective of structure).

Epimecis dibapha, Feld., also from Chili, is doubtless also closely allied to the last species of *Pasithea*.

Harpyia albicans, Walk., from South Africa, approaches nearly the group of *Declana*.

If the species referred to above as probably new are really so, the number of the New Zealand *Geometrina* at present known will be 95.

Art. XI.—*Descriptions of New Zealand* Micro-Lepidoptera.

By E. Meyrick, B.A.

[*Read before the Philosophical Institute of Canterbury, 7th August*, 1884.]

IV.—SCOPARIADÆ.

This family occupies an unusually prominent position in New Zealand, and the principal genera attain here their maximum of development. The development is however mainly specific, and there is no large number of peculiar genera, as in some other groups. The family is undoubtedly of very ancient type, and the food of the larvæ, which probably consists wholly of mosses, will allow of a possible origin earlier in time than the appearance of flowering plants. It is probably due to this persistence of habit that the type has undergone so little generic modification; specific change being sufficient to allow of all the adaptation required. The distribution of the family seems chiefly limited by the suitability of the climate for the growth of their food-plants; hence they are found principally in cool temperate latitudes, or at considerable elevations.

As I have elsewhere pointed out, the oldest form of the family is probably *Nyctarcha*, which is a singular synthetic type. *Xeroscopa* is an early off-shoot from *Scoparia*, and *Tetraprosopus* a development of *Xeroscopa*.

Owing to the small range of colour, and great similarity of markings, which are moreover in most of the species more or less confused and ill-defined, being composed of black, white, and grey scales variously blended, the group is a difficult one either to study or to describe. In order to make this monograph more comprehensive, I have therefore included all the Australian species of *Scoparia*, *Tetraprosopus*, and *Xeroscopa* (which are, however, much less numerous than those from New Zealand), indicating them by an asterisk (*) as not occurring in New Zealand. No species of the family is common to both regions. The Australian species of *Nyctarcha* and *Eclipsiodes*, which I have already described elsewhere, and which are moreover very distinct from anything occurring in New Zealand, I have not thought it necessary to include.

As the descriptions of Walker, Knaggs, and Butler are hardly in any instance sufficiently precise for determination, I may add that the species of Walker and Butler have been identified from the types, and those of Knaggs from types preserved by Mr. R. W. Fereday.

SCOPARIADÆ.

Labial palpi, with hairs of second joint produced in front beneath. Maxillary palpi large, triangularly scaled, porrected, not resting on labial palpi. Forewings with 7 and 10 separate from 9, 8 and 9 stalked. Hindwings with 4 and 5 from a point or stalked (except in *Nyctarcha*); lower median without basal pectination (except in *Eclipsiodes* and *Nyctarcha*). Genital uncus of male generally well developed.

Distinguished from all the other families of the *Pyralidina* by the character of the maxillary palpi, which are large, porrected, triangularly dilated, and obliquely truncate, standing out apart from the labial palpi; differing also from the *Crambidæ* (which some species closely approach in type) in the absence of the basal pectination on the lower median vein of the hindwings (with the exceptions noted above), from the *Botydidæ* in the development of the genital uncus of the male, and from the *Pyralididæ* by the separation of vein 7 of the forewings from the stalk of 8 and 9.

The following tabulation includes all the five Australian genera, of which only three are represented in New Zealand.

A. Lower median with basal pectination.
- 1. Vein 1b of hindwings with well-defined pectination .. .. *Nyctarcha.*
- 2. ,, ,, ,, ,, without ,, ,, ... *Eclipsiodes.*

B. Lower median naked.
- 1. Discal area of hindwings above lower median with long hairs.
  - a. Antennæ of male moderately ciliated .. .. *Xeroscopa.*
  - b. ,, ,, ,, hardly perceptibly ciliated .. .. .. *Tetraprosopus.*
- 2. Discal area of hindwings without hairs .. .. *Scoparia.*

1. NYCTARCHA, Meyr.

Forehead vertical. Ocelli present. Tongue well developed. Antennæ short, less than $\frac{2}{3}$ of forewings, in male stout, filiform, evenly ciliated ($\frac{1}{4}$–$\frac{1}{3}$), above pubescent (*N. atra*) or rough-scaled. Labial palpi moderate, straight, porrected, second joint with dense projecting scales beneath, terminal joint exposed, thick, somewhat expanded towards apex, and obliquely truncate. Maxillary palpi nearly as long as labial, terminally expanded, truncate. Posterior tibiæ with outer spurs half inner; legs short. Abdomen short, stout. Forewings with vein 11 moderately oblique. Hindwings somewhat broader than forewings; 3, 4, 5 approximated at base; lower median and 1*b* each with a strong pectination towards base, surface otherwise without hairs.

Consists at present of two Australian and one New Zealand species, one of the Australian species (*N. ophideres*, Walk.) extending also into India and Madagascar. The genus presents a singular combination of characters, and probably approximates to the ancestral form of the *Scopariadæ*, *Crambidæ*, and *Botydidæ*. The New Zealand species is characterized by the dark fuscous hindwings, which in the two Australian species are partly orange.

1. *Nyct. atra*, Butl.

(*Orosana atra*, Butl., Pro. Zool. Soc. Lond., 1877.)

Male, female.—11–12 mm. Head, palpi, and thorax blackish, irrorated with white, basal joint of palpi white. Antennæ blackish. Abdomen blackish, segmental margins white. Legs white, irrorated with black, tibiæ and tarsi banded with black. Forewings oblong, somewhat dilated posteriorly, costa straight, apex rounded, hind margin very obliquely rounded; dark fuscous, sometimes partially irrorated with white; first line black, angulated; orbicular small, black, detached; claviform absent; reniform 8-shaped, outlined with black, separated from second line by a white spot, sometimes obsolete above but always distinct on under surface, suffused into costa; second line black, indented beneath costa, strongly curved inwards beneath reniform, sometimes margined posteriorly on costa with white; subterminal obsolete: cilia grey, with a waved black line, tips white. Hindwings dark fuscous; neural pectinations white; cilia as in forewings. Under surface of forewings with one or two small white spots between reniform and base, besides posterior blotch, and a whitish suffusion towards inner margin: of hindwings with a white discal suffusion, interrupted by a dark fuscous central spot.

The markings of the under surface in this instance doubtless indicate the original type.

Castle Hill and Lake Wakatipu (1,200 to 3,000 feet), in December and January, on dry grassy slopes; difficult to see; six specimens.

2. Scoparia, Hw.

Forehead vertical. Ocelli present. Tongue well developed. Antennæ moderate, $\frac{2}{3}$ of forewings, in male filiform, evenly ciliated ($\frac{1}{4}$–$1\frac{1}{2}$). Labial palpi moderate or long, straight, porrected, second joint beneath with long dense projecting scales, terminal joint moderate, exposed or resting in scales of second. Maxillary palpi rather long, triangularly dilated. Posterior tibiæ with outer spurs half inner. Abdomen moderate. Forewings with vein 11 rather oblique. Hindwings from somewhat broader to nearly twice as broad as forewings; 3 remote from 4, 4 and 5 stalked or from a point; lower median naked; discal area above it without hairs; internal area loosely haired.

Although of universal distribution, this genus is little developed except in temperate latitudes, hardly occurring in the tropics except at a considerable elevation. Over thirty European species are known, and scattered forms are found in most other regions. Australia possesses at present sixteen, which number will be considerably increased, especially from the Tasmanian mountains. In comparison with these the development of the genus in New Zealand is extraordinary, forty-two species being here given, and it is unquestionable that the actual number is much larger, as each mountain seems to possess peculiar species. *Scoparia* is in fact the largest genus of *Lepidoptera* in New Zealand.

Notwithstanding the extent of the genus, I can find no structural characters for subdividing it into groups. The palpi vary in length, and the antennæ present some differences, being generally rough above, but sometimes pubescent, or serrate at joints, with the ciliations of variable length, but these points are simply specific. Veins 4 and 5 of the hindwings are either from a point or stalked, but both forms often occur in the same species. Roughly, the first 27 species belong to the same group as the European forms, being always of comparatively small size, with the typical markings well developed, whilst the remainder constitute a more specially New Zealand group, usually of larger size, and more crambideous appearance, with the normal markings often obsolete, the palpi longer and hindwings broader; but there is no definite distinction.

The larvæ, so far as known, feed universally on mosses.

In the following descriptions the length of the labial palpi is stated in terms of the breadth of the eye, and the length of the antennal ciliations in terms of the breadth of the stalk; the breadth of the hindwings in terms of the breadth of the forewings. Typically, the markings consist of three transverse lines and three discal spots—viz., (1) the first line, at about $\frac{2}{5}$, usually oblique and somewhat curved, more or less indented in middle; (2) the orbicular spot, usually round, shortly beyond first line above middle; (3) the claviform spot, usually linear, similarly placed below middle; (4) the reniform spot, usually 8-shaped, in disk beyond and above middle; (5) the second line, at about $\frac{4}{5}$, tolerably parallel to hindmargin, usually somewhat curved, generally sinuate inwards below costa and above inner margin; (6) the subterminal line, placed between second line and hindmargin, curved inwards in middle, often interrupted.

Owing to the obscure colouring of all the species, and their great general similarity, it is extremely difficult to construct an accurate tabulation, but the following is an attempt which may be of some practical use:—

1a. Forewings wholly blackish .. .. 2. *anthracias.*

1b. ,, not blackish.

2a. Basal third of forewings deep reddish-ochreous.

3a. Space before second line suffused with white .. .. 44. *epicomia.*
3b. ,, ,, not white .. .. .. 45. *feredayi.*
2b. Basal third of forewings not reddish-ochreous.
3a. Orbicular recognizably represented.
4a. Claviform visible.
5a. Lines somewhat yellowish or ochreous.
6a. Claviform detached.
7a. Base of wing spotted with blackish .. .. .. 27. *anaplecta.*
7b. ,, not spotted .. .. 4. *eumeles.*
6b. Claviform touching first line.
7a. Lines connected in disc by a yellowish-white streak .. 29. *characta.*
7b. ,, not connected .. .. 10. *homala.*
5b. Lines not yellowish or ochreous.
6a. Lower half of subterminal margined above by an ochreous blotch.
7a. Costal space between reniform and second line white.
8a. Dark fuscous costal blotch bounded by submedian fold .. 18. *minualis.*
8b. ,, ,, continued to inner margin .. 17. *minusculalis.*
7b. Costal space between reniform and second line not white .. 19. *chimeria.*
6b. Lower half of subterminal not margined with ochreous.
7a. Orbicular and claviform fused into a single blotch .. .. 5. *aphrodes.*
7b. ,, ,, separate.
8a. With a small ochreous-yellowish spot near base.
9a. Reniform distinctly 8-shaped .. .. 23. *microphthalma.*
9b. ,, not 8-shaped .. .. 13. *gomphota.*
8b. Without yellowish spot near base.
9a. With prismatic spots before and beyond reniform .. .. 36. *diphtheralis.*
9b. Without prismatic spots.
10a. Claviform touching first line.
11a. Orbicular touching first line.
12a. Reniform dot-like .. .. 54. *elaphra.*
12b. ,, 8-shaped.
13a. Forewings ochreous-fuscous .. .. 46. *acompa.*
13b. ,, grey, mixed with white and black.
14a. Hindwings rather dark grey .. .. 26. *critica.*
14b. ,, whitish-grey.
15a. Claviform thick, black, conspicuous .. .. .. 3. *chiasta.*
15b. ,, not conspicuous.
16a. First line distinct, indented .. .. 49. *manganeutis.*
16b. ,, very obscure, not indented .. .. .. 41. *chalicodes.*
11b. Orbicular detached.
12a. Hindwings grey.. .. .. 11. *eremitis.*
12b. ,, pale whitish-grey or whitish.
13a. Hindmargin of hindwings darker.
14a. With well-defined blackish triangular hindmarginal blotch .. 6. *epicryma.*
14b. Hindmarginal blotch obscure, not blackish.. .. .. 34. *philetaera.*
13b. Hindmargin of hindwings not darker .. .. .. 14. *oreas.*
10b. Claviform detached
11a. Orbicular confluent with broad margin of first line .. .. 22. *cymatias.*
11b. ,, detached.

12a. Orbicular wholly dark.
13a. Orbicular suffused, almost obsolete .. .. .. 51. *axena.*
13b. „ tolerably distinct.
14a. With white space before second line .. .. .. 20. *dinodes.*
14b. Without white space.
15a. Hindwings grey .. .. 12. *perierga.*
15b. „ grey-whitish .. .. 50. *crypsinoa.*
12b. Orbicular pale-centred.
13a. Claviform pale-centred.
14a. First line obsolete .. .. 39. *tetracycla.*
14b. „ visible.
15a. First line margined on costa by a black spot .. .. 21. *acharis.*
15b. „ not followed by a black spot .. .. .. 40. *indistinctalis.*
13b. Claviform wholly blackish.
14a. Claviform subquadrate.
15a. First line sharply indented .. .. 8. *syntaracta.*
15b. „ hardly at all indented .. .. .. 9. *synapta.*
14b. Claviform round.
15a. Claviform moderately large.
16a. Hindwings ochreous-tinged .. .. 37. *submarginalis.*
16b. „ not ochreous tinged.. .. .. .. 15. *philerga.*
15b. Claviform dot-like.
16a. Antennæ of male dentate, ciliations $\frac{2}{3}$ .. .. .. 42. *leptalea.*
16b. „ „ filiform „ 1 .. .. .. 43. *psammitis.*
4b. Claviform absent.
5a. Lines obsolete .. .. 57. *sabulosella.*
5b. „ present.
6a. Forewings light fuscous .. .. 47. *acropola.*
6b. „ dark bluish-grey .. .. 38. *cataxesta.*
3b. Orbicular not recognizable.
4a. Claviform visible.
5a. With triangular blackish costal blotch .. .. .. 31. *pongalis.*
5b. Without blackish costal blotch .. .. 53. *exilis.*
4b. Claviform obsolete.
5a. Lines pale yellow .. .. 28. *spelæa.*
5b. „ not yellow.
6a. Basal half of forewings blackish, except small ochreous spot 16. *chlamydota.*
6b. „ „ „ not wholly blackish.
7a. With large dark fuscous costal blotch beyond first line.
8a. Blotch not passing middle of wing .. .. .. 33. *trapezophora.*
8b. „ reaching to near inner margin .. .. .. 32. *melanægis.*
7b. Without large dark fuscous costal blotch.
8a. First line indicated or distinct.
9a. Reniform 8-shaped .. .. 48. *cleodoralis.*
9b. „ not 8-shaped.
10a. Reniform and orbicular absorbed in a blackish streak.
11a. Hindwings fuscous-grey .. .. 24. *hemicycla.*
11b. „ pale whitish-grey .. .. 30. *ustimacula.*

10b.	Without blackish discal streak.	
11a.	First line straight	35. *periphanes.*
11b.	,, curved	25. *ergatis.*
8b.	First line absent.	
9a.	Thorax with sharp blackish-fuscous lateral stripe.	
10a.	Basal dark streak in a line with discal	59. *trivirgata.*
10b.	,, ,, parallel with discal	58. *panopla.*
9b.	Thorax without lateral stripe.	
10a.	Dorsal half of wing white	52. *steropæa.*
10b.	,, ,, not white.	
11a.	Reniform represented by a whitish dot	55. *paltomacha.*
11b.	,, ,, by a black dot	56. *deltophora.*

*2. *Scop. anthracias*, n. sp.

Male, female.—15–16 mm. Head, palpi, antennæ, and thorax dark fuscous mixed with black; palpi $2\frac{1}{2}$; antennal ciliations $\frac{1}{2}$. Abdomen grey. Legs black, apex of joints white. Forewings elongate, triangular, costa slightly arched, apex rounded, hindmargin obliquely rounded; dark slaty-fuscous; markings black, ill-defined; a short interrupted streak from base; first line somewhat curved; orbicular and claviform irregular, somewhat linear, touching first line; reniform represented by a trifurcate mark; second line almost rectangularly bent in disc, followed on costa by some white scales; veins partially marked with black posteriorly: cilia dark slaty-fuscous, with a black line, tips pale. Hindwings $1\frac{1}{3}$; pale whitish-grey, towards hindmargin grey; cilia grey-whitish, with two faint grey lines.

Doubtless protectively coloured to resemble charred tree-trunks, like *Bondia.*

Launceston and Mount Wellington, Tasmania, in January; three specimens.

*3. *Scop. chiasta*, n. sp.

Male.—14–17 mm. Head white. Palpi $1\frac{2}{3}$, dark fuscous, basal and terminal joints white. Antennæ white, annulated with dark fuscous, ciliations $\frac{1}{2}$. Thorax white, irrorated with dark fuscous. Abdomen whitish-grey. Legs dark fuscous, banded with white. Forewings elongate-triangular, costa slightly arched, apex rounded, hindmargin obliquely rounded; white, irregularly irrorated with fuscous and dark fuscous; a short dark fuscous streak from base of costa parallel to inner margin; first line white, oblique, rather indented, posteriorly margined with dark fuscous, which forms a triangular spot on costa; orbicular elongate, touching first line, dark fuscous; claviform strong, elongate, touching first line, dark fuscous; reniform represented by a quadrifurcate dark fuscous mark, upper fork sometimes filled with fuscous; a small dark fuscous spot on costa somewhat beyond middle; second line white, tolerably distinctly margined with dark fuscous; subterminal line white, somewhat broader and more ill-defined, leaving a dark fuscous triangular blotch on hindmargin: cilia white, with a basal row of dark fuscous spots, and posterior row of grey spots. Hindwings $1\frac{1}{3}$, pale whitish-grey, greyer on hindmargin and towards apex; cilia whitish, with a grey line.

Not closely resembling any other, and recognizable by the character of the spots, which are conspicuous though not sharply defined.

Sydney, New South Wales, from May to August, so that it is a winter species; five specimens.

* 4. *Scop. eumeles*, n. sp.

Male.—14–16 mm. Head, palpi, antennæ, thorax, and abdomen whitish-ochreous, slightly mixed with ochreous; palpi 2, basal joint white; antennal ciliations $\frac{1}{2}$. Legs white, anterior and middle tibiæ and tarsi banded with blackish. Forewings somewhat elongate, triangular, costa gently arched, apex rounded, hindmargin obliquely rounded; very pale whitish-ochreous, finely irrorated with fuscous on basal third, with blackish on remainder; a faint blackish triangle on base of costa; first line slender, tolerably clear, somewhat curved, slightly indented, posteriorly finely blackish margined, forming a small black triangular spot on costa; orbicular and claviform both small, round, black, detached; a small black triangular spot on costa beyond middle, separated from second line by a subquadrate light yellow-ochreous spot; reniform irregularly 8-shaped, light yellow-ochreous, only black-margined in middle of posterior side; second line tolerably clear, anteriorly finely blackish-margined, more strongly on inner margin; terminal space suffused with pale grey, except broad cloudy subterminal line, which is interrupted above middle, apex of lower portion touching second line; a terminal row of light yellow-ochreous semi-oval spots, anteriorly blackish-margined: cilia pale whitish-ochreous, faintly barred with grey, with two interrupted lines, first dark fuscous, second grey. Hindwings $1\frac{1}{3}$, pale whitish-ochreous, faintly greyish; cilia ochreous-whitish, becoming pale yellow-ochreous towards base round apex.

A very distinct and elegant species, known by the whitish-ochreous colour and small round detached orbicular and claviform; the hindwings are narrower than usual.

Sydney, New South Wales, in April, on sandstone rock-faces, to which its colouring is adapted; two specimens.

* 5. *Scop. aphrodes*, n. sp.

Female.—15–17 mm. Head white, back of crown, a spot beneath each antenna, and a dot in middle of face black. Palpi $1\frac{2}{3}$, black, basal and terminal joints white. Antennæ dark grey. Thorax white, anterior margin irregularly black. Abdomen ochreous-white, apex more ochreous. Legs white, anterior and middle tibiæ and tarsi banded with black. Forewings rather elongate-triangular, costa slightly arched, apex rounded, hindmargin oblique, slightly rounded; clear ochreous-white; markings fuscous suffused with black, sharply defined; a fascia from base of costa to inner margin before first line, narrow on upper half, irregularly dilated on lower; a small spot on costa at $\frac{1}{5}$, and a sinuate erect mark on inner margin at $\frac{2}{5}$, indicating margins of first line; orbicular and claviform represented by a large irregularly trilobate spot, connected anteriorly with a small spot on costa at $\frac{1}{3}$; a small spot on costa slightly beyond middle; a small spot on inner margin beyond middle; reniform represented by an obtusely angulated linear mark, angle directed towards base; anterior margin of second line indicated on costa by a small mark; space between second line and hindmargin wholly blackish, except the irregular white subterminal line, which is broadly interrupted above middle; cilia white, with a basal row of dark fuscous spots. Hindwings $1\frac{1}{4}$, grey-whitish, hindmargin suffused with grey; cilia ochreous-whitish, with a grey line.

Immediately known by the strongly contrasted and sharply defined markings, and the fusion of orbicular and claviform into a single blotch.

Sydney, New South Wales, in October, on tree-trunks; three specimens.

* 6. *Scop. epicryma*, n. sp.

Male.—15 mm. Head and thorax white mixed with dark fuscous. Palpi 2, dark fuscous, basal joint and apex of other two joints white. Antennæ whitish, annulated with grey; ciliations $\frac{1}{2}$. Abdomen grey, anal tuft whitish-ochreous. Legs white, tibiæ and tarsi banded with dark fuscous. Forewings rather elongate, triangular, costa slightly arched, apex rounded, hindmargin oblique, slightly rounded; white, thinly sprinkled with blackish; markings composed of blackish scales, which become yellowish towards base; a small irregularly diffused basal patch; a small cloudy spot on costa before first line, and a larger subquadrate spot on inner margin; first line white, tolerably well defined, posteriorly dark-margined, slightly curved, somewhat indented, hardly oblique; orbicular small, round, blackish, not touching first line, claviform strong, linear, touching first line, both enclosed in a cloudy suffusion which extends to costa but not to inner margin; a small triangular blackish spot on costa immediately following first line, and another slightly beyond middle; reniform represented by a trifurcate mark; second line white, narrow, strongly dark-margined anteriorly; terminal space wholly dark, except the strongly dentate subterminal line, which is attenuated in middle, not touching second line: cilia ochreous-white, with two interrupted dark fuscous lines. Hindwings $1\frac{1}{4}$, very pale grey, hindmargin darker; a faint darker lunule and postmedian line; cilia ochreous-whitish, with an interrupted grey line.

Nearly allied to *S. exhibitalis*, but smaller, with the markings less sharply contrasted, and without the defined white and black markings of head and thorax.

Mount Gambier, South Australia, in November; one specimen on a tree-trunk.

* 7. *Scop. exhibitalis*, Walk.

(*Scoparia exhibitalis*, Walk., Suppl., 1500.)

Male, female.—17–19 mm. Head ochreous-white, back of crown and two confluent spots beneath antennæ black. Palpi 2, black, basal joint of labial and apex of maxillary palpi white. Antennæ blackish; ciliations $\frac{1}{3}$. Thorax ochreous-white, anterior third and a central quadrate spot black. Abdomen whitish-ochreous, segments suffused with grey towards base. Legs white, tibiæ and tarsi banded with black. Forewings rather elongate-triangular, costa gently arched, apex rounded, hindmargin obliquely rounded; ochreous-white, with a few scattered black scales; markings fuscous suffused with black; an irregular trifurcate mark from base of costa, touching a small spot on inner margin; a small spot on costa and a larger one on inner margin before first line; first line somewhat oblique, slightly curved, indented, posteriorly strongly dark-margined; a cloudy suffusion along costa from first line to a small triangular spot slightly beyond middle, and a stronger suffusion along inner margin from first to second line; orbicular round, black, light-centred; claviform dot-like, black, detached; both sometimes confluent; reniform represented by a linear trifurcate mark; second line strong, anteriorly dark-margined; terminal space wholly dark, except interrupted subterminal line, apex of lower portion touching second line: cilia white, with an interrupted blackish line, and posterior row of grey spots. Hindwings $1\frac{1}{3}$, grey-whitish, ochreous-tinged; a distinct central lunule, postmedian line, and cloudy suffusion towards apex and upper part of hindmargin grey; cilia ochreous-whitish, with an interrupted grey line.

Resembles *S. aphrodes* in the defined markings of the head, but larger, with the markings of the wings less clearly contrasted, and immediately separated by the dark suffusion of the inner margin between first and second lines.

Sydney, New South Wales, from August to October; five specimens, mostly at light.

* 8. *Scop. syntaracta*, n. sp.

Male, female.—20–21 mm. Head and thorax whitish, densely mixed with dark fuscous. Palpi $2\frac{3}{4}$, white, second and terminal joints with blackish basal bands. Antennæ grey, obscurely annulated with paler; ciliations $\frac{1}{2}$. Abdomen grey, segmental margins ochreous-white. Legs white, tarsi and tibiæ banded with blackish. Forewings rather elongate-triangular, costa slightly arched, apex rounded, hindmargin obliquely rounded; white, densely irrorated with black, sometimes partially suffused with light fuscous; several small black spots towards base; first line well-defined, somewhat curved, sharply indented, posteriorly strongly black-margined; orbicular moderate, circular, black, whitish-centred, almost touching first line; claviform quadrate, black, detached; reniform indistinct, irregularly 8-shaped, lower half elongate, whitish, partially black-margined, posteriorly strongly, touching a small blackish spot on costa beyond middle; second line well-defined, anteriorly black-margined; terminal space wholly dark, except rather broad distinct subterminal line, entire or shortly interrupted, not touching second line: cilia white, sharply barred with dark grey, bars partially obsolete on terminal half. Hindwings $1\frac{1}{4}$, whitish-grey, becoming fuscous-grey posteriorly, postmedian line faintly darker; cilia white, with a well-defined grey line.

This and the following species are characterized by the intensity of the irroration and markings, and especially by the subquadrate detached claviform.

Sydney, New South Wales, in September; Mount Wellington (1,000 feet), Tasmania, from December to February; four specimens.

* 9. *Scop. synapta*, n. sp.

Female.—16 mm. Head whitish, mixed with ochreous-brown and black. Palpi $2\frac{1}{2}$, whitish, second and terminal joints with blackish basal bands. Antennæ black. Thorax white, suffused on sides with ochreous-brown, with a small posterior, and large quadrate concave-sided central black spot. Abdomen dark-grey, segmental margins narrowly white. Legs white, tibiæ and tarsi banded with black. Forewings elongate-oblong, hardly dilated, costa almost straight, apex rounded, hindmargin obliquely rounded; white, sprinkled with ochreous-brown and black; basal space ochreous-brown irregularly suffused with black, cut by a narrow white transverse line midway between base and first line; first line narrow, hardly curved, slightly oblique, hardly indented, posteriorly broadly black-margined except in middle; orbicular moderate, round, black, white-centred, detached; claviform quadrate, black, detached; both enclosed in an ochreous-brown patch which is extended to inner margin and dilated beneath; an irregular black spot on costa slightly beyond middle; reniform 8-shaped, black, each half including a minute white dot; second line narrow, anteriorly black-margined, forming a small black spot on inner margin; terminal space black, except the rather broad cloudy white subterminal line, which is narrowly interrupted above middle, apex of lower portion touching second line: cilia obscurely barred with grey and whitish, with a dark fuscous basal line. Hindwings $1\frac{1}{4}$, grey, apex and hindmargin suffusedly darker; cilia grey-whitish, with a dark-grey basal and lighter median line.

Nearly allied to *S. syntaracta*, but distinguished by the much narrower wings, smaller size, greater concentration of the black colouring, and darker margin of hindwings.

Mount Wellington (3,200 feet), Tasmania, in December; one specimen.

* 10. *Scop. homala*, n. sp.

Male, female.—15–18 mm. Head, palpi, and thorax pale ochreous mixed with dark fuscous; palpi 2⅔, externally suffused with dark fuscous, basal joint white. Antennæ dark fuscous, obscurely annulated with ochreous; ciliations ½. Abdomen whitish-ochreous, sometimes irrorated with fuscous. Legs pale ochreous, irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings elongate-triangular, costa slightly arched, apex rounded, hindmargin obliquely rounded; whitish-ochreous, more or less densely and irregularly irrorated with black; black scales tending to form longitudinal streaks at base; first line whitish-ochreous, anteriorly broadly suffused, obscurely double, moderately curved, hardly indented, posteriorly black-margined; orbicular dot-like, blackish, detached; claviform small, suboblong, blackish, touching first line; reniform represented by an x-shaped black mark, separated from orbicular by a small oval clear whitish-ochreous spot; a small triangular blackish spot on costa beyond middle; second line well-defined, whitish-ochreous, anteriorly blackish-margined; terminal space wholly suffused with blackish, except well-defined rather broad whitish-ochreous subterminal line, not interrupted, touching second line in middle: cilia whitish-ochreous, barred with fuscous, with a blackish interrupted line. Hindwings 1¼, ochreous-grey-whitish, postmedian line and hindmarginal suffusion faintly greyer; cilia ochreous-whitish, with a grey line.

Immediately separated from the allied species by the whitish-ochreous ground colour.

Adelaide, South Australia, on fences in October; six specimens.

* 11. *Scop. eremitis*, n. sp.

Male, female.—18–21 mm. Head, palpi, and thorax whitish, densely mixed with dark fuscous; palpi 3. Antennæ grey; ciliations ½. Abdomen grey, segmental margins whitish. Legs dark fuscous irrorated with white, apex of joints white. Forewings rather elongate-triangular, costa slightly arched, apex rounded, hindmargin almost straight, oblique; fuscous-grey, irregularly sprinkled with white, veins obscurely lined with blackish; several small cloudy blackish spots towards base; first line narrow, whitish, ill-defined, posteriorly obscurely blackish-margined, moderately curved, somewhat indented; orbicular moderate, circular, outlined with black, detached; claviform smaller, round, almost wholly blackish, touching first line; reniform obscure, tolerably 8-shaped, obscurely blackish-margined;

second line white, tolerably well-defined, obscurely dark-margined; subterminal very ill-defined, cloudy, whitish, interrupted above middle, not touching second line: cilia ochreous-whitish, obscurely barred with grey, and with two grey lines. Hindwings $1\frac{1}{4}$, light grey, darker posteriorly; cilia whitish, with a well-defined grey line.

Compared with the neighbouring species a rather large and dull-coloured insect, with the lines more abruptly bent and angular than usual.

Wirrabara Forest, South Australia, in October; five specimens.

* 12. *Scop. perierga*, n. sp.

Male, female.—14–15 mm. Head, palpi, and thorax white, densely mixed with fuscous and black; palpi 3. Antennæ dark fuscous; ciliations $\frac{8}{5}$. Abdomen dark grey, segmental margins white. Legs white, irrorated with dark fuscous; tibiæ and tarsi clear white, sharply banded with black. Forewings triangular, costa slightly arched, apex rounded, hindmargin obliquely rounded; white, more or less wholly suffused with light greyish-fuscous or yellowish-fuscous, and irregularly irrorated with black; a short thick interrupted cloudy blackish streak from base of costa; first line indistinct, whitish, somewhat oblique, slightly curved, distinctly indented, margined posteriorly on costa and inner margin by triangular black spots; orbicular small, dot-like, blackish; claviform moderate, round, wholly black, detached; reniform x-shaped, blackish, upper fork generally filled obscurely with whitish, lower with ochreous, and connected with costa by a cloudy dark spot; second line tolerably distinct, white, anteriorly dark-margined; terminal space wholly dark, except moderate cloudy white subterminal line, interrupted above middle, apex of lower portion almost touching second line: cilia white, mixed and obscurely barred with grey, lower half spotted with dark fuscous. Hindwings $1\frac{1}{4}$, whitish-grey suffused with darker, apex and upper part of hindmargin suffused with dark fuscous, central lunule and postmedian line tolerably distinct; cilia grey-whitish, with a broad grey basal line.

A comparatively short-winged species, allied to *S. eremitis*, but much smaller and more distinctly marked, the dark markings much blacker.

Mount Wellington, Tasmania, from 3,000 to 3,800 feet, in December; rather common, sitting on the rocks and readily disturbed.

* 13. *Scop. gomphota*, n. sp.

Male.—15 mm. Head, palpi, and thorax grey, mixed with reddish-ochreous and black; palpi $2\frac{1}{4}$. Antennæ grey; ciliations $\frac{1}{2}$. Abdomen grey. Legs white, tibiæ and tarsi banded with dark grey. Forewings triangular, costa hardly arched, apex rounded, hindmargin straight, rather strongly oblique; fuscous-grey, with a few black and bluish-white scales; a small reddish-ochreous spot near base; first line not paler, curved, obscurely blackish-margined posteriorly; orbicular and claviform irregular, reddish-ochreous, partially black-margined, touching first line; reniform subquadrate, reddish-ochreous, anteriorly and posteriorly blackish-margined; second line not paler, anteriorly blackish-margined; terminal area rather densely irrorated with black, except subterminal line, touching second line in middle: cilia whitish-grey, with a broad interrupted dark grey line. Hindwings 1¼, grey, becoming darker on hindmargin; cilia grey-whitish, with a grey line.

A peculiar and distinct species, with hindmargin of forewings more oblique than usual.

Mount Wellington, Tasmania, (probably about 2,000 feet), in February; one specimen.

14. *Scop. oreas*, n. sp.

Male.—22 mm. Head and thorax whitish, strongly mixed with dark fuscous. Palpi 3¼, dark fuscous, apex and basal joint white. Antennæ pubescent, dark grey, ciliations 1. Abdomen whitish-grey, segmental margins whitish. Legs white, tibiæ and tarsi banded with blackish. Forewings very elongate, tolerably triangular, costa slightly arched, apex rounded, hindmargin obliquely rounded; white, somewhat mixed with pale grey, and rather thinly irrorated with dark fuscous; some obscure dark fuscous spots near base; first line white, very indistinct, somewhat curved, tolerably indented, posteriorly obscurely margined with dark fuscous; orbicular moderate, roundish, dark fuscous, detached; claviform moderate, broadly linear, dark fuscous, touching first line; reniform 8-shaped, whitish, margined with dark fuscous, upper and lower margins incomplete; second line white, indistinct, dilated to form spots on costa and inner margin, obscurely margined with dark fuscous; subterminal broad, white, ill-defined, narrowly interrupted above middle, apex of lower portion almost coalescing with second line; hindmargin dark fuscous, with a row of white dots: cilia white, with a sharply-defined dark fuscous line. Hindwings 1⅓, grey-whitish, apex hardly darker; cilia whitish.

Nearly allied to *S. philerga*, but readily distinguished by the longer and narrower forewings, and whitish hindwings, as well as the pubescence and longer ciliations of antennæ.

Lake Wakatipu, at 5,000 feet, in December; one specimen.

15. *Scop. philerga*, n. sp.

Male, female.—17–21 mm. Head and thorax whitish, mixed with fuscous, and irrorated with black. Palpi 2⅓, dark fuscous, somewhat mixed with white, basal joint white. Antennæ dark fuscous; ciliations ⅔. Abdomen light fuscous-grey, segmental margins ochreous-whitish. Legs ochreous-whitish, tibiæ and tarsi banded with dark fuscous. Forewings moderately elongate, triangular, costa gently arched, apex rounded, hindmargin oblique, faintly sinuate; white, mixed with grey, and coarsely irrorated with black; a thick interrupted obscure blackish streak from base of costa; first line white, obscure, somewhat curved, sharply indented, posteriorly blackish-margined; orbicular round, whitish, blackish-margined; claviform roundish, moderate or large, blackish, often suffused, tolerably detached; reniform 8-shaped, white, blackish-margined, connected with a small blackish triangular spot on costa; second line white, tolerably distinct, anteriorly dark-margined; terminal space wholly dark, except moderate tolerably defined subterminal line, entire or interrupted, touching second line in middle; a hindmarginal row of white dots: cilia whitish, obscurely barred with grey, with an interrupted blackish and posterior grey line. Hindwings $1\frac{1}{4}$, pale whitish-grey, slightly ochreous-tinged, in female rather greyer, postmedian line and hindmargin obscurely darker grey; cilia whitish, with a grey line spotted with darker.

A dull, obscure-looking species, but with the reniform very clearly defined.

Auckland, Hamilton, Christchurch, Nelson, Otira River, Dunedin, and Lake Wakatipu; common in forest, in December, January, March, and April. Near Lake Wakatipu I took one specimen at an elevation of 4,000 feet.

16. *Scop. chlamydota*, n. sp.

Male, female.—13–14 mm. Head, palpi, and thorax whitish-ochreous suffused with black; palpi 2. Antennæ greyish-ochreous; ciliations $\frac{1}{2}$. Abdomen ochreous-whitish. Legs ochreous-white, tibiæ and tarsi banded with dark fuscous. Forewings triangular, costa slightly arched, apex rounded, hindmargin straight, oblique; ochreous-whitish; basal half, bounded by a line parallel to hindmargin, suffused with blackish, except on an oval ochreous spot near middle of base; a moderately broad fascia-like reddish-ochreous suffusion rather beyond and parallel to posterior edge of blackish patch; an irregular reddish-ochreous suffusion towards middle of hindmargin; a rather small triangular blackish spot on costa before apex, and some blackish scales on anal angle: cilia ochreous-whitish, mixed with reddish ochreous beneath and blackish above apex. Hindwings $1\frac{1}{4}$, whitish; postmedian line and apical suffusion faintly grey; cilia whitish.

A peculiar and very distinct species.

Arthur's Pass (3,000 feet), in January; three specimens.

17. *Scop. minusculalis*, Walk.

(*Scoparia minusculalis*, Walk., Suppl., 1503.)

Male, female.—17–19 mm. Head, palpi, and thorax ochreous-fuscous, mixed with whitish-ochreous and dark fuscous; palpi $2\frac{1}{2}$, basal joint white.

Antennæ fuscous; ciliations $\frac{2}{3}$. Abdomen ochreous-whitish, more ochreous near base. Legs white, tibiæ and tarsi banded with dark fuscous. Forewings rather elongate, triangular, costa gently arched, apex rounded, hindmargin rather oblique, distinctly sinuate; white; basal half wholly purplish-fuscous, mixed with reddish-ochreous and irrorated with black, bounded by an inwards-curved line from $\frac{3}{5}$ of costa to $\frac{3}{5}$ of inner margin; indications of a blackish streak from base of costa; first line indicated only by thick black posterior margin, rather strongly indented; orbicular round, black, sometimes centred with ochreous or ochreous-whitish; claviform triangular, black, detached; reniform almost obsolete, pale whitish-ochreous, faintly grey-margined; second line distinct, white, anteriorly margined with dark grey; terminal space wholly fuscous-grey or dark grey, except broad tolerably defined white subterminal line, broadly interrupted, apex of lower portion confluent with second line and margined above by a yellow-ochreous blotch; a hindmarginal row of cloudy white dots: cilia white, obscurely barred with grey, with a dark grey often interrupted line, and lighter posterior line. Hindwings $1\frac{1}{4}$, very pale whitish-grey, slightly ochreous-tinged, postmedian line and hindmargin somewhat darker; cilia whitish, with a grey somewhat interrupted line.

This and the two following species are easily recognized by the yellow-ochreous blotch above lower portion of subterminal line; *S. minusculalis* differs from the other two by its larger size, well-defined white postmedian band, and uniform dark suffusion of the whole anterior half of wing.

Larva rather stout, cylindrical, wrinkled, somewhat attenuated towards extremities; light whitish-brown; spots large, round, brassy-fuscous, each containing a black dot; head ochreous-brown; second segment dark fuscous. Feeds in moss on tree-trunks; pupa in same position; taken in January, almost full-grown.

Akaroa, Bealey River (2,100 feet), and Dunedin; tolerably common in forest in January and February.

18. *Scop. minualis*, Walk.

(*Scoparia minualis*, Walk., Suppl., 1504.)

Male, female.—$15\frac{1}{2}$–17 mm. Head and thorax clear pale whitish-ochreous, with a few fuscous scales, shoulders with a small dark fuscous spot. Palpi $2\frac{1}{2}$–3, ochreous-whitish, somewhat mixed with dark fuscous, base white. Antennæ whitish, annulated with dark fuscous; ciliations $\frac{2}{3}$. Abdomen ochreous-whitish. Legs whitish, tibiæ and tarsi banded with dark fuscous. Forewings somewhat elongate, triangular, costa gently arched, apex rounded, hindmargin rather oblique, distinctly sinuate; whitish-ochreous, mixed with pale yellowish, and thinly irrorated with dark fuscous; basal area mixed with black, with a suffused black streak from base of costa, interrupted by a white mark; first line white, tolerably distinct, hardly indented, near inner margin bent more obliquely outwards, posteriorly narrowly black-margined; a large quadrilateral blotch on costa suffused with dark fuscous, bounded anteriorly by first line, beneath by submedian fold, posteriorly by a straight line passing through anterior edge of reniform parallel to hindmargin; orbicular small, round, black, claviform elongate-oval, black, both tolerably detached but obscured by dark suffusion; reniform 8-shaped, clear white, black-margined, incompletely beneath; a cloudy white subquadrate costal spot before second line, touching reniform, and space between reniform and second line generally white mixed with grey; second line white, distinct, anteriorly blackish-margined; terminal space suffused with dark fuscous except towards anal angle; subterminal line broad, interrupted, lower portion white, edged with pale ochreous above, almost touching second line, upper portion clear whitish-ochreous; an irregular white hindmarginal line: cilia pale whitish-ochreous, with a dark fuscous interrupted and posterior grey line. Hindwings $1\frac{1}{4}$, very pale whitish-grey, postmedian line and hindmargin obscurely darker; cilia whitish, with basal row of cloudy grey spots.

Characterized by the concentration of the dark suffusion into a costal blotch; differing from *S. minusculalis* by the distinct white first line, from *S. chimeria* by the white costal spot before second line.

Christchurch, Bealey River (2,100 feet), and Otira Gorge (1,600 feet), amongst forest in January; eight specimens.

19. *Scop. chimeria*, n. sp.

Male, female.—14–$16\frac{1}{2}$ mm. Head and thorax grey-whitish, mixed with ochreous, dark fuscous and black. Palpi $2\frac{1}{2}$, dark fuscous mixed with whitish, basal joint white. Antennæ dark fuscous; ciliations $\frac{1}{3}$. Abdomen grey. Legs ochreous white, tibiæ and tarsi banded with black. Forewings triangular, costa gently arched, apex rounded, hindmargin distinctly sinuate, oblique; whitish, irregularly suffused with grey, and irrorated with black; a short interrupted black streak from base of costa, and a spot on inner margin near base; first line whitish, ill-defined, curved, hardly indented, posteriorly broadly black-margined, except in middle; orbicular somewhat wedge-shaped, black, touching first line; claviform similar, but often obscured by dark suffusion; veins in disc obscurely lined with yellow-ochreous; reniform 8-shaped, whitish, blackish-margined, connected with costa by a small triangular blackish spot; second line whitish, slender, indistinct, almost straight, anteriorly black-margined; terminal space wholly dark, except well-defined subterminal line, which is reduced to a double white subapical spot, and a curved white bar from middle of second line to hindmargin above anal angle, broadly margined above with ochreous-yellow; a terminal row of white semioval spots: cilia whitish, obscurely barred with grey, with a dark grey interrupted line. Hindwings $1\frac{1}{4}$, whitish-grey, postmedian line and hindmargin obscurely darker grey; cilia grey-whitish, with a dark grey line.

A dull-looking species, yet very easily recognized.

Taranaki, Palmerston, Masterton, Christchurch, Akaroa, Dunedin, and Lake Wakatipu, not met with above 1,000 feet; common in forest from December to March.

20. *Scop. dinodes*, n. sp.

Male.—17 mm. Head and thorax rather dark fuscous, somewhat mixed with whitish. Palpi 2, dark grey, basal joint white. Antennæ dark fuscous; ciliations $\frac{1}{4}$. Abdomen whitish-grey. Legs white, tibiæ and tarsi banded with black. Forewings triangular, costa gently arched, apex rounded, hindmargin nearly straight, oblique; white, densely irrorated with dark fuscous; basal area suffusedly spotted with black; first line hardly whitish, very obscure, posteriorly black-margined, curved, hardly indented; orbicular and claviform small, roundish, obscure, black, detached; a rather broad clear white transverse space before second line, of even width except on inner margin, where it is contracted; reniform included in this, 8-shaped, white, black-margined; second line slender, obscure, white, anteriorly dark-margined, somewhat curved, hardly sinuate; subterminal line narrow, white, distinct, interrupted above middle, not touching second line; a hindmarginal row of white dots: cilia grey, with a dark grey line. Hindwings $1\frac{1}{4}$, whitish-grey, lunule and postmedian line obscurely indicated, hindmargin darker grey; cilia whitish, with a dark grey line.

Allied to the three preceding, but without the ochreous blotch, and specially characterized by the remarkably short antennal ciliations.

Christchurch and Dunedin, in January; two specimens.

21. *Scop. acharis*, n. sp.

Male.—$17\frac{1}{2}$ mm. Head and thorax whitish-ochreous, shoulders dark fuscous mixed with black. Palpi $2\frac{1}{4}$, ochreous-whitish, second and terminal joints with dark fuscous basal bands, basal joint white. Antennæ whitish-ochreous, ringed with dark fuscous; joints short, subdentate, ciliations 1. Abdomen whitish-ochreous, irrorated with fuscous. Legs ochreous-whitish, irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings triangular, costa gently arched, apex rounded, hindmargin rather obliquely rounded; whitish-ochreous, scantily irrorated with fuscous and dark fuscous; a sharply defined oblique black spot from base of costa, inner edge straight, outer irregular; first line indicated only by obscure dark posterior margin, slightly curved, somewhat indented, followed on costa by a sharply-defined moderate triangular black spot; orbicular round, pale, broadly black-margined, touching apex of costal spot; claviform round, upper half margined with black, lower half obsolete, detached; a very small dark fuscous spot on costa beyond middle, between which and first line the costa is narrowly suffused with fuscous; reniform large, double, shaped like two adjacent figures of 8, both irregularly black-margined, adjacent margins confluent; second line pale, anteriorly dark-margined, forming a very small blackish spot on costa; terminal space suffused with brownish-ochreous; subterminal line cloudy, ochreous-whitish, somewhat interrupted, not touching second line; hindmargin suffusedly blackish, with a row of ochreous-whitish marks: cilia pale whitish-ochreous, with a well-defined dark grey line and very faint grey posterior line. Hindwings $1\frac{1}{4}$, very pale whitish grey, central lunule obscurely indicated, postmedian line and a narrow hindmarginal suffusion distinct, darker grey; cilia ochreous-whitish, with a distinct grey line.

A distinct species, characterized by the sharply defined black costal markings, double reniform, and relatively long antennal ciliations.

Akaroa and Dunedin, amongst forest, in January; two specimens.

22. *Scop. cymatias*, n. sp.

Male, female.—21–22 mm. Head and thorax fuscous-grey, irrorated with white. Palpi $2\frac{1}{4}$, dark fuscous, somewhat mixed with white, basal joint white. Antennæ grey; ciliations $\frac{2}{3}$. Abdomen light grey, segmental margins whitish. Legs whitish, irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings rather elongate, triangular, costa gently arched, apex obtuse, hindmargin oblique, distinctly sinuate; fuscous grey, densely mixed with white and irrorated with black; some very obscure small dark spots towards base; first line very obscure, white, somewhat curved and indented, posteriorly slightly dark-margined beneath, on costal third margined by an oblique oblong blackish streak which conceals orbicular; claviform small, roundish, blackish, detached; reniform 8-shaped, whitish, obscurely black-margined, connected with a small dark suffusion on costa; second line whitish, ill-defined, finely dentate throughout, hardly sinuate, anteriorly slightly dark-margined, forming a small blackish spot on costa; subterminal cloudy, whitish, finely dentate, interrupted above middle, apex of lower portion touching second line; an obscure hindmarginal row of whitish marks: cilia whitish, with a dark fuscous interrupted subbasal, and grey posterior line. Hindwings $1\frac{1}{3}$, very pale whitish-grey, slightly ochreous-tinged, central lunule indistinct, post-median line and a slender hindmarginal suffusion distinctly darker grey; cilia whitish, with a dark grey line, slightly interrupted.

A very obscure species, best indicated by the fine dentation of the second and subterminal lines.

Arthur's Pass (2,500 feet) and Mount Hutt, in January; three specimens.

23. *Scop. microphthalma*, n. sp.

Male.—15–16 mm. Head, palpi, and thorax blackish-grey, irrorated with white; palpi $2\frac{1}{4}$, basal joint white; thorax with a small posterior ochreous-yellow spot. Antennæ dark grey; ciliations $\frac{1}{2}$. Abdomen fuscous-grey. Legs dark fuscous, irrorated with white, apex of joints white. Forewings triangular, costa slightly arched, apex rounded, hindmargin slightly rounded, rather oblique; blackish, finely irrorated with white; a small ochreous-yellow spot near base, followed by a faint whitish transverse line; first line whitish, slender, ill-defined, slightly curved, posteriorly indistinctly dark-margined; orbicular and claviform both circular, ochreous-yellow, dark-margined, touching first line; reniform 8-shaped, ochreous-yellow, black-margined, each half containing a white dot, the lower one larger; a small ill-defined whitish costal spot above reniform; second line whitish, ill-defined, obscurely dark-margined, touching similar subterminal line in middle: cilia whitish, with two cloudy dark grey lines, and obscurely barred with grey. Hindwings $1\frac{1}{3}$, fuscous-grey, becoming darker posteriorly; cilia grey, with a darker line, tips whitish.

Easily recognized by the ochreous-yellow spots, and white dots in reniform.

Christchurch in March, and Lake Wakatipu (1,000 feet) in December, amongst bush; two specimens.

24. *Scop. hemicycla*, n. sp.

Female.—17 mm. Head and thorax ochreous-fuscous. Palpi $2\frac{3}{4}$, dark fuscous mixed with white, basal joint white. Antennæ dark fuscous. Abdomen grey, terminal segment very elongate, ovipositor long. Legs grey irrorated with whitish. Forewings elongate-oblong, slightly dilated, costa hardly arched, apex obtuse, hindmargin rather oblique, slightly rounded; fuscous, with scattered pale ochreous-yellowish scales; a cloudy blackish spot on inner margin near base, above which is a line of whitish scales; a longitudinal median black streak from base to $\frac{1}{3}$; a strong semicircular black streak from costa at $\frac{1}{3}$, passing through middle of disc and returning to costa at $\frac{2}{3}$, obscurely margined beneath with whitish, the included space also irrorated with whitish; subterminal line indicated by a few whitish scales: cilia whitish-fuscous with two cloudy darker lines, tips whitish. Hindwings $1\frac{1}{2}$, fuscous-grey, becoming dark fuscous towards hindmargin; cilia as in forewings.

Conspicuously distinct by the semicircular black streak excluding central third of costa.

Arthur's Pass (3,000 feet) in January; one specimen.

25. *Scop. ergatis*, n. sp.

Female.—13–17 mm. Head, palpi, and thorax fuscous or fuscous-grey, slightly mixed with grey-whitish; palpi 2½, basal joint white. Antennæ dark fuscous. Abdomen light grey. Legs whitish, irrorated with fuscous. Forewings elongate, tolerably oblong, costa almost straight, apex obtuse, hindmargin straight, rather oblique; light fuscous, thinly and irregularly irrorated with whitish and darker fuscous; first line obscurely whitish, posteriorly rather broadly and suffusedly dark-margined, strongly curved; orbicular and claviform obsolete; reniform subquadrate, cloudy, dark fuscous; second line whitish, anteriorly dark-margined, rectilinear, obtusely angulated above middle; subterminal line obsolete: cilia light fuscous mixed with whitish. Hindwings 1½, light grey or fuscous-grey, rather darker posteriorly; cilia fuscous-whitish, with a fuscous basal line.

Allied to *S. hemicycla*, which it resembles in form, but quite differently marked.

Castle Hill (3,000 feet), on grassy slopes in January; two specimens.

26. *Scop. critica*, n. sp.

Male, female.—13–15½ mm. Head and thorax black, irregularly mixed with white, and with a few yellow scales. Palpi 2½, black, apex and basal joint white. Antennæ blackish, in male pubescent; ciliations 1. Abdomen dark fuscous-grey. Legs white, irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings elongate, somewhat triangular, costa hardly arched, apex rounded, hindmargin obliquely rounded; fuscous-grey, mixed with blackish, median space irregularly irrorated with white; main veins and some posterior branches streaked with ochreous-yellow; a white streak from first line near costa to near inner margin at ⅙, connected with middle of base by a white line; first line rather strong, white, scarcely indented but angulated below middle, posteriorly blackish-margined, forming an oblique suboblong black spot on costa, which includes orbicular; claviform broadly linear, black, touching first line; reniform 8-shaped, black-margined but incompletely beneath, upper half clear white, lower obscure, ochreous-yellow, connected with costa by a dark spot; second line distinct, white, anteriorly dark-margined; terminal space wholly dark, except cloudy white subterminal line, which is interrupted above middle, not touching second line: cilia fuscous-grey, with a dark fuscous line, tips spotted with white. Hindwings 1⅓, rather dark fuscous-grey, becoming darker posteriorly; cilia grey, with a dark grey line, tips whitish.

Readily recognized by the intensity of marking, yellowish streaks on veins, reniform half white and half yellow, angulated first line, and pubescent antennæ of male.

Arthur's Pass (3,000 feet, and one specimen at 1,500), in January; common.

* 27. *Scop. anaplecta*, n. sp.

Male, female.—$14\frac{1}{2}$–$15\frac{1}{2}$ mm. Head dark fuscous, with a longitudinal whitish-ochreous streak on crown. Palpi $2\frac{2}{3}$, dark fuscous, apex of maxillary white, basal joint of labial ochreous-white. Antennæ dark fuscous, in male pubescent; ciliations $\frac{2}{3}$. Thorax fuscous, irrorated with black, slightly mixed with whitish-ochreous. Abdomen fuscous-grey, segmental margins whitish-ochreous. Legs yellowish-white, tibiæ and tarsi banded with dark fuscous. Forewings triangular, costa slightly arched, apex rounded, hindmargin rounded, rather strongly oblique; purplish-grey, densely irrorated with black; an elongate pale whitish-ochreous spot on inner margin, extending from near base to first line; first line well-defined, ochreous-whitish, rather curved, moderately indented; orbicular small, round, black, touching first line; claviform somewhat larger, roundish, black, tolerably detached; reniform represented by a cloudy black wedge-shaped mark, margined above with some yellow-whitish scales; an ochreous-white suffusion towards middle of inner margin; second line well-defined, ochreous-whitish, near inner margin rather sharply angulated inwards; subterminal line ochreous-whitish, in female broad, hardly interrupted, almost touching second line, in male reduced to several small spots: cilia ochreous-whitish, with a dark grey interrupted basal and faint posterior line. Hindwings $1\frac{1}{6}$, ochreous-whitish, with a few grey scales, lunule and postmedian line obscurely indicated, a rather broad hindmarginal band suffusedly dark fuscous; cilia as in forewings.

This and the following species have the hindwings proportionately narrower than in any other of the genus, and are characterized by the yellowish tint of their pale markings; *S. anaplecta* especially also by the pale dorsal spots, and the ochreous-whitish dark-margined hindwings.

Mount Wellington, Tasmania, at 3,200 feet, in December; two specimens.

* 28. *Scop. spelæa*, n. sp.

Male, female.—9–12 mm. Head pale yellow, with a dark fuscous streak across crown. Palpi $2\frac{1}{2}$, dark fuscous, apex and basal joint whitish-yellow. Antennæ whitish-yellow, annulated with dark fuscous; ciliations $\frac{2}{3}$. Thorax whitish-yellow, a central spot and one on each shoulder blackish. Abdomen dark fuscous-grey. Legs whitish-yellow, banded with dark fuscous. Forewings triangular, costa almost straight, apex rounded, hindmargin obliquely rounded; rather dark fuscous, irrorated with blackish; a pale yellow streak from middle of base to $\frac{1}{4}$ of inner margin; a pale yellow dot on costa near base; first line sharply defined, pale yellow, regularly curved, not indented; orbicular and claviform absent; a cloudy pale yellow spot above middle of inner margin; reniform narrow, pale yellow, sometimes touching second line beneath; second line strong, pale yellow, almost straight, somewhat sinuate inwards below middle; subterminal line narrow, indistinct, pale yellow, hardly interrupted, not touching second line: cilia with basal third dark grey, remainder whitish-yellowish, with a grey posterior line. Hindwings hardly over 1, fuscous-grey, becoming dark fuscous towards hindmargin; cilia grey-whitish, with two cloudy grey lines.

The smallest species of the genus known to me, not to be confused with any other.

Sydney, New South Wales; Fernshaw, Victoria; Hobart, Evandale, and Deloraine, Tasmania; Wirrabara Forest and Mount Gambier, South Australia; from August to December, and in March, common in damp sheltered places, especially under wet and overhanging rock-faces.

29. *Scop. characta*, n. sp.

Male, female.—14–17 mm. Head light ochreous-yellow. Palpi 2½, dark fuscous, mixed with yellowish above, basal joint yellowish-white. Antennæ pale yellowish; ciliations ½. Thorax whitish-ochreous mixed with dark fuscous, with a blackish spot on shoulder. Abdomen whitish-ochreous, sometimes irrorated with grey. Legs yellowish-white, tibiæ and tarsi banded with dark fuscous. Forewings triangular, costa gently arched, apex rounded, hindmargin oblique, distinctly sinuate; light fuscous, densely irrorated with dark fuscous; inner margin whitish-ochreous towards base, margined above with black; an obscure ochreous-whitish transverse line between first line and base; first line yellow-whitish, slender, tolerably distinct, somewhat curved, slightly indented, posteriorly blackish-margined, followed on costa by a small triangular blackish spot; orbicular suboval, cloudy, black, almost touching first line; claviform represented by a triangular cloudy black spot extending from first to second lines, margined above with yellow-whitish, posteriorly confluent with apex of a rather broad yellow-whitish inwardly oblique straight streak from costa at ⅗, which is separated from second line by a blackish shade; a straight light yellow-ochreous streak in disc between orbicular and claviform, extending from first to second lines, terminating in a yellow-whitish dot which represents lower half of reniform; second line almost wholly obsolete, faintly indicated on costa; subterminal line very ill-defined, narrow, yellow-whitish, hardly interrupted, remote from second line: cilia ochreous-whitish, barred with fuscous, with two dark fuscous lines. Hindwings 1¼, very pale whitish-grey, slightly ochreous-tinged; central lunule, postmedian line, and hindmargin darker grey, distinct; cilia whitish, with two grey lines.

A distinct species, easily recognized by the peculiar discal markings.

Palmerston, Makatoku, Christchurch, Akaroa, and Dunedin, amongst forest, in February and March; eight specimens.

30. *Scop. ustimacula*, Feld.

(*Scoparia ustimacula*, Feld., Reis. Nov., pl. cxxxv., 17; *Scoparia conifera*, Butl., Cist. Ent., ii., 493.)

Male.—21 mm. Head and thorax ochreous, mixed with white, reddish-fuscous, and black; patagia margined with white. Palpi 2½, ochreous-fuscous, basal joint white. Antennæ fuscous; ciliations 1½. Abdomen light grey. Legs ochreous-white, tibiæ and tarsi banded with black. Forewings rather elongate, triangular, costa gently arched, apex rounded, hind-margin somewhat sinuate, oblique; rather bright ochreous; costa and inner margin irrorated with black and white; base suffused with dark fuscous; a slender obscure whitish line near before first line; first line slender, white, posteriorly irregularly black-margined, not curved, rather oblique, thrice sinuate; a broad fascia-like oblique blackish streak from costa immediately beyond first line, white-margined, reaching submedian fold, apex rounded; a similar inwardly oblique broad streak from costa beyond middle, reaching middle of disc, broadly bifurcate at apex, anterior branch almost coalescing with first streak; second line slender, white, margined anteriorly on costa, submedian fold, and inner margin by three small blackish spots; terminal space somewhat suffused with dark fuscous, tending to form streaks on veins; subterminal line cloudy, whitish, almost marginal throughout; a terminal row of white dots: cilia grey-whitish, with dark grey anterior and lighter posterior lines. Hindwings 1⅓, whitish-grey; central lunule, postmedian line, and hindmargin darker grey; cilia as in forewings.

Also a very distinct and handsome species, characterized by the two conspicuous black fasciæ from costa to disc, and unusually long antennal ciliations, the longest in the genus. Butler's description is hardly recognizable, but is intended for this species, as I have seen his type in the British Museum.

Castle Hill (Mr. J. D. Enys) and Dunedin (Mr. A. Purdie), probably amongst bush; I have not met with the species myself; three specimens.

31. *Scop. pongalis*, Feld.

(*Scoparia pongalis*, Feld., Reis. Nov., pl. cxxxvii., 33.)

Male, female.—15–19 mm. Head, antennæ, and thorax whitish-grey, slightly ochreous-tinged, shoulders narrowly black; antennal ciliations ½. Palpi 3, dark fuscous, apex and basal joint whitish. Abdomen ochreous-whitish. Legs grey-whitish, tibiæ and tarsi somewhat suffused with darker grey. Forewings somewhat elongate, triangular, costa slightly arched, apex obtuse, hindmargin rather oblique, faintly sinuate; pale whitish-grey, slightly ochreous-tinged, with a few scattered grey and black scales; first line only indicated by a short cloudy blackish oblique streak from inner margin; costa black from base to beyond middle, at first very narrowly, but shortly dilating to form a triangular sharply-defined patch, of which apex is in middle of disc; claviform dot-like, black, or sometimes obsolete; reniform 8-shaped, obscurely outlined with blackish; second line not paler, but distinctly dark-margined, somewhat bent but hardly sinuate; a row of black dots immediately before hindmargin; cilia grey-whitish, with a grey basal line. Hindwings $1\frac{1}{4}$, in male whitish, in female very pale whitish-grey; postmedian line and hindmargin very faintly greyer; cilia whitish, with a faint grey line.

Very distinct by the peculiar black costal marking. Felder's figure is very coarse, but indicates this correctly.

Makatoku and Dunedin, amongst forest, in March; five specimens.

32. *Scop. melanægis*, n. sp.

Male, female.—22–23 mm. Head and thorax ochreous mixed with whitish, shoulders suffused with dark fuscous. Palpi $2\frac{1}{4}$, dark fuscous, apex whitish, basal joint white. Antennæ grey. Abdomen ochreous-grey-whitish. Legs white irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings elongate, triangular, costa slightly arched, apex rounded, hindmargin slightly sinuate, oblique; pale fuscous, very densely irrorated with black; a whitish streak from base to inner margin at $\frac{1}{5}$, beneath which the black suffusion is obsolete; an obscure dentate irregular whitish transverse line a little before first line, between which and first line the ground colour is mixed with pale yellow; first line slender, white, almost straight, oblique, not reaching inner margin, but continued near and parallel to it to meet second line, which is also narrow, sharply defined, and does not reach inner margin; reniform somewhat 8-shaped, narrow, clear white; space included between a straight line passing through anterior edge of reniform and blackish margin of second line suffused with white; inner margin from before first line to anal angle suffused with pale yellow; veins in terminal space more or less indicated with yellowish; subterminal line cloudy whitish, rather broad, obscurely interrupted, hardly touching second line; a waved white hindmarginal line; cilia whitish, basal third barred with dark grey, with a grey posterior line. Hindwings $1\frac{1}{3}$, very pale whitish-grey, faintly ochreous-tinged; postmedian line and hindmargin obscurely darker grey; cilia white, with a grey line.

The blackish suffusion appears to form a very large blotch on costa beyond first line, nearly reaching to inner margin; this distinguishes the species from all others.

Arthur's Pass (1,700 to 2,600 feet) and Lake Wakatipu (4,200 feet), frequenting rocks in sheltered situations or amongst bush, in December and January; rather common.

33. *Scop. trapezophora*, n. sp.

Female.—21 mm. Head and thorax whitish-ochreous, mixed with whitish. Palpi $2\frac{1}{4}$, whitish-ochreous mixed with fuscous, basal joint white. Antennæ whitish. Abdomen ochreous-whitish. Legs ochreous-whitish, unicolorous. Forewings elongate, narrow, somewhat triangular, costa hardly arched, apex obtuse, hindmargin very faintly sinuate, oblique; pale whitish-ochreous; an oblong very oblique blackish spot from base of costa, reaching more than half across wing; a large sharply defined quadrilateral blackish blotch, extending along costa from $\frac{1}{5}$ to $\frac{3}{5}$, reaching only half across wing, anterior edge parallel to oblique spot, lower edge parallel to inner margin, posterior edge forming a right angle with lower edge; inner margin broadly suffused with whitish from $\frac{1}{4}$ to anal angle; reniform white, anteriorly touching costal blotch, posteriorly ill-defined; space between costal blotch and second line suffused with whitish; second line distinct, white, dark-margined, obsolete below costal blotch; terminal space irrorated with dark fuscous, especially towards costa; subterminal line cloudy whitish, obscure, not touching second line: cilia whitish, with a dark fuscous line. Hindwings $1\frac{2}{3}$, grey-whitish; postmedian line and hindmargin faintly darker; cilia whitish.

Allied to *S. melanægis*, but much narrower-winged (though the male may probably not differ so much in this respect); immediately separated by the very different form of the black costal blotch, which does not pass downwards beyond middle of wing, and therefore appears very much more compressed longitudinally.

Castle Hill (3,000 feet), in January; one specimen.

34. *Scop. philetaera*, n. sp.

Male.—19 mm. Head white, somewhat mixed with fuscous. Palpi 3, dark fuscous mixed with whitish, basal joint white. Antennæ white, annulated with grey; ciliations $\frac{1}{2}$. Thorax white, mixed with black on back and suffusedly spotted with black on shoulders. Abdomen grey-whitish. Legs whitish, tibiæ and tarsi banded with dark fuscous. Forewings triangular, costa slightly arched, apex obtuse, hindmargin oblique, slightly sinuate; white, irregularly mixed with light grey, with a few fine scattered black scales; a suffused blackish spot on costa at base; first line strong, white, blackish-margined, somewhat curved, hardly indented, bent more obliquely outwards on inner margin, followed by a cloudy blackish triangular spot on costa; costa dark fuscous from first line to $\frac{3}{5}$, a rather darker grey suffusion extending from this to reniform and claviform; orbicular small, round, obscure, black-margined; claviform elongate, cloudy, black, touching first line; reniform 8-shaped, black-margined, upper half grey, lower clear white; second line strong, whitish, anteriorly dark-margined, forming a small blackish spot on costa; terminal space grey, veins suffused with black; subterminal line cloudy, whitish, somewhat interrupted, not touching second line: cilia whitish, with two dark grey lines. Hindwings $1\frac{1}{4}$, very pale whitish-grey, lunule, postmedian line, and hindmargin hardly darker; cilia whitish, with two grey lines.

Of somewhat doubtful affinity; recognizable by the rather broad distinct lines, dark suffusion towards costa, and clear white lower half of reniform.

Bealey River, amongst forest (2,100 feet), in January; one specimen.

35. *Scop. periphanes*, n. sp.

Male.—20 mm. Head and thorax whitish mixed with ochreous-grey, shoulders narrowly blackish. Palpi 3, dark fuscous mixed with whitish, basal joint white. Antennæ grey-whitish; ciliations $\frac{1}{2}$. Abdomen grey-whitish. Legs whitish, tibiæ and tarsi banded with dark fuscous. Forewings somewhat elongate, triangular, costa hardly arched, apex rounded, hindmargin sinuate, rather oblique; grey, slightly brownish-tinged; a thick black very oblique streak from base of costa, not reaching inner margin, irregularly bifurcate, upper branch touching first line; first line distinct, rather strong, almost straight, oblique, white, posteriorly strongly and evenly black-margined; spots all obsolete; second line sharply defined, white, finely blackish-margined, preceded by a rather broad whitish space; subterminal line distinct, white, interrupted above middle, apex of lower portion touching second line, the two triangular blotches enclosed between second and subterminal lines suffused with black, apex of upper blotch connected with middle of hindmargin by a blackish streak; a hindmarginal row of cloudy confluent black dots: cilia whitish, with two dark grey lines. Hindwings $1\frac{1}{3}$, very pale whitish-grey, postmedian line and hindmargin suffusedly darker grey; cilia as in forewings.

A sharply marked species, conspicuously distinct by the straight first line, and absence of all the discal spots.

Lake Wakatipu, in January (Mr. R. W. Fereday); two specimens.

36. *Scop. diphtheralis*, Walk.

(*Scoparia diphtheralis*, Walk., Suppl., 1501.)

Male, female.—23–26 mm. Head pale ochreous, face black. Palpi $2\frac{1}{4}$, black, mixed with white, basal joint white. Antennæ black, beneath ochreous-whitish. Thorax white, anterior half, a square central spot, and posterior extremity suffused with black. Abdomen whitish-ochreous, slightly irrorated with grey, segmental margins more ochreous towards base. Legs white, thinly sprinkled with black, tibiæ and tarsi banded with black. Forewings elongate, triangular, costa hardly arched, apex rounded, hindmargin sinuate, slightly oblique; white, irregularly irrorated with black scales which are ochreous at their base; a triangular blackish spot on costa at base, apex extended to form a smaller spot, but not quite reaching inner margin; inner margin beneath this whitish-ochreous; a broad cloudy white line near first line, more or less confluent with it above; first line broad, cloudy, white, oblique, hardly curved, rather irregular, posteriorly blackish-margined, forming a cloudy triangular blackish spot towards costa; a pale ochreous-yellowish streak along submedian fold from basal spot to anal blotch; orbicular roundish, whitish-ochreous, broadly b ack-margined, detached; claviform small, oblique, black, sometimes pale-centred, detached; reniform 8-shaped, whitish-ochreous, black-margined, connected with costa by a small blackish spot, between which and second line is a whitish suffusion; space between orbicular and reniform, and between reniform and second line, clothed with peculiarly appressed brassy prismatic scales, appearing as though transparent; second line broad, white, blackish-margined; terminal space wholly suffused with black; subterminal line broad, white, more or less pale ochreous-yellowish on veins, generally interrupted above middle, apex of lower portion touching second line; a hindmarginal row of white dots: cilia grey, with two darker lines, basal third slightly barred with whitish, tips whitish. Hindwings 1½, whitish-ochreous, partially irrorated with grey; lunule, postmedian line, and a tolerably defined hindmarginal band rather dark grey; cilia ochreous-whitish, with two dark grey lines.

A fine species, differing from all others by the peculiar prismatic spots preceding and following reniform.

Hamilton, Palmerston, Napier, Wellington, Christchurch, and Otira Gorge, from December to March, usually near forest; common where it occurs, but I have never taken it except at lamps, and always females only; I have seen one male, taken by Mr. R. W. Fereday, and perhaps sixty females.

37. *Scop. submarginalis*, Walk.

(*Hypochalcia submarginalis*, Walk., 48; *Nephopteryx maoriella*, ib., Suppl., 1720.)

Male, female.—21–25 mm. Head and thorax whitish, mixed with pale ochreous, densely irrorated with grey or dark fuscous. Palpi 3, dark fuscous mixed with whitish, basal joint white. Antennæ grey; ciliations ½. Abdomen ochreous-whitish suffused with grey, more ochreous towards base. Legs whitish irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings elongate, triangular, costa hardly arched, apex obtuse, hindmargin very faintly sinuate, rather oblique; ochreous or ochreous-brown, more or less densely irrorated with black, and sprinkled irregularly with whitish; a short obscure blackish line from base of costa; a cloudy whitish line near before and partially confluent with first line, sometimes obsolete; first line white, cloudy, posteriorly black-margined, somewhat curved, irregular, bent outwards on inner margin; orbicular roundish, not pale, finely black-margined, separated from reniform by a round black-margined spot, somewhat paler and more whitish than ground colour; claviform roundish, cloudy, black, detached; reniform 8-shaped, not pale, black-margined; often a clear whitish or ochreous streak from claviform along submedian fold to second line; sometimes a rather broad dark fuscous streak above submedian fold from first to second lines; second line rather narrow, white, dark-margined, generally suffused with ochreous towards submedian fold, rather abruptly bent above middle; subterminal line broad, very cloudy and indistinct, whitish, interrupted, generally touching second line; a waved whitish hindmarginal line: cilia pale greyish, with a dark fuscous interrupted line, basal and terminal thirds obscurely barred with whitish. Hindwings $1\frac{1}{2}$, whitish-ochreous irrorated with grey; lunule and postmedian line very indistinctly darker; a tolerably well-defined dark fuscous hindmarginal band; cilia whitish, with a dark grey line.

A variable species, but generally distinguishable from its nearest allies by the irregular dark suffusion of the forewings, and the ochreous tinge and dark marginal band of the hindwings.

Cambridge, Palmerston, Wellington, Christchurch, Castle Hill, Mount Hutt, and Lake Wakatipu, probably universally distributed at low levels, from November to March, on rock-faces, fences, etc.; generally abundant.

38. *Scop. cataxesta*, n. sp.

Male, female.—23–27 mm. Head and thorax dark slaty-grey, somewhat mixed with grey-whitish. Palpi $2\frac{1}{3}$, dark fuscous, slightly mixed with whitish, basal joint white. Antennæ dark grey, ciliations $\frac{2}{3}$. Abdomen whitish-grey. Legs white, irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings very elongate, triangular, costa hardly arched, apex rounded, hindmargin almost straight, slightly oblique; rather dark slaty-grey, with an indigo-bluish tinge (strong in very fresh specimens), with fine scattered grey-whitish scales, the coalescence of which forms obscure first and second lines; first line hardly curved, moderately indented; second line tolerably distinct on costa and inner margin; orbicular faintly perceptible as a slightly darker suffusion; reniform 8-shaped, slightly darker, lower or sometimes both halves centred with whitish; subterminal line obscurely indicated, interrupted, not touching second line: cilia slaty-grey, tips paler. Hindwings $1\frac{3}{5}$, whitish-grey; postmedian line faintly indicated; a narrow hindmarginal band suffusedly darker grey; cilia white, with a grey line.

Very obsoletely marked; distinguished from all by the peculiar dark bluish-grey colouring, adapted for concealment on the bare slaty rocks of the mountain-range, which it exactly resembles. The same tint recurs with the same habits in several species of other groups.

Otira Gorge, Castle Hill, Lake Guyon, and Lake Wakatipu, in January and February, from 1,500 to 3,000 feet; always on bare shingle, usually in the bed of a mountain stream, but sometimes also in a road-way, flying a short distance close to the ground and quickly settling again; common where it occurs.

39. *Scop. tetracycla*, n. sp.

Female.—25 mm. Head, palpi, and thorax grey, densely irrorated with white; palpi 3, basal joint white. Antennæ grey. Abdomen pale grey, suffused with pale ochreous towards base. Legs white irrorated with fuscous, tibiæ and tarsi banded with dark fuscous. Forewings very elongate, somewhat triangular, costa straight, apex obtuse, hindmargin straight, slightly oblique; ochreous-grey, densely irrorated with whitish; lines obsolete; orbicular and claviform both round, whitish, black-margined; reniform 8-shaped, unusually oblique, whitish, obscurely black-margined: cilia ochreous-grey mixed with whitish, with an obscure darker line. Hindwings $1\frac{3}{5}$, pale fuscous-grey, hindmargin suffusedly darker; cilia whitish, with a fuscous line.

Characterized by the obsolescence of the usual lines, whilst the spots are all distinctly indicated, round, dark-margined.

Christchurch and Lake Coleridge, in March; two specimens.

40. *Scop. indistinctalis*, Walk.

(*Hypochalcia indistinctalis*, Walk., 48; *Scoparia rakaiensis*, Knaggs, Ent. Mo. Mag., iv., 80.)

Male, female.—23–25 mm. Head and thorax white, densely irrorated with dark grey. Palpi 3, dark grey mixed with white, basal joint white. Antennæ dark grey, obscurely annulated with white; ciliations $\frac{1}{3}$. Abdomen whitish-ochreous, suffused with grey. Legs white, irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings very elongate, tolerably triangular, costa gently arched, apex rounded, hindmargin slightly sinuate, rather oblique; white, very finely irrorated with blackish or dark fuscous; indications of a white line before first line; first line indistinct, white, posteriorly blackish-margined, rectangularly bent above middle, near inner margin turned more obliquely outwards; orbicular obliquely oval, hardly indicated except by two or three blackish marginal dots; claviform small, oval, blackish-margined; reniform 8-shaped, oblique, obscurely blackish-margined; second line white, tolerably distinct, obscurely dark-margined; terminal space suffused with blackish towards anal angle; subterminal line broad, cloudy, whitish, interrupted, both portions touching second line; a row of blackish dots on veins before hindmargin: cilia whitish, with two blackish-grey lines. Hindwings $1\frac{2}{3}$, pale whitish-ochreous, suffused with light greyish; lunule and postmedian line obscurely darker; a moderately broad suffused dark fuscous hindmarginal band; cilia white, with a dark grey line.

Allied to *S. submarginalis*, but much lighter and greyer, with the dark suffusion confined to the anal angle, and always separable by the quite different form of the rather sharply angulated first line.

Wellington, Christchurch, and Lake Wakatipu (1,000 feet), from December to February, on rocks and fences; rather common.

41. *Scop. chalicodes*, n. sp.

Male, female.—$15\frac{1}{2}$–$16\frac{1}{2}$ mm. Head and thorax whitish irrorated with grey, with a short black stripe on each side of thorax from anterior margin. Palpi $2\frac{2}{3}$, dark fuscous, apex and basal joint white. Antennæ whitish-grey, ciliations $\frac{2}{3}$. Abdomen grey-whitish. Legs white, tibiæ and tarsi banded with dark fuscous. Forewings very elongate-triangular, narrow, costa almost straight, apex obtuse, hindmargin very obliquely rounded; light ochreous-grey, densely irrorated with white; veins irregularly and partially lined with blackish; first line faintly perceptible, curved; orbicular moderate, pale greyish-ochreous, obscurely dark-margined, touching first line; claviform small, cloudy, dark fuscous, touching first line; reniform obscurely 8-shaped, pale greyish-ochreous, partially dark-margined; all spots sometimes very obscure; a small blackish spot on costa beyond middle; second line very obscure, indented beneath costa, angulated above middle; terminal space darker, subterminal line cloudy, whitish, touching second line, very obscure beneath: cilia whitish, with dark fuscous anterior and grey posterior line. Hindwings $1\frac{1}{2}$, grey-whitish, apex hardly darker; cilia white, with a faint grey line.

Characterized by the comparatively small size, narrow pale forewings, dark veins, and wholly whitish hindwings.

Wanganui, Napier, Christchurch, and Mount Hutt, from January to March; six specimens.

42. *Scop. leptalea*, n. sp.

Male, female.—16–19 mm. Head, palpi, and thorax greyish-ochreous or grey, mixed with whitish; palpi 3, basal joint white. Antennæ grey, in male stout, dentate, ciliations $\frac{2}{3}$. Abdomen whitish-ochreous, suffused with pale grey. Legs white, irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings very elongate, narrow but variable, somewhat triangular, costa slightly arched, apex rounded, hindmargin obliquely rounded; whitish-ochreous or ochreous-grey, suffusedly irrorated with dark fuscous or black, and densely irrorated with whitish; markings variable in distinctness, sometimes almost wholly obsolete; first line white, very oblique, almost straight, indented above middle, posteriorly dark-margined; orbicular somewhat annular, almost wholly obsolete; claviform dot-like, blackish, usually distinct; reniform 8-shaped, oblique, obscurely dark-margined, indistinct; second line white, dark-margined; terminal space generally darker, especially towards anal angle; subterminal line very obscure, whitish, touching second line, not interrupted: cilia whitish, with a grey line. Hindwings 1¾, whitish-grey, postmedian line obscurely darker, hindmargin suffused with darker grey; cilia as in forewings.

Easily known by the narrow forewings, very oblique first line, and usually distinct blackish dot-like claviform.

Hamilton, Napier, Masterton, and Christchurch, in sandy grassy places or at lamps, from January to March, tolerably common.

43. *Scop. psammitis*, n. sp.

Male, female.—21–27 mm. Quite similar to *S. leptalea*, but antennæ of male slender, filiform, ciliations 1; orbicular tolerably distinct, partially outlined with blackish.

This species so closely resembles *S. leptalea*, except in the considerably larger size, that it would probably pass for a local variety, but the structural difference in the antennæ of the male must be taken to warrant specific separation. The forewings are perhaps even somewhat narrower proportionately, and the claviform usually more conspicuous.

Arthur's Pass, on grassy slopes at 4,500 feet, in January; three specimens (2 male, 1 female). A more ochreous-tinged female from near Dunedin is probably also referable to this species.

44. *Scop. epicomia*, n. sp.

Male, female.—18–19 mm. Head, palpi, antennæ, and thorax reddish-ochreous-brown; palpi 4, towards base white beneath. Antennal ciliations ½. Abdomen ochreous-whitish, tinged with grey. Legs white, tarsi and anterior tibiæ banded with dark fuscous. Forewings triangular, narrow at base, costa almost straight, posteriorly moderately arched, apex rounded, hindmargin slightly sinuate, oblique; light ochreous-grey; basal third reddish-ochreous-brown, terminated by first line; first line straight, slender, white, not oblique, followed by a narrow dark reddish-brown fascia edged with black posteriorly and suffused with black on inner margin; median space irrorated with white, wholly suffused with white posteriorly; reniform small, linear, transverse, reddish-ochreous; a small triangular reddish-ochreous black-margined spot on costa beyond middle; second line slender, whitish, anteriorly dark-margined; terminal space greyish-ochreous, irrorated with blackish, subterminal line obscure, whitish, suffused into hindmargin: cilia ochreous-whitish, with an interrupted dark fuscous line. Hindwings 1¼, pale whitish-grey; lunule, postmedian line, and hind-marginal band light grey; cilia grey-whitish, with dark grey dots on veins.

Conspicuously distinct, and of doubtful affinity, but perhaps allied to *S. feredayi*; the straight perpendicular dark reddish-brown fascia beyond first line is a peculiar feature.

Arthur's Pass (2,600 feet), and Dunedin, amongst bush in January; four specimens.

45. *Scop. feredayi*, Knaggs.

(*Scoparia feredayi*, Knaggs, Ent. Mo. Mag., iv., 80; *Scoparia moanalis*, Feld., Reis. Nov., pl. cxxxvii., 34.)

Male, female.—18–21 mm. Head, palpi, and thorax reddish-ochreous-brown: palpi $2\frac{3}{4}$, basal joint white. Antennæ grey; ciliations $\frac{2}{3}$. Abdomen whitish-ochreous. Legs white, banded with ochreous-brown. Forewings triangular, costa almost straight, apex obtuse, hindmargin almost straight, oblique; reddish-ochreous, densely irrorated with dark reddish-brown; first line very obscurely whitish, posteriorly suffusedly dark-margined, not oblique, angulated above middle; orbicular and claviform small, roundish, very obscurely darker, touching first line; reniform very obscure, somewhat 8-shaped, suffusedly darker; second line white, distinct, anteriorly suffusedly dark-margined, upper sinuation slight, lower angular; terminal space wholly irrorated with white, except sometimes towards costa and narrowly along hindmargin: cilia grey-whitish, base white, with a reddish-fuscous anterior and grey posterior line. Hindwings $1\frac{1}{3}$, very pale whitish-grey, ochreous-tinged, postmedian line and hindmarginal band very suffusedly darker grey; cilia white, with a faint grey line.

Also a very distinct species, immediately known by the reddish-ochreous colour, with whitish lines and posterior irroration. As Butler has quoted the name as a synonym of *S. submarginalis*, it may be worth while stating that there is not the least resemblance between the two species.

Eketahuna, Wellington, Bealey River (2,100 feet), Castle Hill (2,500 feet), Lake Guyon, and Lake Wakatipu, amongst bush from January to March, not common; eight specimens.

46. *Scop. acompa*, n. sp.

Male.—$17\frac{1}{2}$–19 mm. Head, antennæ, and thorax ochreous-fuscous, shoulders suffusedly dark fuscous; antennæ deeply dentate, ciliations $\frac{2}{3}$. Palpi 3, ochreous-fuscous irrorated with blackish, internally and on basal joint white. Abdomen whitish-ochreous. Legs whitish-ochreous, irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings triangular, costa gently arched, apex round-pointed, hindmargin almost straight, oblique; ochreous-fuscous; base irrorated with dark fuscous; first line very slender, obscure, whitish, posteriorly finely blackish-margined, not oblique, somewhat curved, sinuate inwards above inner margin; space between first and second lines fuscous, irrorated with dark fuscous, with a few pale scales; orbicular and claviform both round, ochreous-brown, obscurely blackish-margined, touching first line; reniform 8-shaped, white, suffusedly blackish-margined; second line very slender, obscure, whitish, anteriorly finely blackish-margined, rather abruptly curved above middle; subterminal obsolete; a slender interrupted white hindmarginal line: cilia ochreous-whitish, with two dark grey lines. Hindwings $1\frac{1}{3}$, whitish-grey; lunule, postmedian line and a hindmarginal line darker grey, distinct; cilia whitish, with a dark grey interrupted line.

Apparently allied to *S. feredayi*, but very distinct by the ochreous-fuscous ground colour, fine black margins of lines, and well-defined white reniform.

Lake Wakatipu, at 1,200 feet, in December; two specimens.

* 47. *Scop. acropola*, n sp.

Male.—25–28 mm. Head, palpi, antennæ, and thorax ochreous-fuscous; palpi 4, white towards base beneath. Antennal ciliations 1. Abdomen very pale whitish ochreous. Legs white irrorated with fuscous, tibiæ and tarsi suffused with dark fuscous. Forewings elongate, triangular, moderately broad, costa gently arched, apex rounded, hindmargin straight, oblique; light ochreous-fuscous, finely irrorated with dark reddish-fuscous, with a few whitish scales; first line not pale, indicated only by suffused dark posterior margin, somewhat curved, oblique; orbicular rather large, oval, somewhat whitish, obscurely dark-margined, touching first line; claviform obsolete; reniform 8-shaped, somewhat whitish or not pale, obscurely dark-margined; orbicular and reniform connected by a very elongate, hardly pale, obscurely dark-margined spot; second line hardly pale, anteriorly suffusedly dark-margined, almost rectilinear, sharply angulated above middle; subterminal obsolete; a hindmarginal row of cloudy dark fuscous dots: cilia ochreous-whitish, with two fuscous-grey lines. Hindwings $1\frac{1}{2}$, ochreous-grey-whitish; postmedian line very faintly indicated; cilia white, base ochreous-tinged.

Allied to *S. cleodoralis*, but much larger, and differing in the longer palpi, much longer ciliations of antennæ, defined orbicular, sharp angulation of second line, and other characters.

Mount Wellington, Tasmania, amongst rocky scrub at 3,000 feet in December; apparently very local, being confined to a small patch of ground in which it was common, and readily disturbed from the herbage.

* 48. *Scop. cleodoralis*, Walk.

(*Scopula cleodoralis*, Walk., Pyr., 793.)

Male, female.—18–21 mm. Head and thorax light ochreous-brownish, slightly mixed with whitish. Palpi $3\frac{1}{4}$, dark fuscous, slightly mixed with whitish, apex of maxillary and basal joint of labial white. Antennæ grey, ciliations $\frac{1}{2}$. Abdomen ochreous-whitish. Legs whitish, anterior and middle pair suffused with dark fuscous. Forewings elongate-triangular, costa slightly arched, apex obtuse, hindmargin obliquely rounded; light ochreous-brownish, with a few irregularly-scattered white scales, veins more or less suffused with dark fuscous; first line slender, whitish, posteriorly obscurely dark-margined, somewhat curved, not oblique; orbicular and claviform obsolete; reniform 8-shaped, indistinct, somewhat whitish, obscurely dark-margined; second line slender, whitish, obscurely dark-margined, sinuations very slight; subterminal very indistinct, cloudy, whitish; a row of cloudy dark fuscous dots before hindmargin: cilia ochreous-whitish, with two dark grey lines. Hindwings 1½, very pale whitish-grey; postmedian line and hindmargin hardly darker; cilia whitish, with a grey line.

An indistinct-looking species, yet hardly to be confused with any other.

Blackheath (3,500 feet), New South Wales; Mount Macedon and Fernshaw, Victoria; Deloraine and Mount Wellington (to 3,100 feet), Tasmania; amongst forest, from November to February, tolerably common.

49. *Scop. manganeutis*, n. sp.

Male.—17–18 mm. Head and thorax white, mixed with grey and irrorated with black. Palpi 2½, dark fuscous, mixed with white, basal joint white. Antennæ grey, sharply serrate, ciliations 1. Abdomen pale grey. Legs whitish, tibiæ and tarsi banded with black. Forewings elongate, somewhat triangular, costa slightly arched, apex obtuse, hindmargin rather strongly oblique, slightly indented above middle, rounded beneath; light grey, irregularly mixed with white and irrorated with black; first line strong, distinct, white, rather curved, moderately indented in middle and again above inner margin, posteriorly suffusedly dark-margined; orbicular dot-like, faint, whitish, claviform small, cloudy, blackish, both obscured by suffusion; reniform 8-shaped, whitish, dark-margined, tolerably distinct; second line whitish, tolerably distinct, dark-margined; subterminal cloudy, whitish, dentate, interrupted above middle, apex of lower portion confluent with second line; a hindmarginal row of obscure whitish dots: cilia whitish, basal third barred with dark fuscous, with a posterior grey line. Hindwings 1½, whitish-grey; postmedian line faintly indicated, hindmargin narrowly grey; cilia whitish, with an interrupted grey line.

Characterized by the relatively small size, elongate forewings, strong white dentate first line, and the peculiarly serrate and strongly ciliated antennæ.

Otira Gorge, 1,600 to 2,600 feet, in January; two specimens.

50. *Scop. crypsinoa*, n. sp.

Male.—23–24 mm. Head white. Palpi 2½, dark fuscous, apex of maxillary and basal joint of labial white. Antennæ grey; ciliations ½. Thorax fuscous-grey irrorated with whitish, with a white anterior spot.

Abdomen ochreous-whitish. Legs whitish, anterior and middle pair suffused with dark fuscous. Forewings very elongate, narrow, triangular, costa almost straight, apex obtuse, hindmargin very faintly sinuate, oblique; light ochreous-grey, irrorated with white, veins slenderly but irregularly marked with blackish; first line obscure, whitish, posteriorly suffusedly dark-margined, moderately curved, not oblique, somewhat indented; orbicular very small, linear, blackish, detached; claviform moderate, linear, black, detached; reniform represented by a black x-shaped mark, lower fork filled with white; second line broad, cloudy, whitish, anteriorly suffusedly dark-margined, somewhat angulated above middle; subterminal very indistinct, whitish, not touching second line; a hindmarginal row of cloudy blackish dots: cilia grey-whitish, with two fuscous-grey lines. Hindwings $1\frac{1}{2}$, grey-whitish; cilia whitish, with a faint grey line.

Allied to *S. axena*, but readily recognized by the narrower forewings and distinct lines.

Lake Wakatipu (3,000 feet), and Castle Hill (3,000 feet), in December and January; two specimens.

51. *Scop. axena*, n. sp.

Male.—24–26 mm. Head and thorax greyish-fuscous, slightly mixed with whitish. Palpi 3, dark fuscous, apex of maxillary and basal joint of labial white. Antennæ dark grey; ciliations $\frac{1}{2}$. Abdomen whitish-grey, somewhat suffused with ochreous. Legs pale grey, tarsi darker, posterior pair whitish. Forewings elongate-triangular, costa slightly arched, apex rounded, hindmargin slightly rounded, oblique; dull fuscous-grey, irrorated with whitish towards costa and hindmargin; lines hardly perceptible, slightly whitish, faintly dark-margined internally, first line curved, rather irregular, second line preceded by a row of short linear obscure dark fuscous marks on veins; orbicular and claviform represented by small obscure dark fuscous suffusions, detached; reniform by an obscure dark fuscous x-shaped mark, lower fork sometimes filled with whitish: cilia whitish, with two grey lines. Hindwings $1\frac{1}{3}$, grey-whitish; cilia white.

Closely allied to *S. paltomacha*, but separable by the larger size; broader forewings, and absence of the distinct blackish lines on veins.

Arthur's Pass, on grassy slopes at 4,500 feet, in January; three specimens.

52. *Scop. steropæa*, n. sp.

Male, female.—13–16 mm. Head white. Palpi 3, fuscous, apex and basal joint white. Antennæ dark grey, ciliations $\frac{3}{4}$. Thorax fuscous, with a blackish central and white anterior spot. Abdomen grey-whitish. Legs whitish, tibiæ and tarsi banded with dark fuscous. Forewings elongate-triangular, costa very slightly arched, apex round-pointed, hindmargin sinuate, very oblique; pale fuscous, irrorated with darker; a small blackish spot at base of inner margin; a straight rather irregular black streak from base to somewhat before middle of disc, almost meeting a triangular blackish blotch, of which the apex is directed downwards, placed in disc beyond middle, its posterior side bounded by second line; dorsal half of wing below these black markings wholly white, sharply defined above, slightly suffused with greyish beneath; first line faintly indicated by angulated darker posterior margin; two short oblique cloudy dark fuscous streaks in disc, terminating in triangular blotch; second line white, indistinct towards costa, obsolete in dorsal suffusion, rectilinear, very obtusely angulated above middle, very slightly sinuate near costa; upper half of subterminal line forming a whitish triangular blotch, suffusedly margined beneath with black, apex touching angle of second line, lower half merged in dorsal suffusion; a hindmarginal row of black dots: cilia whitish, with two grey lines. Hindwings $1\frac{1}{2}$, grey-whitish, hindmargin faintly suffused with darker; cilia white, with a grey line.

Nearly allied to *S. exilis*, but easily distinguished by the smaller size, well-defined white dorsal suffusion, strong black streak from base, black triangular blotch beyond middle, straighter second line, and black triangular spot on middle of hindmargin.

Castle Hill, amongst grass in a swampy place at 2,500 feet, flying freely towards dusk, in January; common.

53. *Scop. exilis*, Knaggs.

(*Scoparia exilis*, Knaggs, Ent. Mo. Mag., iv., 81.)

Male.—18–20 mm.; *female.*—16 mm. Head white. Palpi $3–3\frac{1}{4}$, dark fuscous, apex and basal joint white. Antennæ grey; ciliations $\frac{3}{4}$. Thorax fuscous, with a white anterior spot. Abdomen whitish-grey, segmental margins white. Legs white irrorated with fuscous, anterior and middle pair suffused with dark fuscous. Forewings very elongate, narrow, triangular, costa straight, apex rounded, hindmargin almost straight, very oblique; pale greyish-ochreous, irregularly irrorated with white; veins obscurely lined with blackish; costal edge narrowly suffused with blackish; first line very obscure, whitish, posteriorly slightly dark-margined, angulated in middle, not oblique; orbicular obsolete; claviform moderately large, elongate, black, conspicuous; reniform obsolete on upper half, lower half round, white, partially finely black-margined; second line tolerably distinct, white, anteriorly irregularly blackish-margined except towards inner margin, angularly indented beneath costa, very shortly angulated above middle, slightly indented near inner margin; subterminal broad, cloudy, white, not interrupted, almost touching second line; a hindmarginal row of cloudy almost confluent blackish dots: cilia white, with two dark grey lines. Hindwings $1\frac{2}{3}$, very pale whitish-grey, slightly ochreous-tinged; postmedian line and hindmargin suffusedly darker; cilia white, with a faint grey line.

Especially recognizable by the conspicuous dark claviform, and termination of dark margin of second line before inner margin, but the inner margin is not white as in *S. steropæa.*

Christchurch and Lake Wakatipu (1,200 feet), on dry grassy hill slopes, in October, December, and April; six specimens.

54. *Scop. elaphra*, n. sp.

Male, female.—12–14 mm. Head and thorax pale ochreous mixed with whitish, shoulders narrowly suffused with dark fuscous. Palpi $4\frac{1}{2}$, dark fuscous, white above and beneath. Antennæ whitish-ochreous; in male joints serrate with apical teeth only, ciliations 1. Abdomen grey-whitish. Legs white, anterior pair suffused with dark fuscous. Forewings very elongate, narrow, triangular, costa straight, apex round-pointed, hindmargin slightly sinuate, very oblique; pale brownish-ochreous, irregularly irrorated with white on veins, and generally with scattered dark fuscous scales; base of costa rather suffused with dark fuscous; some blackish scales on submedian fold before first line; first line hardly whitish, posteriorly margined with dark fuscous, rather strongly curved; orbicular small, linear, black, touching first line; claviform smaller, similar, generally indistinct; reniform dot-like, blackish; second line obscurely whitish, anteriorly dark-margined, somewhat curved above middle, otherwise straight; a row of blackish dots on hindmargin; cilia whitish, with two fuscous-grey lines. Hindwings $1\frac{1}{3}$, grey-whitish; lunule, postmedian line and hindmargin grey; cilia white.

Distinguished by its small size, sharply triangular wings, and fragile appearance, with very simple markings; the palpi here attain their greatest length.

Palmerston (Wanganui), and Christchurch, chiefly at lamps, in March; seven specimens.

55. *Scop. paltomacha*, n. sp.

Male.—22–24 mm.; *female.*—17 mm. Head whitish, sometimes mixed with greyish-ochreous. Palpi 3, dark grey, apex of maxillary and basal joint of labial white. Antennæ grey; ciliations $\frac{2}{3}$. Thorax fuscous-grey, slightly mixed with whitish, with a whitish anterior spot. Abdomen whitish-grey. Legs whitish, tibiæ and tarsi suffused with grey. Forewings very elongate, triangular, costa almost straight, apex round-pointed, hindmargin straight, oblique; light fuscous, irregularly irrorated with whitish; veins distinctly lined with blackish; a whitish dot in disc beyond middle, margined above with blackish: cilia whitish, with two fuscous-grey lines. Hindwings $1\frac{2}{3}$, grey-whitish; cilia white, with a light grey line.

Easily recognized by the dark veins and white discal dot, without other marking.

Mount Hutt and Castle Hill (2,500 feet), on grassy slopes, in January; six specimens.

56. *Scop. deltophora*, n. sp.

Male.—21–23 mm.; *female.*—16 mm. Head and thorax light ochreous-grey, sides of head whitish. Palpi $3\frac{1}{4}$, ochreous-grey, white above and on basal joint. Antennæ grey; ciliations 1. Abdomen grey-whitish. Legs grey-whitish, anterior pair grey. Forewings elongate, triangular; costa almost straight, apex round-pointed, hindmargin somewhat sinuate, oblique; light greyish-ochreous, suffusedly irrorated with whitish, especially towards costa; sometimes a few scattered black scales; first line obsolete; reniform represented by a minutely trifurcate black dot, connected with a short black longitudinal line in middle of disc; second line obscurely whitish, not dark-margined, somewhat bowed; veins posteriorly obscurely darker; a hindmarginal row of black dots: cilia whitish, with two light ochreous-grey lines. Hindwings $1\frac{2}{5}$, grey-whitish; cilia white.

Allied to *S. paltomacha*; characterized by the short black discal line, and posterior black dot.

Arthur's Pass, on grassy slopes at from 3,000 to 4,200 feet, in January; common.

57. *Scop. sabulosella*, Walk.

(*Crambus sabulosellus*, Walk., 178.)

Male, female.—20–22 mm. Head, palpi, antennæ, and thorax ochreous-fuscous, thorax sometimes mixed with dark fuscous; palpi $3\frac{1}{2}$, basal joint white; antennal ciliations $\frac{2}{3}$. Abdomen ochreous-whitish. Legs whitish-ochreous, anterior and middle pair somewhat darker. Forewings very elongate, triangular, costa almost straight, apex round-pointed, hindmargin sinuate, oblique; pale greyish-ochreous, irrorated with white along costa and on dorsal half, sometimes with scattered black scales; veins sometimes obscurely lined with blackish, in female sometimes strongly and suffusedly; a suffused blackish streak from base along submedian fold to middle; orbicular dot-like, black, reniform also very small, subquadrate, black, often connected together by a cloudy dark fuscous streak; a row of distinct black dots before hindmargin: cilia ochreous-whitish, with two light-grey lines. Hindwings $1\frac{1}{2}$, grey-whitish, ochreous-tinged, in female becoming greyer posteriorly; cilia white.

Somewhat variable in respect of the dark suffusion, but always distinguishable by the pale ochreous ground-colour, two black discal dots, and suffused indistinct basal streak.

Hamilton, Wellington, Christchurch, Dunedin, Lake Wakatipu, and Invercargill, probably generally distributed, on dry grassy slopes in December and January; very common. Butler has identified a Chilian species with this; I cannot vouch for the identification.

58. *Scop. panopla*, n. sp.

Male.—31 mm.; *female.*—25 mm. Head and thorax pale ochreous, mixed with whitish-ochreous, with a dark ochreous-fuscous stripe from eye along inner edge of patagia to extremity. Palpi 2½–3, ochreous-fuscous, mixed with dark fuscous, above and on basal joint white. Antennæ whitish-ochreous; ciliations ½. Abdomen whitish-ochreous. Legs light ochreous. Forewings elongate-triangular, costa straight, apex rounded, hindmargin oblique, somewhat sinuate; brownish-ochreous, suffusedly irrorated with white on a broad streak along costa, a broad sinuate streak from middle of disc to hindmargin beneath apex, and less distinctly along inner margin; a narrow black streak from base along submedian fold to middle; a blackish slightly curved linear streak from above extremity of this to reniform, which is represented by a short oblique blackish mark; veins between apex and anal angle posteriorly marked with blackish streaks, except on white suffusion, not reaching hindmargin except at apex; a hindmarginal row of blackish dots: cilia whitish, with two fuscous lines. Hindwings 1⅔, grey-whitish, with a rather narrow hindmarginal band somewhat darker; cilia white.

Separated from its allies by its large size, and somewhat curved irregular discal streak, which is not placed to form a continuation of the basal streak; the female is more strongly and sharply marked than the male.

Mount Hutt, in January; several specimens taken by Mr. R. W. Fereday.

59. *Scop. trivirgata*, Feld.

(*Crambus trivirgatus*, Feld., Reis. Nov., pl. cxxxvii., 29.)

Male, *female.*—16–23 mm. Head and thorax whitish-ochreous, often becoming white above, with a blackish-fuscous stripe from eye along inner edge of patagia to extremity. Palpi 4, whitish-ochreous, mixed with dark fuscous, apex of maxillary and basal joint of labial white. Antennæ dark grey; ciliations ¾. Abdomen whitish-ochreous. Legs ochreous-whitish. Forewings very elongate, triangular, in female sometimes very narrow, costa straight, apex round-pointed, hindmargin sinuate, oblique or very oblique; whitish-ochreous, veins obscurely lined with white; a moderate straight blackish-fuscous median streak from base to apex, interrupted by a very oblique narrow bar before middle, and more or less attenuated at ¾; a blackish-fuscous longitudinal wedge-shaped mark above anal angle, not quite touching hindmargin; above this are sometimes one or two very short blackish-fuscous lines on veins; generally a hindmarginal row of cloudy blackish dots: cilia ochreous-whitish, mixed with white, with two pale grey lines. Hindwings $1\frac{1}{2}$, in male grey-whitish, with a grey lunule; in female whitish-grey, becoming darker grey posteriorly, with a darker lunule; cilia white, in female with a grey line.

Conspicuously characterized by the sharply-defined interrupted blackish streak from base to apex.

Christchurch and Lake Wakatipu, on dry grassy hill-slopes, in December, February and March; tolerably common.

* 3. Tetraprosopus, Butl.

Forehead vertical. Ocelli present. Tongue well-developed. Antennæ moderate, $\frac{2}{3}$ of forewings, in male filiform, hardly perceptibly ciliated ($\frac{1}{6}$). Labial palpi rather long, straight, porrected, second joint beneath with dense projecting tuft, terminal joint moderately long, exposed. Maxillary palpi rather long, triangularly dilated. Posterior tibiæ with outer spurs half inner. Abdomen moderate. Forewings with vein 11 rather oblique. Hindwings almost twice as broad as forewings; 3 remote from 4, 4 and 5 stalked; lower median naked; discal area above it furnished with long hairs, continued almost to hindmargin; internal area loosely haired.

Differs from *Xeroscopa* only by the approximate obsolescence of the antennal ciliations. But the extension of the discal hairs of the hindwings almost to the hindmargin is only found also in *X. philonephes*, of which the male is unknown, and it is possible that that species should be referred to this genus, in which case there would be an additional point of distinction.

Butler's characters for this genus do not suffice to separate it from *Scoparia.*

* 60. *Tetr. meyrickii*, Butl.

(*Tetraprosopus meyrickii*, Butl., Ann. Mag. Nat. Hist., 1882, 97.)

Male, female.—24–25 mm. Head and thorax greyish-fuscous, or reddish-ochreous-brown, often mixed with whitish, sometimes with a blackish-fuscous lateral stripe from eye to extremity of patagia. Palpi $2\frac{1}{2}$, dark fuscous, mixed with white above, basal joint white. Antennæ dark fuscous. Abdomen light ochreous-grey. Legs whitish, anterior and middle pair suffused with dark fuscous. Forewings elongate-oblong, narrow, hardly dilated, narrow, costa almost straight, apex obtuse, hindmargin straight, rather oblique; greyish-fuscous or ochreous-fuscous, irrorated irregularly with whitish and darker fuscous; first line very obsoletely indicated, strongly angulated above middle; sometimes an irregular blackish streak from base along submedian fold to first line, often obsolete; a dark fuscous or blackish streak, variable in intensity, from angle of first line to position of reniform, interrupted in middle except on lower margin by an oblique oblong pale or whitish spot; claviform small, linear, blackish, often indistinct; second line whitish, generally distinct, interrupting veins which are more or less distinctly lined with blackish posteriorly, rectilinear, sharply indented below costa and sharply angulated above middle; subterminal line cloudy, whitish, suffused into hindmargin, interrupted above middle; a hindmarginal row of blackish dots: cilia grey-whitish, with two dark fuscous lines. Hindwings pale ochreous-grey, with a narrow hindmarginal dark grey suffusion, broader at apex; cilia grey-whitish, with a dark grey line.

Variable both in colour and intensity of marking; imitating the bark on which it sits.

Blackheath (3,500 feet), New South Wales; Mount Macedon, Victoria; Mount Gambier, South Australia; locally very abundant on trunks of fibrous-barked species of *Eucalyptus*, in November and December, taking flight with great activity when approached. It is exceedingly probable that the larva feeds in the bark of these trees.

4. Xeroscopa, Meyr.

Forehead vertical. Ocelli present. Tongue well-developed. Antennæ moderate, $\frac{2}{3}$ of forewings, in male filiform, evenly ciliated ($\frac{1}{3}$–1). Labial palpi rather long or long, straight, porrected, second joint beneath with long dense projecting scales, terminal joint moderate, exposed or resting in scales of second. Maxillary palpi rather long, triangularly dilated. Posterior tibiæ with outer spurs half inner. Abdomen moderate. Forewings with vein 11 rather oblique. Hindwings from $\frac{1}{3}$–$\frac{3}{4}$ broader than forewings; 3 remote from 4, 4 and 5 stalked or from a point; lower median naked; discal area above it furnished with long hairs, not continued beyond transverse vein (except in *X. philonephes*); internal area loosely haired.

Distinguished from *Scoparia* only by the long hairs of the discal area; the genus is undoubtedly natural, and its separation materially assists the study of the group. The species resemble those of the second group of *Scoparia*, and almost all of large size and decidedly crambideous facies. The larvæ are yet unknown, but probably of similar habits.

The genus is especially characteristic of New Zealand, whence fifteen species are described; there is one Tasmanian species, and also one Australian, if the latter is correctly separated from *Tetraprosopus*. None are yet known elsewhere, but perhaps only because they have not been recognized.

The following is a tabulation of the seventeen species :—

1a.	Forewings dark fuscous, with two fine white lines	77. *leucogramma.*
1b.	,, not dark fuscous.	
2a.	With blackish median band	71. *aspidota.*
2b.	Without blackish band.	
3a.	With a black streak from middle of base.	
4a.	Costa moderately arched	62. *encausta.*
4b.	,, almost straight	68. *ejuncida.*
3b.	Without streak from middle of base.	
4a.	Orbicular and reniform connected by a black streak	66. *rotuella.*
4b.	,, ,, not connected.	
5a.	First line very indistinct or obsolete.	
6a.	Forewings brownish-ochreous	70. *apheles.*
6b.	,, not brownish-ochreous.	
7a.	Costal edge dark fuscous	69. *niphospora.*
7b.	,, ,, not dark fuscous	67. *harpalea.*
5b.	First line distinct.	
6a.	With conspicuous black streak from base of costa.	
7a.	Reniform containing a linear black mark	64. *eyameuta.*
7b.	,, ,, a subquadrate black spot	65. *astragalota.*
6b.	Without black streak from base of costa.	
7a.	Second line nearly straight.	
8a.	Hindwings ochreous-whitish	74. *legnota.*
8b.	,, dark grey	73. *epicremna.*
7b.	Second line not straight.	
8a.	Forewings very elongate.	
9a.	Outer edge of reniform very deeply indented	61. *philonephes.*
9b.	,, ,, ,, slightly indented	63. *petrina.*
8b.	Forewings not very elongate.	
9a.	Hindwings dark grey	72. *nomeutis.*
9b.	,, grey-whitish.	
10a.	Lower half of reniform ochreous-white	75. *octophora.*
10b.	,, ,, ,, not ochreous-white	76. *asterisca.*

* 61. *Xer. philonephes*, n. sp.

Female.—31 mm. Head, palpi, and thorax dark fuscous-grey, irrorated with white; palpi 2½, basal joint white. Antennæ grey. Abdomen pale greyish-ochreous. Legs ochreous-white, tibiæ and tarsi banded with dark fuscous. Forewings very elongate, narrow, somewhat triangular, costa hardly arched, apex obtuse, hindmargin rounded, somewhat oblique; rather dark fuscous-grey, densely irrorated with white, with a few black scales; first line whitish, indistinct, posteriorly obscurely dark-margined, rather oblique, slightly curved, somewhat indented; orbicular and claviform both elongate-oval, blackish-margined, ill-defined, touching first line; reniform large, 8-shaped, blackish-margined; second line white, tolerably distinct, obscurely dark-margined; subterminal broad, cloudy, very obscure; a white interrupted hindmarginal line: cilia whitish, barred with dark grey, with a grey line. Hindwings $1\frac{3}{4}$, very pale whitish-ochreous, greyish-tinged; apex and upper part of hindmargin rather narrowly grey; cilia white, base whitish-ochreous, with an interrupted grey line.

This species may perhaps be transferred to *Tetraprosopus* when the male is known, since it agrees with that genus and differs from the other species of *Xeroscopa* in the extension of the discal hairs of hindwings almost to hindmargin; but it so closely resembles *X. petrina* that it seems better left here until then.

Mount Macedon, Victoria, in December (Mr. G. H. Raynor); Mount Lofty, South Australia (Mr. E. Guest); two specimens.

* 62. *Xer. encausta*, n. sp.

Male.—27 mm. Head and thorax fuscous-grey, irrorated with white, with a dark fuscous lateral stripe from eye to beyond middle of thorax. Palpi $2\frac{3}{4}$, dark fuscous, apex and basal joint white. Antennæ grey, ciliations $\frac{1}{2}$. Abdomen whitish-ochreous. Legs white, irrorated with fuscous, tibiæ and tarsi banded with fuscous. Forewings elongate-triangular, costa moderately and evenly arched, apex rounded, hindmargin obliquely rounded; fuscous-grey, densely irrorated with white; a black median streak, margined with fuscous, from base to near middle of disc; first line obsolete; a fine black streak, acutely attenuated anteriorly, in disc above middle from $\frac{1}{3}$–$\frac{2}{3}$, posteriorly coalescing with a fuscous longitudinal bar which extends from beyond middle of disc to middle of hindmargin; from upper margin of discal streak beyond middle proceeds a short irregular strigula, representing reniform; veins posteriorly more or less distinctly marked with black, on fuscous bar strongly lined; second line very obscure, white, posteriorly suffusedly dark-margined towards costa: cilia whitish, basal third broadly barred with dark grey, and with a grey posterior line. Hindwings $1\frac{1}{2}$, very pale whitish-ochreous, greyish-tinged, apex and upper part of hindmargin rather narrowly fuscous-grey; cilia whitish, with a grey line.

Differs from all by the more arched costa of the forewings, and black basal, median, and posterior streaks, appearing to form parts of a single broken streak.

Mount Wellington, Tasmania, at 1,200 feet, on a tree-trunk in December; one specimen.

63. *Xer. petrina*, n. sp.

Male.—30–31 mm.; *female.*—24 mm. Head and thorax dark grey, irrorated with white. Palpi 3, dark fuscous, apex and basal joint white. Antennæ grey; ciliations $\frac{1}{2}$. Abdomen pale whitish-ochreous. Legs white, irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings very elongate, triangular, costa slightly arched, apex obtuse, hindmargin straight, rather oblique; fuscous-grey or dark grey, densely irrorated with white, especially in disc; a very small dark fuscous triangular spot at base of costa; first line whitish, distinct, posteriorly suffusedly margined with dark fuscous, rather strongly oblique, slightly curved, somewhat indented; orbicular small, oval, whitish, dark-margined, detached; claviform represented only by a small dark spot very obliquely beyond orbicular; reniform large, irregularly 8-shaped, grey, margined first with whitish and then incompletely with dark fuscous, dark margin strongest on anterior indentation; second line whitish, distinct, anteriorly dark-margined and with blackish dots on veins: terminal space hardly irrorated with white, except broad suffused subterminal line, not interrupted; veins posteriorly obscurely blackish: cilia white, basal third barred with grey, and with a grey posterior line. Hindwings $1\frac{3}{4}$, very pale whitish-ochreous; apex in female greyish; cilia ochreous-white.

Characterized by the absence of black markings.

Bealey River (2,100 feet), Castle Hill (2,400 feet), Lake Guyon, and Mount Hutt, in January and February; not common.

64. *Xer. cyameuta*, n. sp.

Male, female.—25–28 mm. Head and thorax grey, irrorated with white, with a short blackish or dark fuscous lateral stripe from eye, not reaching middle of thorax. Palpi $2\frac{3}{4}$, dark fuscous, apex and basal joint white. Antennæ grey; ciliations $\frac{1}{2}$. Abdomen whitish-ochreous. Legs white, irrorated with fuscous, tibiæ and tarsi banded with dark fuscous. Forewings very elongate, triangular, costa slightly arched, apex obtuse, hindmargin straight, somewhat oblique; fuscous, densely irrorated with white, especially in disc; a black median streak from base of costa to first line; first line white, tolerably distinct, moderately oblique, somewhat curved, rather indented, posteriorly strongly black-margined on upper half; orbicular oval, whitish, outlined with fuscous above and black beneath, touching first line; claviform similar, margined with two or three blackish spots; reniform 8-shaped, obscure, fuscous, partially dark-margined, cut by a strong black longitudinal streak from near orbicular; second line white, distinct, anteriorly dark-margined; terminal space hardly irrorated with white, except suffused broad subterminal line, interrupted above middle; veins posteriorly obscurely blackish: cilia white, basal third barred with dark fuscous, with a fuscous posterior line. Hindwings $1\frac{2}{3}$, pale whitish-ochreous; postmedian line obscurely indicated; apex and upper part of hindmargin very narrowly grey; cilia ochreous-white.

Very closely allied to *X. petrina*, but distinguished readily by the various sharply defined black markings.

Wellington, Arthur's Pass (1,600 to 2,600 feet), Bealey River (2,100 feet), Mount Hutt, Dunedin, and Lake Wakatipu (1,000 feet), from December to February, frequenting rocks ; common.

65. *Xer. astragalota*, n. sp.

Male, female.—27 mm. Head and antennæ ochreous white. Palpi $2\frac{1}{2}$, dark fuscous, apex broadly and basal joint white. Thorax ochreous-white, somewhat irrorated with fuscous on sides, with a short irregular black lateral mark from anterior margin. Abdomen ochreous-whitish. Legs white, irrorated with fuscous, tibiæ and tarsi banded with dark fuscous. Forewings very elongate, triangular, costa hardly arched, apex round-pointed, hindmargin somewhat sinuate, hardly oblique; light ochreous, almost wholly suffused with white; markings black, somewhat suffused with reddish fuscous; a short very oblique streak from base of costa, reaching $\frac{1}{6}$; posterior margin of first line indicated by an oblique narrow triangular spot from costa, uniting with orbicular, which is elongate, linear; reniform quadrate, concave-sided, connected by a fuscous spot with a small spot on costa; second line obscurely pale, anteriorily somewhat dark-margined, with a few black scales on veins, and a small black spot on costa ; a light fuscous triangular spot on middle of hindmargin ; a hind-marginal row of very ill-defined blackish dots: cilia white, basal third barred with grey, and with a posterior grey line. Hindwings $1\frac{2}{3}$, pale whitish-grey, ochreous-tinged; lunule, postmedian line, and apex greyer; cilia whitish.

Immediately known by the pale colouring, and the conspicuous black subquadrate spot which represents the reniform.

Mount Hutt, in December and January (Mr. R. W. Fereday); several specimens.

66. *Xer. rotuella.*

(*Crambus rotuellus*, Feld., Reis. Nov., pl. cxxxvii., 30.)

Female.—28–29 mm. Head and thorax light greyish-ochreous, somewhat mixed with whitish, with a narrow black lateral stripe from eye to middle of thorax. Palpi $3\frac{1}{4}$, light greyish-ochreous, irrorated with dark fuscous, apex and basal joint white. Antennæ, abdomen, and legs pale greyish-ochreous. Forewings very elongate, triangular, costa slightly arched, apex round-pointed, hindmargin sinuate, rather oblique; light greyish-ochreous, beneath costa irrorated with white; a sharply-defined black median streak from base of costa to disc at about $\frac{1}{3}$, margined with clear yellowish-ochreous, acutely attenuated; first line obsolete; a sharply-defined black streak, margined with clear yellowish-ochreous, in disc above middle, extending from $\frac{1}{3}$–$\frac{2}{3}$, upper margin somewhat protuberant near anterior extremity, and terminating posteriorly in an acutely trifurcate dilation which represents reniform; anterior margin of second line represented by a row of black dots; a terminal row of black dots: cilia whitish-ochreous, with two grey lines. Hindwings $1\frac{3}{4}$, very pale ochreous-grey; lunule and postmedian line faintly darker; cilia ochreous whitish, with a grey line.

Easily recognized by the two very conspicuous black streaks.

Mount Hutt, in January (Mr. R. W. Fereday); several specimens.

67. *Xer. harpalea*, n. sp.

Male.—24 mm. Head and thorax white irrorated with grey. Palpi $2\frac{1}{2}$, dark fuscous, apex and basal joint white. Antennæ grey; ciliations $\frac{1}{2}$. Abdomen whitish-grey. Legs white irrorated with fuscous-grey, tibiæ and tarsi banded with dark fuscous. Forewings very elongate, triangular, narrow at base, costa slightly arched, apex almost acutely pointed, hindmargin strongly sinuate, oblique; white, irrorated with ochreous-grey; veins obscurely marked with blackish; first line obsolete; orbicular roundish, claviform elongate-oval, reniform irregular, all very obscure, slightly ochreous-tinged, partially dark-margined; second line whitish, obscure, interrupting streaks on veins; subterminal obscurely whitish, confluent with second line in middle; a hindmarginal row of blackish dots: cilia whitish, with a fuscous-grey line. Hindwings $1\frac{1}{2}$, very pale greyish-ochreous; postmedian line and apex grey; cilia white, base ochreous, with a grey line round apex.

A rather obscurely-marked species, but distinguished from all by the more pointed apex and strongly sinuate hindmargin of forewings.

Otira Gorge, on a rock-face at 1,600 feet, in January; one specimen.

68. *Xer. ejuncida*, Knaggs.

(*Scoparia ejuncida*, Knaggs, Ent. Mo. Mag., iv., 81.)

Male, female.—19–24 mm. Head grey, suffused with white. Palpi 3, dark fuscous, apex and basal joint white. Antennæ grey; ciliations $\frac{1}{2}$. Thorax grey, sides irrorated with white, with a narrow black stripe on each side of back. Abdomen ochreous-whitish. Legs dark fuscous, irrorated with whitish. Forewings very elongate, triangular, narrow at base, costa almost straight, apex rounded, hindmargin straight, oblique; grey, irrorated with white, very densely towards costa except on edge; a fine black median line from base to first line; first line very obscure, curved, moderately indented, rather oblique; orbicular represented by a fine black longitudinal line; claviform obsolete; reniform subquadrate, grey, cut by a fine black discal line which does not reach orbicular; second line tolerably distinct, sharply angulated above middle, sharply indented beneath costa, sinuate near inner margin; veins posteriorly obscurely marked with blackish; subterminal line cloudy, hardly irregular, almost on hindmargin throughout; a hindmarginal row of black dots: cilia whitish, with two grey lines. Hindwings $1\frac{2}{3}$, very pale whitish-grey, somewhat ochreous-tinged, apex somewhat darker; cilia white, with a grey line.

A rather elegant and sufficiently distinct species.

Bealey River (2,100 feet), Castle Hill (2,500 to 3,000 feet), Lake Coleridge, Mount Hutt, and Lake Wakatipu (3,000 feet), from December to March, generally on the skirts of the beech-forests; common.

69. *Xer. niphospora*, n. sp.

Male, female.—26–29 mm. Head and antennæ white; ciliations $\frac{2}{3}$. Thorax white, irrorated with fuscous on sides. Palpi 3–$3\frac{1}{2}$, fuscous, apex and basal joint white. Abdomen ochreous-whitish. Legs whitish, anterior and middle pair suffused with dark fuscous. Forewings very elongate, narrow, somewhat triangular, costa almost straight, apex round-pointed, hindmargin very obliquely rounded; light greyish-ochreous, densely and suffusedly irrorated with white except along costa; costa narrowly dark fuscous, posteriorly somewhat suffused; a few scattered dark fuscous scales, and veins posteriorly somewhat marked with dark fuscous; orbicular and reniform dot-like, black; margins of second line obscurely indicated by dark marks on veins; a hindmarginal row of black dots: cilia white, with two light grey lines. Hindwings $1\frac{3}{4}$, very pale whitish-ochreous; cilia white.

Immediately known by the whitish suffusion and dark costal streak.

Arthur's Pass (4,500 feet), Castle Hill (2,500 to 3,000 feet), and Lake Wakatipu, frequenting dry grassy slopes, in January; five specimens.

70. *Xer. apheles*, n. sp.

Male.—31 mm. Head and thorax brownish-ochreous, somewhat mixed with ochreous-whitish. Palpi 3, ochreous-fuscous, apex and basal joint white. Antennæ light ochreous, ciliations $\frac{1}{2}$. Abdomen ochreous-whitish. Legs ochreous-brown, posterior tarsi whitish. Forewings very elongate, triangular, costa slightly arched, apex round-pointed, hindmargin straight, oblique; rather light brownish-ochreous; lines wholly obsolete; reniform indicated by a faint darker mark; veins posteriorly somewhat whitish; a hindmarginal row of black dots: cilia whitish, suffused with light brownish-ochreous towards base. Hindwings $1\frac{2}{3}$, ochreous-whitish; cilia white.

Recognizable by the large size and brownish-ochreous forewings, with almost wholly obsolete markings.

Arthur's Pass, on a grassy slope at 4,500 feet, in January; one specimen.

71. *Xer. aspidota*, n. sp.

Male, female.—22–26 mm. Head, antennæ, and thorax clear light ochreous, margins of eyes white; antennal ciliations $\frac{1}{2}$. Palpi 2, black, apex of maxillary and basal joint of labial white. Abdomen whitish-grey, somewhat suffused with pale ochreous. Legs white, irrorated with fuscous, tibiæ and tarsi banded with black. Forewings elongate, triangular, costa slightly arched, apex rounded, hindmargin slightly sinuate, somewhat oblique; light ochreous, sometimes mixed with reddish-ochreous; a black white-margined triangular spot on costa at base; first line slender, white, very oblique, almost straight, somewhat indented; a broad black median band, narrowing gradually downwards, bounded anteriorly by first line, and posteriorly by a nearly straight line from beyond middle of costa to $\frac{2}{3}$ of inner margin, triangularly indented below middle; space between this band and second line white; reniform pale ochreous, surrounded by a few grey scales; second line white, anteriorly suffused, margined with a few black scales in curve and a small black mark on costa; subterminal obsolete or somewhat whitish, anteriorly suffusedly margined with grey; a small black triangular spot on middle of hindmargin; a row of black dots before hindmargin: cilia shining grey. Hindwings $1\frac{1}{3}$, pale grey, postmedian line and hindmargin suffusedly darker grey; cilia white or whitish, with two grey lines.

Conspicuously distinct from any other.

Wellington, Castle Hill, Mount Hutt, Dunedin, and Lake Wakatipu (1,000 feet), amongst bush in December and January; several specimens.

72. *Xer. nomeutis*, n. sp.

Male, female.—17–21 mm. Head and thorax dark grey, mixed with white and black. Palpi $2\frac{3}{4}$, blackish mixed with white, basal joint white. Antennæ dark grey, in male strongly pubescent, ciliations 1. Abdomen grey or dark grey, irrorated with white. Legs white irrorated with dark fuscous, tibiæ and tarsi banded with black. Forewings somewhat elongate, triangular, in female more oblong, costa hardly arched, apex rounded, hindmargin rounded, rather oblique; greyish-ochreous or fuscous, densely irrorated with white, and with a few black scales; a suffused blackish spot in middle of base, and one on inner margin near base; first line whitish, obscure, posteriorly blackish-margined, oblique, hardly curved, slightly indented; orbicular very small, round, black, sometimes pale-centred, detached; claviform very small, black, detached; reniform 8-shaped, black-margined except above and beneath, touching a blackish suffusion on middle of costa; second line whitish, anteriorly blackish-margined, rather abruptly angulated above middle, indented beneath costa; subterminal whitish, very obscure, touching second line in middle: cilia grey, basal third barred with dark grey and white, tips whitish. Hindwings $1\frac{1}{4}$, fuscous-grey, hindmargin suffusedly darker; cilia whitish, with two suffused grey lines.

A peculiar species, in markings approaching more the typical forms of *Scoparia*; differs also from the other species, in which the male is known, by the structure of the antennæ.

Lake Wakatipu, amongst rocky ground at from 3,500 to 5,000 feet elevation, in December; seven specimens.

73. *Xer. epicremna*, n. sp.

Male.—14–15 mm. Head, palpi, and thorax fuscous mixed with yellow-ochreous, with a few white scales; palpi 3, apex of maxillary and base of labial white. Antennæ blackish, in male pubescent, ciliations $\frac{1}{3}$. Abdomen fuscous-grey, irrorated with ochreous-whitish. Legs whitish irrorated with dark fuscous, tibiæ and tarsi banded with dark fuscous. Forewings rather elongate, somewhat triangular, costa almost straight, apex rounded, hindmargin rather oblique, distinctly sinuate; fuscous, irregularly mixed with yellow-ochreous, and median third much mixed with white; a small white basal spot, and another on costa near base; a cloudy blackish streak indicated along fold from base to anal angle, obsolete in middle, posteriorly distinct and somewhat dilated; first line white, tolerably distinct, somewhat curved, slightly indented, posteriorly obscurely dark-margined; orbicular dot-like, black, obscure; claviform small, round, black, touching first line; reniform 8-shaped, obscurely ochreous, indistinctly black-margined; second line white, distinct, almost straight, hardly sinuate, anteriorly dark-margined; subterminal cloudy, white, tolerably entire, widely remote from second line; a few white scales on hindmargin: cilia pale-greyish, with a cloudy darker grey line. Hindwings $1\frac{1}{3}$, fuscous-grey, hindmargin broadly suffused with dark fuscous; cilia whitish, with a dark grey basal and faint posterior line.

Allied to *X. nomeutis*, but very distinct by the smaller size and almost straight second line.

Castle Hill (2,500 feet), in January; two specimens.

74. *Xer. legnota*, n. sp.

Male, female.—18–23 mm. Head and thorax ochreous, somewhat mixed with whitish. Palpi 3, ochreous-fuscous, basal joint white. Antennæ ochreous; ciliations $\frac{1}{3}$. Abdomen whitish-ochreous. Legs whitish, irrorated with fuscous, tibiæ and tarsi banded with dark fuscous. Forewings elongate, triangular, costa hardly arched, apex round-pointed, hindmargin almost straight, oblique; pale brownish-ochreous, more or less irrorated irregularly on veins with dark fuscous or blackish; first line white, angulated in middle, anteriorly broadly suffused with whitish, posteriorly dark-margined, forming a small dark spot on costa; orbicular strong, linear, blackish, touching first line; claviform obsolete or indicated by a few black scales; reniform rather small, x-shaped, white, irregularly blackish-margined; a rather broad space before second line densely irrorated with white, towards inner margin almost suffused into first line; second line white, almost straight, slightly curved in middle; subterminal white, tolerably distinct, remote from second line; a hindmarginal row of black dots, resting on a terminal whitish line: cilia ochreous-whitish, with two fuscous lines. Hindwings $1\frac{1}{3}$, ochreous-grey-whitish; cilia white.

Resembles the preceding in the form of the straight second line, but widely differing in the very light colouring.

Mount Hutt and Lake Wakatipu (1,000 feet), amongst bush, in December and January; six specimens.

75. *Xer. octophora*, n. sp.

Male, female.—22–24 mm. Head and thorax brownish-ochreous, shoulders irrorated with dark fuscous. Palpi $3\frac{1}{2}$, dark fuscous, mixed with white above, basal joint white. Antennæ fuscous; ciliations $\frac{1}{2}$. Abdomen ochreous-whitish. Legs whitish-ochreous, anterior pair suffused with dark fuscous. Forewings rather elongate, triangular, costa slightly arched, apex round-pointed, hindmargin slightly sinuate, rather oblique; brownish-ochreous, more or less irrorated with dark fuscous, generally forming dark lines on veins, and with a few white scales; first line obscurely pale, posteriorly indistinctly dark-margined, curved, indented, hardly oblique; orbicular and claviform suffused, dark fuscous, generally obscure; reniform 8-shaped, somewhat blackish-margined, upper half ochreous, lower half white; second line whitish, distinct, dark-margined, moderately curved in middle; a hindmarginal row of black dots: cilia ochreous-whitish, with two dark grey lines. Hindwings $1\frac{2}{5}$, ochreous-grey-whitish, postmedian line and apex obscurely greyer; cilia ochreous-white, with a faint grey line.

Recognizable by the brownish-ochreous ground-colour and well-defined reniform, with the lower half white.

Christchurch, Akaroa, Castle Hill (2,500 to 3,000 feet), Bealey River (2,100 feet), Mount Hutt, and Invercargill (sea-level), in dry grassy places, in December, January, and March; tolerably common.

76. *Xer. asterisca*, n. sp.

Male, female.—21–23 mm. Head and thorax fuscous, suffused with dark fuscous. Palpi $2\frac{1}{4}$, dark fuscous, basal joint white. Antennæ fuscous; ciliations $\frac{1}{2}$. Abdomen whitish-grey. Legs whitish irrorated with dark fuscous, tibiæ and tarsi banded with black. Forewings rather elongate, triangular, costa hardly arched, apex rounded, hindmargin almost straight, rather oblique; dull ochreous-fuscous, basal and terminal areas suffused with dark greyish-fuscous; first line, orbicular, and claviform all obsolete, merged in the basal suffusion; reniform x-shaped, suffused, dark fuscous; second line slender, whitish, dark-margined, moderately curved; subterminal slender, whitish, not touching second line: cilia whitish, basal third and a posterior line dark greyish-fuscous. Hindwings $1\frac{2}{5}$, ochreous-grey-whitish; lunule distinct, dark grey; hindmargin narrowly suffused with dark grey; cilia white, with a dark grey line.

Allied to *X. octophora*, but distinguished by the partial dark suffusion, the incomplete reniform, without white centre, and the dark lunule and margin of hindwings.

Arthur's Pass (4,500 feet), Mount Hutt, and Lake Wakatipu, in January; four specimens.

77. *Xer. leucogramma*, n. sp.

Male, female.—21 mm. Head, palpi, antennæ, thorax, and abdomen blackish-fuscous; palpi $2\frac{1}{2}$, basal joint white. Legs ochreous-whitish, irrorated with dark fuscous, tibiæ and tarsi banded with blackish. Forewings somewhat elongate, triangular, costa gently arched, apex rounded, hindmargin rather oblique, slightly rounded; blackish-fuscous, with a few white scales; first line white, sharply defined, slightly curved, not oblique, not indented; orbicular and claviform very obsoletely darker; reniform almost obsolete, 8-shaped, obscurely pale-centred; second line slender, white, sharply defined, terminating hardly before anal angle, and therefore much less inwardly oblique than usual, curved in middle; subterminal indicated by a few white scales: cilia dark fuscous, with a blackish basal line, tips whitish. Hindwings $1\frac{1}{3}$, in male light grey, lunule, postmedian line and hindmargin darker; in female dark fuscous-grey, lunule and apex darker; cilia grey with two dark grey lines, tips whitish.

Extremely distinct from all other species by the blackish ground-colour, slender white lines, and peculiar position of second line.

Mount Hutt, in January (Mr. R. W. Fereday); two specimens.

78. Appendix.

The following specific names are not quoted above; viz.:—

(1.) *Scoparia linealis*, Walk. Suppl., 1503. The specimen which I suppose to be Walker's type I did not determine, and it is perhaps not recognizable; with it was placed a small specimen of *Scoparia submarginalis*, Walk.

(2.) *Nephopteryx favilliferella*, Walk. Suppl., 1719. The type is unset, and therefore not generically recognizable; it is certainly either a *Scoparia* or a *Xeroscopa*, but it seems hardly possible to assert anything more.

(3.) *Scoparia objurgalis*, Gn., 425, pl. x., 10, and *Scoparia australialis*, Gn., 426, appear to me unidentifiable at present; the latter is, if correctly described, probably new to me, the former might possibly be *S. exhibitalis*, Walk.

In the following indices the numbers refer to those prefixed to the names:—

Index of Genera.

Index of Species.

Names italicized are synonyms.

Art. XII.—*Descriptions of New Zealand* Micro-Lepidoptera.

By E. Meyrick, B.A.

[*Read before the Philosophical Institute of Canterbury, 2nd October*, 1884.]

VI.—PYRALIDINA.

Seven families of *Pyralidina* are represented in New Zealand, of which the two most important here, the *Crambidæ* and *Scopariadæ*, have been discussed in former papers. Three others—the *Pyralididæ*, *Pterophoridæ*, and *Hydrocampidæ*—are given here, as well as some considerable additions to the *Crambidæ*. The remaining two, which are the *Botydidæ* and *Musotimidæ*, I have recently given a list of in the Transactions of the Entomological Society of London for 1884, with descriptions of the new species, in connection with a paper on Australian species of the group; these will also be given here in a subsequent paper.

The *Pyralididæ* and *Hydrocampidæ* are each represented only by a single species, and neither is indigenous in the strict sense. The species of *Pyralididæ* is a common domestic insect introduced from Europe, and now established throughout most of the world; that of *Hydrocampidæ*, is an Australian species, and must be considered to have found its way over in recent times. The *Pterophoridæ* contain eleven species, of which one is also Australian, and belongs to a genus not otherwise represented in New Zealand; one is closely allied to a European form, and may even prove identical with it; the remaining nine are all endemic. These appear to be all of cosmopolitan genera; an unexpected result, and rather suggesting the inference that the generic limitation is not yet sufficiently precise, but I do not at present see tangible points of difference. Australia is relatively poor in *Pterophoridæ*, having as yet only furnished me with the same number as New Zealand; the character of the fauna shows little resemblance. The tendency to partial obsolescence in the neuration of this family makes their study a difficult one.

I give a table showing the comparative numbers of all the families of *Pyralidina* in New Zealand and in the European region, to show the great irregularity of their representation here: in Australia their relative numbers are very much as in Europe:—

—	Europe.	New Zealand.
Pyralididæ	40	*1
Musotimidæ	0	2
Botydidæ	204	11
Pterophoridæ	104	11
Hydrocampidæ	18	*1
Scopariadæ	36	58
Crambidæ	108	44
Phycididæ	250	0
Galleriadæ	7	0

* Not indigenous.

The *Epipaschiadæ* do not occur in either region.

The *Pyralidina* may be recognized by the close approximation or partial anastomosis of veins 7 and 8 of the hindwings for a short distance beyond the cell. Normally the forewings have 12 veins, veins 8 and 9 being stalked, and the hindwings 8 veins, but the number of veins is sometimes reduced. The hindwings have 3 free inner-marginal veins (1a, 1b, 1c), reckoned as one; the group is thus distinguished from the *Noctuina*, in which there are only two.

The following tabulation will serve to distinguish the families of the group as represented in New Zealand:—

1a.	Wings cleft into plumes	*Pterophoridæ.*
1b.	,, not cleft.	
2a.	Forewings with 11 veins	*Musotimidæ.*
2b.	,, with 12 veins.	
3a.	Lower median vein of hindwings pectinated.	
4a.	Maxillary palpi resting on labial	*Crambidæ.*
4b.	,, ,, separately porrected	*Scopariadæ* (part).
3b.	Lower median vein of hindwings naked.	
4a.	Vein 7 of forewings stalked with 9	*Pyralididæ.*
4b.	,, ,, separate.	
5a.	Genital uncus of male absent	*Botydidæ.*
5b.	,, ,, ,, developed.	
6a.	Maxillary palpi resting on labial	*Hydrocampidæ.*
6b.	,, ,, triangular, separately porrected	*Scopariadæ* (part).

PYRALIDIDÆ.

Forewings with 12 veins, vein 7 stalked with 8 and 9, 10 separate. Hindwings with lower median naked; vein 7 from angle of cell.

1. Asopia, Tr.

Ocelli absent. Antennæ in male ciliated. Labial palpi moderate, curved, ascending. Maxillary palpi slender or rudimentary. Forewings with veins 4 and 5 stalked. Hindwings with veins 4 and 5 stalked, 8 free.

1. *Asop. farinalis*, L.

Male, female.—18–25 mm. Forewings moderate, triangular; ochreous, basal and terminal areas reddish-fuscous; lines whitish, first curved, second with median third strongly curved outwards. Hindwings grey or grey-whitish; two whitish lines as in forewings, but much nearer together.

A well-known cosmopolitan and domestic species, introduced from Europe.

Christchurch; although I have not obtained it elsewhere, it probably occurs generally.

PTEROPHORIDÆ.

No ocelli or maxillary palpi. Wings cleft into two or three feathers. Forewings with vein 7 separate from 9; venation often much degraded and simplified. Hindwings with lower median naked.

This group, usually separated as a main division, offers in my opinion no characters sufficient to admit of its separation from the *Pyralidina*, with the other families of which it is closely allied. The wings are unusually narrow, and the abdomen and legs very long and slender.

Oxyptilus vigens, Feld., said (perhaps erroneously) to be from New Zealand, I have not been able absolutely to identify. Felder would probably (loose as he is) have hardly classed it as an *Oxyptilus* unless he had observed the characteristic tuft on the third plume of the hindwings.

The four genera may be thus tabulated :—

1a. No veins to costa from cell of forewings .. .. 2. *Aciptilia.*
1b. Two or more veins to costa from cell.
2a. Face smooth .. .. 3. *Lioptilus.*
2b. ,, with a cone of scales.
3a. Hindwings 5-veined .. .. 4. *Mimæseoptilus.*
3b. ,, 6-veined .. .. 5. *Platyptilia.*

2. ACIPTILIA, Hb.

Face smooth. Antennæ moderately ciliated. Palpi moderate or short, very slender, ascending. Posterior tibiæ with spurs very long, inner longer than outer. Forewings cleft more than $\frac{1}{3}$, segments linear-acute ; with 6 veins (3, 3); 2 and 3 from a point, 4 from transverse vein, 5 to apex, 6 free. Hindwings with segments linear-acute, third dilated anteriorly; with 5 veins (1, 2, 2); 1b. distinct, 2 and 3 from a point (rarely 2 obsolete), 4 apparently coalescing wholly with 5 beyond cell.

Stands isolated by the entire obsolescence of all the veins usually rising from the cell before the upper angle, and marks a terminal development in this direction. Apparently of world-wide distribution, though from Australia I have only a single species.

1a. Hindwings dark grey .. .. 5. *innotatalis.*
1b. ,, white.
2a. Forewings with a fuscous longitudinal stripe.
3a. Thorax mostly fuscous .. .. 2. *furcatalis.*
3b. ,, wholly white .. .. 3. *lycosema.*
2b. Forewings without fuscous stripe .. .. 4. *monospilalis.*

2. *Acipt. furcatalis*, Walk.

(*Aciptilus furcatalis*, Walk., 950 ; Feld., Reis. Nov., pl. cxl., 52.)

Male, female.—16–19 mm. Head, palpi, antennæ, and legs white; anterior legs internally dark fuscous. Thorax pale fuscous irrorated with dark fuscous, anterior margin broadly white. Abdomen white, with a central longitudinal fuscous stripe. Forewings light fuscous irrorated with dark fuscous; a broad costal streak from base to opposite cleft, an oblong spot on costa beyond $\frac{3}{4}$, and a narrow line along upper edge of second segment snow-white: cilia white, costal cilia dark fuscous except on white spot, dorsal cilia on terminal half of second segment dark fuscous. Hindwings and cilia snow-white, with a more or less distinct dark fuscous spot in costal cilia before apex.

A handsome and distinct species.

Hamilton, Palmerston, Makatoku, and Otira Gorge, locally common amongst dense forest, from January to March.

3. *Acipt. lycosema*, n. sp.

Male, female.—21–25 mm. Head, palpi, antennæ, thorax, abdomen, and legs white; anterior legs internally dark fuscous. Forewings fuscous or ochreous-fuscous; a broad streak along costa from base to $\frac{4}{5}$, attenuated posteriorly, a slender line along lower edge of first segment, a narrow streak along inner margin from $\frac{1}{4}$, and whole of second segment snow-white: cilia snow-white, on costa mixed with fuscous, on lower edge of second segment with two small blackish spots before apex and one at apex, sometimes also with one on lower edge of first segment before apex. Hindwings and cilia snow-white.

Included by Walker as a variety of the preceding, from which it is undoubtedly distinct, and separable by the larger size, and wholly white thorax and second segment of forewings.

Wellington, Christchurch, and Dunedin, amongst bush in December and January; rather common.

4. *Acipt. monospilalis*, Walk.

(*Aciptilus monospilalis*, Walk., 950; *Aciptilia patruelis*, Feld., Reis. Nov., pl. cxl., 56.)

Male, female.—21–24 mm. Head, palpi, antennæ, thorax, abdomen, and legs white; anterior legs internally fuscous. Forewings snow-white; extreme costal edge and a few scattered scales, especially along costa, brownish-ochreous; a blackish dot before cleft, and a minute one on inner margin before middle; sometimes one or two additional black dots on first segment, and rarely a streak of blackish scales along lower edge of first segment: cilia snow-white, on costa ochreous-tinged, on lower edge of second segment with two small blackish spots before apex, and one at apex, and usually a dot on lower edge of first segment before apex. Hindwings and cilia snow-white.

Most allied to the Australian *A. aptalis*, which ranges into Fiji and Tonga.

Auckland, Wellington, Christchurch, Otira River, and Dunedin, common amongst forest, from December to March.

5. *Acipt. innotatalis*, Walk.

(*Pterophorus innotatalis*, Walk., 945.)

Male, female.—15–16 mm. Head, palpi, antennæ, thorax, and abdomen pale ochreous. Legs ochreous-whitish, anterior pair internally fuscous. Forewings pale whitish-yellowish, suffused with pale ochreous on anterior half: cilia dark fuscous, becoming yellow-whitish on costa before apex, on lower margin of second segment generally containing a black dot before middle and another beyond middle of segment. Hindwings dark grey; cilia fuscous-grey.

This species might almost be considered identical with the European *A. tetradactyla*, L., which it approaches very closely; but my specimens of *A. tetradactyla* are decidedly larger, the cilia darker and more sharply contrasted, and the costa suffused with light fuscous, without trace of black dots in the cilia of the lower margin; these differences are very slight, and if intermediate localities produce connecting forms, the two may be united under the name of *tetradactyla*, L.; meanwhile it seems well to keep them separate.

Masterton, Otira River, Christchurch, and Invercargill, rather common on open grassy hills, in August and from December to March.

3. Lioptilus, Wallgr.

Face smooth, hairs projecting between antennæ. Antennæ shortly ciliated. Palpi moderately long, slender, porrected, second joint smoothly scaled. Posterior tibiæ with spurs moderate, nearly equal. Forewings cleft to $\frac{1}{3}$, segments moderate, pointed; with 10 veins (4, 6); 2 from rather near angle, 3 and 4 from a point, 6 and 7 stalked, 6 to costa, 10 free. Hindwings with segments narrow, pointed; with 6 veins (1, 3, 2); 2 from before middle of lower margin of cell, 3 and 4 from a point, 5 apparently shortly anastomosing with 6 in middle.

Distinguished from *Platyptilia* and *Mimæseoptilus* by the smooth face, smoothly scaled palpi, and pointed wing-segments. The genus is well represented in Europe and North America, and probably elsewhere; the single New Zealand species is found also in Australia.

6. *Liopt. celidotus*, n. sp.

Male, female.—15–16 mm. Head, palpi, thorax, and abdomen light fuscous, irregularly mixed with white. Antennæ fuscous. Legs whitish, internally dark fuscous. Forewings light fuscous, irregularly strewn with white, sometimes suffused with white in disc, and on a small costal spot above base of cleft; an oblique blackish spot before cleft; apex and sometimes costal edge dark fuscous: cilia white, on costa fuscous. Hindwings fuscous-grey; cilia whitish.

Well characterized by the conspicuous oblique discal spot.

Christchurch and Lake Wakatipu, in December and April; four specimens. Occurs also in South-east Australia.

4. Mimæseoptilus, Wallgr.

Face with a cone of scales. Antennæ shortly ciliated. Palpi rather long or very long, porrected, second joint loosely scaled above, terminal joint exposed. Posterior tibiæ with spurs moderate or short, nearly equal.

Forewings cleft to $\frac{1}{4}$, segments moderately broad, obliquely truncate; with 10 veins (4, 6); 2 from before posterior third of cell, 3 and 4 closely approximated at base, 6 and 7 stalked, 6 to costa, 10 free. Hindwings with segments moderate, upper two obliquely truncate; with 5 veins (1, 2, 2); 2 from before angle of cell, 3 from angle, 4 apparently shortly anastomosing with 5 in middle: cilia without black scales.

Distinguished from *Platyptilia* by the 5-veined hindwings, and the origin of vein 2 of the forewings before posterior third of cell; also by the absence of black scales in the cilia of the lower margin of hindwings. Well represented in Europe and North America, and probably elsewhere.

1a. Costa posteriorly dark fuscous.
- 2a. Forewings with a whitish line before hindmargin .. .. .. 8. *charadrias.*
- 2b. „ without whitish line .. .. 9. *lithoxestus.*

1b. Costa posteriorly not dark fuscous .. .. 7. *orites.*

7. *Mimæs. orites*, n. sp.

Male.—21 mm. Head and thorax pale ochreous, mixed with white. Palpi pale ochreous, above white, very long. Antennæ fuscous. Abdomen brownish-ochreous, with dark fuscous dots on edge of segments. Legs whitish, apex of spurs dark fuscous, spurs short. Forewings light greyish-ochreous, irregularly strewn with whitish, and with some black scales tending to accumulate on veins; costa obscurely spotted with blackish towards base; a distinct black dot in disc at $\frac{1}{3}$, and another before and below base of cleft: cilia pale greyish-ochreous, on hindmargin with an interrupted black basal line. Hindwings and cilia light grey.

The palpi are much longer in this species than in the two following.

One specimen taken near Clinton by Mr. G. F. Mathew, who states that it frequented the tussock-grass, and fell down to the roots when disturbed; it is therefore probably often overlooked.

8. *Mimæs. charadrias*, n. sp.

Male, female.—16–20 mm. Head, palpi, thorax, and abdomen whitish-ochreous. Antennæ fuscous. Legs fuscous-whitish, internally dark fuscous. Forewings light fuscous, more or less suffused with whitish-ochreous posteriorly and towards inner margin, suffused with whitish along submedian fold (broadly posteriorly) and on a costal spot above base of cleft; costa suffused with dark fuscous, anteriorly obscurely spotted with whitish; a small blackish spot before cleft, in female larger and touching cleft; in female a suffused blackish triangular subapical patch, terminated by a whitish line a little before hindmargin; in male the whitish line broader and suffused into hindmargin, but blackish patch wholly absent: cilia whitish-fuscous, within cleft and on hindmargin of first segment white, with a dark fuscous line from middle of first segment to anal angle, on costa dark fuscous. Hindwings and cilia fuscous.

The sexes would readily be taken for distinct species.

Arthur's Pass, from 1,500 to 4,000 feet, but principally at the lower levels; common in January.

9. *Mimæs. lithoxestus*, n. sp.

Male, female.—23–28 mm. Head, palpi, thorax, and abdomen whitish-ochreous, mixed with white. Antennæ fuscous. Legs ochreous-whitish, internally dark fuscous. Forewings light fuscous, suffused with whitish-ochreous posteriorly and towards inner margin, and strewn with white in disc; a sharply-defined very narrow blackish-fuscous costal streak from base to apex, rather strongly dilated between $\frac{1}{2}$ and $\frac{3}{4}$, obscurely margined beneath with pale whitish-ochreous; a black dot in disc before and rather below cleft; apex and hindmargin rather darker fuscous, somewhat mixed with whitish; a fine black line along lower edge of first segment: cilia whitish-ochreous, on costa dark fuscous, within cleft and on hindmargin of first segment snow-white. Hindwings fuscous-grey; cilia pale greyish-ochreous.

Nearly allied to *M. charadrias*, but easily separated by the larger size, much neater appearance, sharply defined costal streak, black line on lower margin of first segment, and absence of distinct dark line in cilia.

Arthur's Pass, from 3,000 to 4,000 feet, common amongst rough herbage in January.

5. PLATYPTILIA, Hb.

Forehead with a cone of scales. Antennæ shortly ciliated. Palpi rather long, porrected, second joint loosely scaled above, terminal joint exposed. Posterior tibiæ with apex sometimes somewhat thickened, all spurs nearly equal, moderate. Forewings cleft to $\frac{1}{4}$, segments moderately broad, hindmargin of first segment concave, of second convex; with 10 veins (4, 6); 2 from near angle of cell, 3 and 4 from a point, 6 and 7 stalked, 6 to costa, 10 free. Hindwings with segments moderate, upper two considerably dilated, obliquely truncate; with 6 veins (1, 3, 2); 2 from near middle of lower margin of cell, 3 and 4 from a point, 6 apparently shortly anastomosing with 5 in middle; cilia of lower margin with more or less of black scales.

A genus of probably universal distribution, well represented in Europe and North America; in Australia only by a single species, nearly allied to *P. falcatalis*. The larvæ appear to be usually attached to *Compositæ*.

1a. Forewings with a dark costal triangle beyond middle.
  2a. Dorsal margin of hindwings fringed with black scales on basal half 11. *falcatalis*.
  2b. ,, ,, ,, without black scales, except in middle 10. *haasti*.
1b. Forewings without costal triangle .. .. 12. *heliastis*.

10. *Platypt. haasti*, Feld.

(*Platyptilia haasti*, Feld., Reis. Nov., pl. cxl., 58.)

Male, female.—16–17 mm. Head, palpi, thorax, and abdomen yellowish-whitish, often suffused with light brownish-ochreous. Antennæ grey. Legs yellow-whitish, banded with dark fuscous. Forewings yellow-whitish, with numerous obscure fuscous or brownish-ochreous transverse strigæ, sometimes nearly obsolete, in other specimens nearly concealing ground-colour; costa from base to $\frac{3}{4}$ spotted with dark fuscous; a triangular blackish-fuscous spot on costa before $\frac{3}{4}$, reaching $\frac{1}{3}$ across wing, connected at apex with a sometimes obsolete dark fuscous transverse mark in disc; a short interrupted dark fuscous longitudinal streak in disc beyond middle; a blackish dot on inner margin at $\frac{2}{3}$; a small elongate dark fuscous spot on costa a little before apex, followed by a tolerably distinct irregular yellow-whitish line not reaching inner margin: cilia yellow-whitish, often suffused with pale ochreous, with a blackish interrupted basal line. Hindwings rather dark reddish-grey; cilia grey, on hindmargin with a partially obsolete blackish basal line, on lower margin of third segment with a small spot of black scales in middle.

Distinguished from both the following by the restriction of the black scales on the lower margin of hindwings to a small central spot, and the obscurely transversely strigulated forewings.

Hamilton, Otira River, Christchurch, Lake Wakatipu, and Invercargill; common in December and January.

11. *Platypt. falcatalis*, Walk.

(*Platyptilus falcatalis*, Walk., 931; *Platyptilus repletalis*, ib., 931.)

Male, female.—20–25 mm. Head, palpi, thorax, and abdomen light reddish-fuscous, irregularly mixed with white, sides of abdomen spotted with blackish. Antennæ fuscous. Legs white, banded with reddish-fuscous. Forewings light reddish-fuscous, irregularly strewn with whitish; costa narrowly dark fuscous from base to $\frac{3}{4}$, somewhat spotted with whitish; a cloudy rather dark reddish-fuscous spot on inner margin at $\frac{1}{3}$ and another beyond middle; a sharply marked blackish-fuscous triangular blotch on costa about $\frac{2}{3}$, reaching half across wing, its apex touching a dark fuscous discal dot; a small white spot on costa immediately beyond this; a white sometimes interrupted line near and parallel to hindmargin, preceded on first segment below middle by a blackish-fuscous triangular spot, and on second segment by a blackish-fuscous suffusion; on first segment ground-colour between this line and costal blackish blotch whitish-ochreous, on lower edge margined with blackish: cilia pale reddish-fuscous, with a dark fuscous line, within cleft and on apical and costal spots white, on inner margin white with a tooth of black scales at $\frac{2}{3}$ and a smaller one at $\frac{5}{6}$. Hindwings and cilia grey, somewhat reddish-tinged, lower margin of third segment fringed with coarse black scales on basal half, a patch beyond middle, and a small spot at apex.

Nearly allied to *P. haasti*, but larger, and readily separated by the reddish-fuscous ground-colour, white costal spot beyond the dark triangular blotch, and abundant black scales of the cilia of hindwings.

Otira River, Christchurch, Dunedin, and Invercargill; common from December to March, amongst bush.

12. *Platypt. heliastis*, n. sp.

Male.—19 mm. Head, palpi, antennæ, thorax, abdomen and legs reddish-fuscous, somewhat mixed with whitish, posterior tarsi white. Forewings light brownish-ochreous, suffused with reddish-fuscous towards base and inner margin, and less strongly on hindmargin, and slightly strewn with whitish in disc; costa suffusedly ochreous-whitish towards $\frac{3}{4}$, towards base suffused with dark fuscous and obscurely spotted with whitish; a dark fuscous dot before and below cleft: cilia dark reddish-fuscous, on costa whitish-ochreous. Hindwings and cilia light grey, slightly reddish-tinged, lower margin of third segment fringed with coarse black scales from base to $\frac{3}{4}$.

Immediately recognized by the entire absence of the dark fuscous costal triangle, and other markings.

Castle Hill; one specimen received from Mr. J. D. Enys.

HYDROCAMPIDÆ.

Maxillary palpi resting on labial, rarely dilated. Abdomen in male with uncus well-developed. Forewings with vein 7 separate from 9 (rarely stalked with 10). Hindwings with lower median vein naked; vein 7 from angle of cell.

Represented in New Zealand by a single species only, which cannot be regarded as belonging to the endemic fauna; it occurs commonly in South-east Australia, and has probably migrated thence in comparatively recent times.

6. HYGRAULA, n. g.

Face tolerably vertical. Ocelli absent. Tongue moderate. Antennæ $\frac{1}{2}$ of forewings, in male filiform, shortly pubescent-ciliated. Labial palpi moderate, $1\frac{1}{4}$, nearly straight, porrected, second joint with short rough scales, terminal joint moderate, obtuse. Maxillary palpi moderate, porrected, slightly dilated with scales, truncate. Posterior tibiæ with outer spurs half inner. Abdomen rather elongate, in male with large broad exserted valves, and long curved uncus. Forewings with veins 4 and 5 closely approximated at base, 10 rising out of stalk of 8 and 9. Hindwings as broad as forewings, veins 4 and 5 from a point 6 and 7 stalked, 8 anastomosing with 7 from before origin of 6 to $\frac{3}{4}$.

In structure approaching nearest to *Cataclysta*, but distinguished by the filiform antennæ and porrected palpi. The larva is doubtless aquatic.

13. *Hygr. nitens*, Butl.

(*Paraponyx nitens*, Butl., Cist. Ent., ii., 556.)

Male, female.—14–17 mm. Head, palpi, and thorax fuscous mixed with whitish, face white. Antennæ grey-whitish. Abdomen fuscous, segmental margins and apex white. Legs whitish, anterior pair internally fuscous. Forewings elongate-triangular, very narrow at base, considerably dilated posteriorly, costa almost straight, towards apex moderately arched, apex rounded, hindmargin strongly rounded, oblique; light fuscous or ochreous-fuscous, closely irrorated with dark fuscous, veins sometimes lined with dark fuscous; first line moderate, whitish, curved, not touching margins, connected with base by whitish streaks along subcostal and submedian, sometimes obsolete; second line moderate, white, from $\frac{3}{4}$ of costa to $\frac{2}{3}$ of inner margin; median third forming a very strong curve outwards; median space usually white except a broad margin all round, and a small quadrate dark fuscous spot in disc beyond middle; a submarginal row of irregular white confluent spots, largest beneath apex and on anal angle, almost obsolete in middle, margined posteriorly by a dark line: cilia grey-whitish, base white spotted with dark fuscous. Hindwings white, markings light fuscous; a small round discal spot; a fascia somewhat beyond middle, angulated outwards above middle, curved inwards below middle; a hind-marginal band, narrower at anal angle, containing several obscure white submarginal spots; cilia whitish, with two pale fuscous lines.

Variable in intensity of colouring; Australian specimens sometimes exceed the size given above, reaching 21 mm., and are then usually lighter and more suffusedly marked.

Hamilton, Napier, Masterton, Christchurch, and Lake Wakatipu, always near water, common from November to March; often taken at light. Also occurs in New South Wales, Victoria and South Australia.

CRAMBIDÆ.

The following are additions to the list already published (Trans. N.Z. Inst., 1882).

7. Diptychophora, Z.

14. *Dipt. interrupta*, Feld.

(*Crambus interruptus*, Feld., Reis. Nov., pl. cxxxv., 15; *Diptychophora astrosema*, Meyr., Trans. N.Z. Inst., 1882, 13.)

Felder's figure, which is sufficiently good for recognition, was accidentally overlooked when I was preparing my former paper; it should now be restored,

15. *Dipt. selenæa*, n. sp.

Male, female.—14–16 mm. Head, palpi, and thorax ochreous-yellow, apex of palpi dark fuscous. Antennæ and abdomen whitish-ochreous. Legs ochreous-whitish. Forewings broad, triangular, costa slightly arched, apex rounded, hindmargin oblique, slightly rounded, twice indented on upper half; pale ochreous-yellowish; markings rather dark reddish-fuscous, suffused with deep ochreous-yellow; a transverse line near base, twice very sharply angulated; first line double, from $\frac{1}{4}$ of costa to before middle of inner margin, obtusely angulated outwards in middle, and indented inwards near inner margin; an irregular transverse shade from beyond middle of costa to beyond middle of inner margin, and another from inner margin before first line to costa beyond second line; on the intersection of these is the discal spot, which is moderately large, transverse, upper half narrow, dark metallic-grey, lower half dilated, round, white; second line double, from $\frac{3}{4}$ of costa to $\frac{4}{5}$ of inner margin, moderately curved outwards, hardly sinuate below middle; three sharply-marked longitudinal dark metallic-grey streaks from near discal spot to near hindmargin; hindmargin suffused with deep yellow, and marked with three small roundish black spots below middle: cilia whitish-yellowish, with a shining dark grey basal line. Hindwings white, faintly ochreous-tinged; an ochreous-yellow hindmarginal line; cilia white.

Nearly allied to *D. metallifera*, Butl., but apparently distinguished by the two transverse fasciæ intersecting in the middle of wing; in the absence of specimens of *D. metallifera* for comparison I cannot certainly indicate any other reliable point of difference. When recently revisiting the British Museum, I again examined the specimen of the latter species, and can confirm my previous remarks on the distinctness of the species and the incorrectness of Mr. Butler's description, but omitted to describe it myself.

Otira Gorge and Dunedin, in January; four specimens.

16. *Dipt. holanthes*, n. sp.

Male, female.—15–17 mm. Head, palpi, and thorax ochreous-yellow, palpi suffused with dark fuscous towards base and apex. Antennæ pale greyish-ochreous. Abdomen grey. Legs whitish-grey, posterior tarsi ochreous-whitish. Forewings broad, triangular, costa slightly arched, apex rounded, hindmargin oblique, slightly rounded, twice indented on upper half; bright deep ochreous-yellow; some black scales at base of costa, and one or two in disc towards base; first line very slender, blackish, partially obsolete, from $\frac{1}{3}$ of costa to before middle of inner margin, dilated on margins and on a dot in middle, obtusely angulated outwards above middle and inwards below middle; discal spot represented by two blackish dots longitudinally placed; second line very slender, blackish, tolerably distinct, followed by a paler yellow line, from $\frac{2}{3}$ of costa to $\frac{2}{3}$ of inner margin, upper half strongly curved outwards, lower half nearly straight; three obscure light metallic-grey longitudinal streaks on upper half of wing, extending from before second line to hindmargin; three small quadrate black spots on hindmargin below middle: cilia shining grey, with a darker metallic basal line. Hindwings and cilia grey.

A conspicuous species, easily recognized by the uniform deep yellow forewings and double black dot representing the discal spot, with grey hindwings; it may be placed after *D. auriscriptella*, Walk.

Near the foot of the Otira Gorge, frequenting rock-faces where moss grows, in January; I found it very common, but in a very restricted locality.

17. *Dipt. bipunctella*, Walk.

(*Eromene bipunctella*, Walk., Suppl., 1761.)

I saw this insect in the British Museum, and identified it as certainly a new species of *Diptychophora*; from the type I made a brief diagnosis.

Size of *D. auriscriptella*. Forewings brown, very neatly marked, markings much as in *D. auriscriptella*, discal spot small, round, white: cilia white except near apex. Hindwings grey.

Immediately distinguished by the uniform brown forewings, small round white discal spot, and grey hindwings; intermediate between *D. holanthes* and *D. epiphæa*.

Locality given as New Zealand, without further indication.

18. *Dipt. epiphæa*, n. sp.

Male, female.—12–14 mm. Head, palpi, antennæ, thorax, abdomen, and legs fuscous. Forewings broad, triangular, costa hardly arched, apex rounded, hindmargin oblique, slightly rounded, once indented below apex; fuscous, with green reflections; lines slender, irregularly denticulate, dark fuscous; first line from beyond $\frac{1}{3}$ of costa to before middle of inner margin, angulated above middle and bent inwards below middle; discal spot obsolete or represented by a faint darker suffusion; second line from $\frac{3}{4}$ of costa to $\frac{3}{4}$ of inner margin, angulated above middle, thence tolerably straight; sometimes two or three whitish longitudinal streaks towards hindmargin above middle; a small black apical spot: cilia whitish, with a shining dark grey basal and lighter median line. Hindwings grey or dark grey, with greenish reflections; cilia light grey, with a dark grey basal line.

Allied to *D. bipunctella*, from which it is distinguished by the much less distinct markings, and the absence of the white discal spot.

Arthur's Pass, about 3,000 feet, in January; six specimens.

19. *Dipt. elaina*, Meyr.

In this species the discal spot should have been described as terminating beneath in a round white dot; this is sometimes obscure, and was therefore overlooked previously, but is always present.

The number of New Zealand species of this interesting genus is now thirteen. Since my remarks on the distribution of the genus, Snellen has described from the Malay Archipelago a species which he considered referable to it, under the name of *Diptychophora amœnella*; but it is represented as having strongly pectinated antennæ, and is therefore doubtless generically distinct; probably Snellen was not at the time acquainted with the real neuration of the genus.

8. Orocrambus, n. g.

Ocelli large. Forehead rounded. Antennæ moderate, in male filiform, simple. Labial palpi rather long, straight, porrected, clothed with very long rough hairs, attenuated to apex. Maxillary palpi long, broadly triangular, terminally expanded with rough hairs. Thorax and coxæ clothed with long fine hairs beneath. Forewings with vein 7 rising out of the stalk of 8 and 9. Hindwings much broader than forewings; vein 8 free, approximated to 7 in middle.

Closely allied to *Crambus*, from which it is essentially distinguished by the free vein 8 of hindwings; the neuration is otherwise identical. Other less reliable points are the wholly simple antennæ, the peculiarly broad and rough hairing of the palpi, and the hairy coxæ and under surface of thorax, but this last character is shared by some mountain species of *Crambus*, as *C. catacaustus*.

The genus is confined to New Zealand; I have only one species, but from a note of Mr. A. Purdie's in the N.Z. Journal of Science it appears probable that there is a second, darker and without the pale fascia.

20. *Orocr. melampetrus*, n. sp.

Male, female.—24–26 mm. Head, palpi, antennæ, thorax, abdomen, and legs dark fuscous-grey; head and palpi mixed with grey-whitish. Forewings moderate, oblong, slightly dilated posteriorly, costa gently arched, apex obtuse, hindmargin not oblique, rounded beneath; fuscous, strewn with dark grey, appearing dark fuscous-grey, with a slight bluish gloss; a whitish irroration forming a moderate nearly straight cloudy fascia (appearing grey-whitish) from $\frac{2}{3}$ of costa to $\frac{3}{4}$ of inner margin, very slightly curved outwards: cilia greyish-fuscous. Hindwings and cilia fuscous.

Unusually stout in build, and of singular facies.

Castle Hill and Mount Hutt, sitting on the bare shingle slopes (which it imitates in colour) at an elevation of 4,000 to 5,000 feet, in January; not uncommon, but very active in flight, and difficult to capture from the nature of the ground, which affords but insecure footing.

9. Crambus, F.

Ten additional species of this genus have been discovered since my paper was written, principally in the mountain districts. At the same time the second Australian species has, as I anticipated, been satisfactorily proved to be also, like the first, a species of wide range, occurring through many Pacific Islands, and consequently not attributable to the true Australian fauna, which therefore includes no endemic species of this genus.

21. *Cr. catacaustus*, n. sp.

Male, female.—22–26 mm. Head and thorax dark ochreous-fuscous. Palpi rather long, dark fuscous, mixed with greyish-ochreous beneath. Antennæ dark fuscous, in male very shortly ciliated. Abdomen dark fuscous, hairy beneath towards base. Legs dark fuscous, coxæ densely hairy beneath, posterior legs ochreous-whitish. Forewings moderate, oblong, posteriorly somewhat dilated, costa slightly arched, apex obtuse, hindmargin not oblique, rounded beneath ; ochreous-brown, sometimes slightly reddish-tinged ; costal edge narrowly whitish-ochreous in male, ochreous-white in female, except near apex ; a straight moderately broad ochreous-white central streak from base to hindmargin slightly above middle, hardly narrower at extremities, more or less indented obtusely on both margins a little beyond middle, suffusedly margined above and beneath with dark fuscous : cilia shining grey, tips white. Hindwings dark grey, posteriorly still darker, pectinations grey-whitish ; cilia ochreous-white, with a shining grey basal line.

This species and *C. tritonellus* appear to differ from all the other New Zealand species of the genus by the hairy coxæ and undersurface of thorax, and probably mark the developmental connection with *Orocrambus*. *C. catacaustus*, although marked quite as in typical species of the genus, has a different superficial appearance from the much stouter build, the forewings much broader anteriorly and therefore more oblong, and the deep colouring, especially of the hindwings.

Arthur's Pass, taken commonly in swampy places at from 3,000 to 4,000 feet, in January ; flies with much activity.

22. *Cr. tritonellus*, n. sp.

Female.—22 mm. Head ochreous-white. Palpi, thorax, and abdomen ochreous-white mixed with dark fuscous ; palpi rather long. Antennæ whitish-grey. Legs whitish, coxæ hairy beneath. Forewings elongate-triangular, costa almost straight, apex rounded, hindmargin straight, oblique ; pale greyish-ochreous, somewhat mixed with fuscous ; costal edge obscurely whitish, posteriorly rather broadly suffused with whitish ; inner margin narrowly white towards base, margined above by a strong dark fuscous streak from base to $\frac{1}{3}$; a rather broad white central streak from base to middle of hindmargin, attenuated towards base, margined beneath from base to middle with dark fuscous, and cut by a faint greyish-ochreous line from near base of upper margin to beyond middle of lower margin ; veins on posterior half marked with strong dark fuscous streaks, two margining the central white streak, one within it obsolete: cilia white. Hindwings pale fuscous-grey, towards hindmargin darker, veins paler; cilia white.

Allied to *C. catacaustus*, which it agrees with in the hairy coxæ, but differing much in the strictly-triangular form of the forewings, and also in colour.

Castle Hill; one specimen received from Mr. J. D. Enys.

23. *Cr. ephorus*, n. sp.

Male.—32 mm. Head snow-white. Palpi very long, ochreous, above and internally snow-white. Antennæ grey-whitish, very shortly ciliated. Thorax snow-white, patagia deep ochreous-yellow. Abdomen grey-whitish. Legs light ochreous, posterior pair more whitish. Forewings very long, narrow, somewhat dilated posteriorly, costa slightly arched, apex round-pointed, hindmargin rather strongly sinuate, oblique; shining snow-white; extreme costal edge fuscous, becoming yellow-ochreous posteriorly; a rather broad straight bright deep ochreous-yellow stripe from base below middle to hindmargin above anal angle; inner margin narrowly ochreous-yellow from $\frac{1}{3}$ to anal angle: cilia snow-white, opposite submedian stripe and on anal angle whitish-ochreous. Hindwings pale whitish-ochreous-grey; cilia ochreous-whitish.

This handsome species is nearly allied to *C. angustipennis*, but much more clearly and brightly coloured; the forewings are equally long and narrow, but without the acute produced apex of that species, and the hindwings more greyish-tinged.

Arthur's Pass; one specimen taken at 4,800 feet, in January.

24. *Cr. crenæus*, n. sp.

Male, female.—32–36 mm. Head white, behind eyes ochreous-brown, towards middle of face whitish-ochreous. Palpi very long, light brownish-ochreous, above and internally white. Antennæ whitish, in male shortly ciliated. Thorax ochreous-white, patagia brownish-ochreous. Abdomen whitish. Legs brownish-ochreous, posterior pair whitish above. Forewings very elongate-triangular, costa moderately arched, apex round-pointed, hindmargin rather oblique, straight or faintly sinuate, rounded beneath; rather light brownish-ochreous, slightly brassy-tinged, somewhat browner in disc; a rather narrow almost straight white median streak from base to hindmargin slightly above middle; inner margin slenderly white near base: cilia white, sometimes partially slightly ochreous-tinged, beneath anal angle greyish-tinged. Hindwings whitish, faintly greyish-tinged; cilia white.

This species and the four following belong to the group of *C. vittellus*, and doubtless other allied species will be discovered. *C. crenæus* is readily known by the entire absence of all white marking except the central streak and the base of inner margin, the costa being wholly ochreous; it is also the largest species of the group. It most resembles *C. diplorrhous* and *C. dicrenellus*, but in both of these there is a clear white costal streak.

Arthur's Pass, from 3,000 to 4,500 feet; common in January, appearing to frequent rather damp places.

25. *Cr. enchophorus*, n. sp.

Male, female.—29–33 mm. Head white, behind eyes brownish-ochreous, centre of face somewhat ochreous. Palpi very long, brownish-ochreous, above and internally white. Antennæ dark fuscous, in male rather stout, dentate, moderately ciliated. Thorax light brownish-ochreous, with a white central longitudinal stripe. Abdomen whitish. Legs pale brownish-ochreous, posterior pair whitish. Forewings very elongate-triangular, narrow towards base, costa slightly arched, apex round-pointed, hindmargin oblique, nearly straight, rounded beneath; dull light brownish-ochreous; a slender white line immediately beneath costa from base to middle; veins on posterior half of wing suffused with white and obscurely margined with dark fuscous; a whitish suffusion towards inner margin throughout, towards base defined and margined above with dark fuscous; a rather narrow nearly straight white median streak from base to middle of hindmargin, unevenly margined with blackish throughout, posterior half slightly curved upwards; a curved transverse row of black dots towards hindmargin, and a hindmarginal row of similar dots: cilia white, faintly barred with very pale greyish-ochreous. Hindwings pale whitish-ochreous-grey; cilia white, base ochreous-tinged.

Allied to *C. callirrhous*, in which species the male has similar dentate antennæ (not mentioned in my description); but larger, with white markings (except median streak) considerably suffused, whilst *C. callirrhous* is specially characterized by their definiteness; distinguished also by the posterior and hindmarginal rows of black dots, and by the uppermost white line being distinctly subcostal, not costal, towards base.

Castle Hill, on dry slopes from 2,500 to 4,000 feet, in January; rather common, but apparently local.

26. *Cr. diplorrhous*, n. sp.

Male, female.—31–34 mm. Head whitish-ochreous, becoming white on crown. Palpi very long, light brownish-ochreous, above and internally white. Antennæ fuscous, in male subdentate, moderately ciliated. Thorax pale ochreous, with a suffused white central stripe. Abdomen whitish. Legs light ochreous, tarsi dark fuscous, posterior legs whitish. Forewings very elongate-triangular, narrow, not much dilated, costa slightly arched, apex round-pointed, hindmargin slightly sinuate, rather oblique, rounded beneath; pale brownish-ochreous, brassy-tinged, towards inner and hind margins paler; a narrow white streak almost along costa from base to apex, leaving extreme costal edge of ground-colour, more widely posteriorly, posterior extremity suffused; a moderate straight white central streak from base to middle of hindmargin, narrowed anteriorly; inner margin suffusedly white from base to beyond middle; cilia snow-white. Hindwings ochreous-grey-whitish, becoming greyer posteriorly; cilia white.

Very similar to *C. dicrenellus*, but with the apex of the forewings less pointed and the hindmargin less sinuate; readily distinguishable by the uppermost white streak being subcostal instead of costal.

Lake Wakatipu, taken commonly on the dry mountain slopes at from 2,000 to 5,000 feet, in December.

27. *Cr. pedias*, n. sp.

Male, female.—24–27 mm. Head white, behind eyes pale greyish-ochreous. Palpi very long, pale ochreous, above and internally white. Antennæ whitish, in male serrate, shortly ciliated. Thorax pale greyish-ochreous, with a central longitudinal white stripe. Abdomen grey-whitish. Legs whitish-ochreous, posterior pair whitish. Forewings very elongate-triangular, narrow, not much dilated, costa slightly arched, apex almost acute, hindmargin sinuate, oblique; very pale dull greyish-ochreous; costal edge except towards base, and all veins narrowly and suffusedly white, obscurely margined with fuscous; a whitish obscure suffusion towards inner margin; a narrow nearly straight white central streak from base to hindmargin somewhat above middle, slightly bent beyond middle, obscurely fuscous-margined; a row of small blackish dots along hindmargin: cilia shining greyish-white, with a shining whitish-grey basal line. Hindwings ochreous-grey-whitish, towards apex greyer; cilia white.

Most like *C. callirrhous*, but much duller and greyer, not brassy-tinged, and without the sharply defined white lines of that species; the antennæ are whitish, not distinctly dentate in male, and the hindmargin of forewings is somewhat more sinuate, distinctly dotted with black.

Masterton and Wanganui, on the grassy river-banks; common in March.

28. *Cr. paraxenus*, n. sp.

Male, female.—28–31 mm. Head white, on centre of face and behind eyes ochreous. Palpi very long, ochreous, above and internally white. Antennæ dark fuscous, in male serrate, moderately ciliated. Thorax pale ochreous, with a suffused white central longitudinal stripe. Abdomen whitish. Legs ochreous-fuscous, posterior pair whitish. Forewings very elongate-triangular, narrow at base, moderately dilated, costa gently arched, apex round-pointed, hindmargin almost straight, rather strongly oblique; light yellowish-ochreous, slightly brassy-tinged, sometimes fuscous-tinged in disc; extreme costal edge white from about middle to apex; a moderate straight white central streak from base to hindmargin somewhat above middle, lower edge rather irregular, narrowed towards base; inner margin very slenderly white towards base; a narrow white streak along hindmargin from extremity of central streak to apex: cilia pale shining grey, on upper half of hindmargin barred with white. Hindwings whitish-grey; cilia white.

Closely allied to *C. vittellus*, with which it agrees in the distinctly barred cilia of forewings, and resembling the most simply marked forms of that species, but constant; larger, more ochreous-yellowish, not fuscous; the antennæ of male somewhat more slender, the apex of forewings less pointed and the hindmargin not distinctly sinuate, the hindmarginal black dots absent, and the hindwings greyer, not ochreous-tinged.

Lake Wakatipu, on the dry mountain sides at from 2,000 to 5,000 feet; taken commonly in December.

29. *Cr. sophronellus*, n. sp.

Female.—19 mm. Head and thorax ochreous-white, coarsely irrorated with greyish-fuscous. Palpi long, whitish, externally irrorated with grey. Antennæ grey. Abdomen whitish, irrorated with grey. Legs grey-whitish. Forewings elongate, tolerably oblong, costa hardly arched, apex round-pointed, hindmargin straight, rather strongly oblique; greyish-fuscous, densely irrorated with white, and with a few black scales: cilia whitish-grey mixed with white, base white. Hindwings light fuscous-grey, towards hindmargin darker; cilia grey-whitish.

Nearly allied to *C. cyclopicus*, but shorter-winged, and immediately separated from it by the grey hindwings; possibly other specimens may possess distinct markings, since in the female of *C. cyclopicus* they are also sometimes quite obsolete.

One specimen received from Mr. R. W. Fereday, of uncertain locality.

30. *Cr. oncobolus*, n. sp.

Male, female.—24–27 mm. Head white. Palpi very long, white, externally slightly ochreous-tinged. Antennæ whitish, in male shortly ciliated. Thorax white or greyish-white, shoulders ochreous. Abdomen whitish-ochreous. Legs white, anterior pair internally fuscous. Forewings elongate, narrow, tolerably dilated, costa gently arched, apex round-pointed, hindmargin straight, oblique, strongly rounded beneath; pale fuscous; all veins suffused with white, more or less confluent towards costa posteriorly, and obscurely margined with dark fuscous; a narrow white central streak from base to middle of disc, its apex sharply hooked downwards, margined beneath throughout by a strong black streak finely attenuated at base, and its apex margined posteriorly with black; above the white central streak is a yellow-ochreous streak becoming dilated beyond it and suffused into ground-colour, and beneath the black streak a yellow-ochreous streak reaching apex of hook; an ill-defined strongly dentate blackish posterior transverse line, tending to separate into longitudinal dashes, sharply angulated outwards above middle, and sinuate inwards towards inner margin: cilia pale greyish, suffusedly barred with white, tips white. Hindwings pale grey; cilia whitish-grey.

Closely allied to *C. harpophorus*, which it resembles in form of wing, having the forewings therefore much narrower than in *C. strigosus*; readily separated from *C. harpophorus* by the absence of the sinuate dark-bordered white streak in middle of disc, and by the strong dentations and inward sinuation of the posterior line.

Castle Hill, from 2,300 to 2,500 feet, especially in the bed of the Porter River; common in January.

The following are additional localities for species of this family described in my former paper:—

Thinasotia leucophthalma, Meyr. Also taken in December.

Cryptomima acerella, Walk. Bealey River, at 2,100 feet.

Scenoploca petraula, Meyr. Also in January.

Diptychophora pyrsophanes, Meyr. Otira Gorge (to 3,000 feet), Castle Hill (2,500 feet), Christchurch and Dunedin; also in December.

D. interrupta, Feld. Arthur's Pass (3,000 feet).

D. auriscriptella, Walk. Otira Gorge (1,500 feet).

D. helioctypa, Meyr. I took this in December on hill-sides near Lake Wakatipu, at about 1,400 feet.

D. elaina, Meyr. Taranaki and Palmerston; occurs from November to March.

Crambus æthonellus, Meyr. Invercargill, nearly at the sea-level, in December.

C. ramosellus, Dbld. Taranaki, Lake Wakatipu and Invercargill, not above 2,000 feet. According to Butler's specimens in the British Museum, *C. leucanialis*, Butl., is merely a synonym of this species, and not of *C. angustipennis*, as formerly identified by me from the description and figure.

C. angustipennis, Z. Rakaia and Castle Hill (2,500 feet).

C. dicrenellus, Meyr. Castle Hill (2,500 to 3,000 feet), Arthur's Pass (4,000 to 5,000 feet).

C. haplotomus, Meyr. Castle Hill (2,500 feet), and in the bed of the Waimakariri River (2,100 feet).

C. callirrhous, Meyr. Castle Hill, in the bed of the Porter River (2,300 feet).

C. simplex, Butl. Napier and Lake Wakatipu (not above 2,000 feet).

C. vittellus, Dbld. Taranaki, Napier, Wellington, Lake Wakatipu and Invercargill (not above 2,500 feet); also in December. In one part of the

Hawke's Bay district I observed this species flying in immense profusion, literally in clouds; they must here have committed frightful ravages on the grass.

C. flexuosellus, Dbld. Taranaki, Lake Wakatipu and Invercargill; as a rule not above 2,000 feet, but at Lake Wakatipu I took a single isolated specimen at 4,500 feet, the species being at the time common at the lower levels.

C. tuhualis, Feld. Castle Hill (2,500 feet).

C. cyclopicus, Meyr. Napier; also in April.

C. harpophorus, Meyr. Arthur's Pass (2,500 feet), Lake Wakatipu (4,200 feet); also in December.

C. strigosus, Butl. Palmerston and Masterton.

C. xanthogrammus, Meyr. Castle Hill, in the bed of the Porter River (2,300 feet), and in that of the Waimakariri River (2,100 feet), taken commonly in January and February; this species sits persistently on the small bare shingle and gravel of the river-beds, the variegated colours of which it exactly imitates; if disturbed it flies a very short distance close to the ground, and settles again. The hindwings should have been described as light grey (not whitish).

Index of Genera.

Index of Species.

ART. XIII.—*Descriptions of New Zealand* Micro-Lepidoptera.

BY E. MEYRICK, B.A.

[*Read before the Philosophical Institute of Canterbury, 2nd October*, 1884.]

VII. TORTRICINA.—(SUPPLEMENTARY).

THIS paper is supplementary to that which I published on the *Tortricina* in the Transactions for 1882. It contains nine additional species, of which eight are new, the ninth having been previously known from the Hawaiian Islands ; and also some corrections of classification.

I propose to recast the definitions of the *Tortricidæ* and *Grapholithidæ* thus :—

Tortricidæ: Lower median veins of hindwings almost always without basal pectination ; vein 2 of forewings rising before posterior third of lower margin of cell; genital uncus of male developed.

Grapholithidæ : Lower median vein of hindwings pectinated with hairs towards base; vein 2 of forewings rising before posterior third of lower margin of cell ; genital uncus of male not developed.

I am indebted to Professor Fernald, well known as a special authority on this group, for the information on which this change is founded. He states that the genital uncus never occurs in the *Grapholithidæ*, and considers that such genera as *Ctenopseustis*, hereafter described, should be therefore referred to the *Tortricidæ;* which amounts to saying that the possession of the uncus is a more valuable systematic character than the possession of the basal pectination. As Professor Fernald has devoted much labour to the investigation of material from all parts of the world, there is little doubt that he is correct, and I have adopted his suggestion. I have not yet found leisure to examine the genitalia of all the *Tortricina* of this region, but I have investigated a few species, which appear to confirm his views; and in the case of the *Pyralidina* I have found the same character valuable for family separation. The genital uncus (when present) is a hard cylindrical, more or less downwards-hooked, process from the apex of the abdomen in the male, and in some groups of *Lepidoptera* assumes complex forms.

The occurrence of the Hawaiian *Chiloides straminea* is interesting, and may be compared with the presence of the genus *Heterocrossa* in both regions. Probably they extend over the intervening space, but I have not at present any evidence of this. The other additional species are all of genera already recorded from New Zealand, and mostly interesting as representatives of the old indigenous fauna. It seems probable that *Proselena*, *Harmologa*, and *Heterocrossa* will be found to be richer in species than I had previously anticipated. I think that *Cacœcia alopecana* is also peculiarly interesting in another way, from its bearing on general theories of development, since it is my opinion that although now justifiably to be regarded as a species, it has reached this stage only within extremely recent times; I think it would be interesting to experiment on the larvæ of this species with different food-plants, and conversely to try the effect of feeding *C. excessana* on *Phyllocladus*.

GRAPHOLITHIDÆ.

Chiloides, Butl.

Thorax smooth. Antennæ in male serrate, with whorls of moderate cilia. Palpi long, straight, porrected, triangularly scaled. Forewings with costa in male simple. Hindwings broader than forewings. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin, secondary cell well-defined. Hindwings with 8 veins, 3 and 4 remote at base, 4 and 5 almost from a point, 6 and 7 approximated towards base.

Allied to *Bactra*, Stph. (*Aphelia*, Stph.), but differing in the separation of veins 3 and 4 of the hindwings, and the longer palpi; only the species here given is known.

Chil. straminea, Butl.

(*Chiloides straminea*, Butl., Ann. Mag. Nat. Hist., 1881, 393.)

Media, alis ant. ochreis, venis omnibus lineisque inter venas punctatis, puncto etiam disci postico nigrescentibus; post. griseis.

Male, female.—17–24 mm. Head, palpi, antennæ, and thorax pale ochreous. Abdomen whitish. Legs pale ochreous, posterior pair ochreous-whitish. Forewings elongate, oblong, costa moderately arched, apex round-pointed, hindmargin slightly sinuate, rather strongly oblique; light ochreous; all veins marked with fine fuscous or blackish lines; intervenal spaces also marked each with a fine incomplete, often interrupted or dotted, fuscous or blackish line; a larger dark fuscous dot in disc beyond middle; inner margin dotted with black: cilia pale ochreous. Hindwings grey, towards base lighter; cilia white, with a grey line.

Recalls some forms of *Bactra lanceolana*, Hb., from which it is easiest separated by the structural characters.

Hamilton, Taranaki, Wanganui, and Otaki; common amongst rushes (*Juncus*) in swampy ground, from January to March. Also occurs in the Hawaiian Islands, from which it was originally described; I have seen Butler's type, and there is no doubt whatever of its identity; probably therefore it will be found to range through all the Pacific islands.

Bactra, Stph.

This generic name should be substituted for *Aphelia*, Stph., of which *lanceolana*, Hb., is the representative in New Zealand. I make this change on the authority of Professor Fernald, who has specially investigated the point, and is doubtless correct.

TORTRICIDÆ.

Pyrgotis, Meyr.

Pyrg. eudorana, n. sp.

Media, alis ant. ochreo-rufis, area basali externe non angulata, fascia media perobliqua latiore recta, strigulaque subapicali saturatioribus, ciliis purpureo-fuscis; post. flavido-albis, apice flavidiore.

Female.—20 mm. Head, palpi, and thorax purplish-ochreous. Antennæ ochreous-whitish. Abdomen and legs yellow-whitish, anterior and middle pair suffused with reddish-fuscous. Forewings broad, oblong, costa anteriorly very strongly arched, apex round-pointed, produced, hindmargin strongly sinuate, hardly oblique; purplish-ochreous, obscurely strigulated with greyish-purple; a slightly darker purplish basal patch, its outer edge extending from $\frac{1}{5}$ of costa to $\frac{2}{5}$ of inner margin, not angulated; central fascia straight, broad throughout, greyish purple, suffused with bright reddish-ochreous on upper half posteriorly, running from middle of costa to anal angle; a more distinct strigula from $\frac{3}{4}$ of costa to hindmargin below middle: cilia rather dark fuscous purplish. Hindwings yellow-whitish, towards apex more yellowish, somewhat spotted with pale grey towards inner margin; cilia yellow-whitish.

A handsome species, readily known by the different form of wing, straight outline of basal patch, and broad central fascia; the costa is very much more strongly arched anteriorly than in any other species. Although the male is not known to me, I have no doubt of the generic position.

Taranaki, in February; one specimen amongst forest.

Proselena, Meyr.

Pros. elephantina, n. sp.

Magna, alis ant. albido-ochreis, linea disci breviore obscura, punctisque plerisque posticis sparsis nigris; post. albidis.

Male.—27 mm. Head, palpi, and antennæ whitish-ochreous, palpi externally fuscous-tinged. Thorax pale yellowish-ochreous. Abdomen and legs whitish-ochreous, anterior and middle pair infuscated. Forewings elongate-triangular, costa slightly arched, apex round-pointed, hindmargin hardly perceptibly sinuate, oblique; whitish-ochreous; a cloudy central streak from base to beyond middle more yellowish-ochreous, containing several small dots of black scales, and an ill-defined longitudinal blackish line in disc, extending from $\frac{1}{3}$–$\frac{2}{3}$; some fine scattered black dots towards hindmargin: cilia pale whitish-ochreous. Hindwings and cilia whitish.

Singularly distinct by its comparatively gigantic size, pale colouring, and blackish discal line.

Arthur's Pass, in January; one specimen on the grassy mountain-side at 4,700 feet.

Pros. eremana, n. sp.

Parva, alis ant. fusco-ochreis, innotatis; post. saturate griseis.

Male.—12–14 mm. Head, palpi, and thorax brownish-ochreous. Antennæ dark fuscous. Abdomen dark grey. Legs whitish-ochreous. Forewings elongate-oblong, costa moderately arched, apex round-pointed, hind-margin straight, oblique; uniform brownish-ochreous: cilia light brownish-ochreous. Hindwings dark grey, posteriorly still darker; cilia pale grey or whitish, with a grey line.

Closely allied to *P. siriana*, Meyr., but lighter, more ochreous, and recognizable by the absence of any discal dot in the forewings, and the paler cilia of the hindwings.

Castle Hill (2,500 feet), and Invercargill, frequenting swampy ground; taken commonly in December and January.

Pros. zatrophana, Meyr.

(*Harmologa zatrophana*, Meyr., Trans. N.Z. Inst., 1882, 46.)

Having obtained what I believe to be undoubtedly the male of this species, I find that there is no costal fold, and the species is therefore referable to *Proselena.* As the male is distinctly marked, and these markings were lost in the dark suffusion of the female, I give a diagnosis and description of the former.

Parva, alis ant. læte ochreis, albido-maculosis, fascia antica angusta obliqua, altera media latiore perobliqua cum tertia postica erecta sub medio confluentibus, hac lineas duas plumbeas metallicas includente, rufo-ochreis, nigro-mixtis; post. saturate fuscis.

Male.—11–12 mm. Forewings bright ochreous, irregularly and suffusedly spotted with whitish; markings deep reddish-ochreous, somewhat mixed with blackish; a narrrow straight fascia from before $\frac{1}{4}$ of costa to beyond $\frac{1}{3}$ of inner margin; a moderately broad very oblique fascia from costa before middle, confluent in middle of disc with a similar straight fascia from $\frac{3}{4}$ of costa to inner margin before anal angle, the latter fascia containing two irregular incomplete metallic-grey transverse lines: cilia bright ochreous, towards tips paler. Hindwings dark fuscous; cilia grey-whitish, with a dark grey basal line.

Common in Arthur's Pass from 2,600 to 3,000 feet, flying freely over thick herbage in January.

HARMOLOGA, Meyr.

Harm. oblongana, Walk.

Larva 16-legged, rather stout, cylindrical, somewhat tapering at both ends; dull grey; dorsal slender, dark grey; subdorsal indistinctly darker than ground-colour; spots small, pale, dark-centred; head and second segment dark fuscous. Feeds on *Discaria toumatou*, forming a shelter of very dense web, and loose silken galleries along the branches. I found these larvæ at the beginning of February, near Castle Hill; from their habit I was led to expect one of the *Pyralidina*. They are doubtless not confined to this food-plant.

Harm. latomana, n. sp.

Media, alis ant. albis, area basali bis secta externe perobliqua, fascia media cum macula costæ postica tripunctata per dentem fere connexa, altera etiam e margine postico in angulum analem percurrente flavido-fuscis, nigro-mixtis; post. albis, apice griseo-suffuso.

Female.—20 mm. Head whitish, spotted with ochreous behind antennæ. Palpi whitish, towards apex of second joint ochreous. Antennæ blackish. Thorax blackish, somewhat mixed with ochreous, apex of patagia and posterior margin white. Abdomen and legs whitish, anterior tarsi dark fuscous internally. Forewings elongate-oblong, costa strongly arched towards base, somewhat sinuate beyond middle, apex very obtusely rounded, hindmargin slightly rounded, hardly oblique; white, with a few grey scales; markings fuscous, densely mixed with yellow-ochreous and black; basal patch with outer edge straight, very oblique, from $\frac{1}{5}$ of costa to beyond middle of inner margin, cut in middle and beneath costa by two very irregular longitudinal streaks of ground-colour; central fascia moderate, from before middle of costa to anal angle, anterior edge connected with basal patch above middle and on inner margin by cloudy fuscous bars, posterior edge giving rise in middle to a strong irregular projection almost or quite touching an elongate spot which extends along costa from middle to near apex, and contains three white dots; a small spot on costa immediately before apex; a tolerably straight irregular fascia from hindmargin above middle to lower extremity of central fascia; an irregular hindmarginal line: cilia pure white, base ochreous spotted with dark fuscous. Hindwings white, suffused with grey towards apex; cilia white.

A very distinct species, but evidently allied to *H. ænea* and *H. siræa*.

Arthur's Pass, at 4,700 feet, in January; one specimen.

Harm. siræa, n. sp.

Media, alis ant. ♂ ochreis, costa late ochreo-rufa, ♀ dilute stramineis; post. ♂ griseis, apicem versus saturatioribus, ♀ albis.

Male.—21 mm. Head, palpi, and thorax brownish-ochreous mixed with grey; thorax hairy beneath. Antennæ stout, dark fuscous. Abdomen grey-whitish. Legs whitish-ochreous. Forewings moderate, oblong, costal fold very short, costa moderately arched towards base, thence straight, apex obtusely rounded, hindmargin rounded, not oblique; yellow-ochreous, becoming deeper towards inner margin; a broad reddish-ochreous-brown streak along costa from base to apex, becoming deep ashy-grey towards costa, pointed at apex; extreme costal edge whitish: cilia pale grey, tips whitish. Hindwings grey, becoming dark grey posteriorly, costa suffusedly yellow-whitish; cilia yellow-whitish, with an indistinct greyish line.

Female.—22–23 mm. Head, palpi, and thorax yellowish-white. Antennæ whitish. Abdomen and legs white, anterior and middle pair light ochreous. Forewings as in male, but hindmargin straighter; whitish-yellowish, interspersed with pale-greyish; costa suffusedly white: cilia white, base whitish-yellowish. Hindwings white, towards inner margin faintly suffused with very pale greyish; cilia white.

Allied to *H. ænea*, but smaller, and distinguished in both sexes by the absence of yellow in the hindwings; in the male also by the conspicuous dark costal stripe; in the female by the pale yellowish forewings.

Arthur's Pass; four specimens (1 male, 3 females) taken in a grassy place at about 4,500 feet, in January.

Ctenopseustis, n. g.

Thorax smooth. Antennæ in male shortly ciliated. Palpi moderate, porrected, second joint roughly scaled. Forewings in male with strong costal fold. Hindwings broader than forewings, lower median vein with strong basal pecten. Forewings with 12 veins, 7 and 8 separate, 7 to hindmargin. Hindwings with 8 veins, 3 and 4 from a point, 5 approximated to 4 at base, 6 and 7 from a point. Abdomen in male with genital uncus well developed.

Cten. obliquana, Walk.

(*Pædisca obliquana*, Walk.; Meyr., Trans. N.Z. Inst., 1882, 60.)

Professor Fernald assures me that the genital uncus of the male (the value of which as a divisional character he has been the first to discover in this group) is never developed in the *Grapholithidæ*, and that this species (of which I sent him specimens) should therefore be included in the *Tortricidæ*, notwithstanding the pectination of the lower median vein, this latter structure being indeed also found in *Œnectra*, which is certainly referable to the *Tortricidæ*. In this view I quite concur, and therefore place the species here, which involves the formation of a new genus for its reception as above, since it differs from *Œnectra* by the costal fold and separations of veins 7 and 8 of the forewings, and from the rest of the family by the basal pecten of the hindwings.

Epalxiphora, Meyr.

The characters given for this genus are in part quite erroneous; this is in some measure due to my having mistaken my single specimen for a male, whilst it proves to be a female; I have since obtained several specimens of both sexes, and therefore give a fresh and more correct characterization of the genus, with some additions to the specific description, as the species is found to be very variable. Moreover the development of the genital uncus proves that the genus must be transferred with the preceding to the *Tortricidæ*; it differs from *Œnectra* by the costal fold, from *Ctenopseustis* by the stalking of veins 7 and 8 of the forewings, from both by the triple thoracic crest. The combination of characters in this genus is very interesting.

Thorax with a large erect crest on each side of back, and a small double crest behind. Antennæ in male shortly ciliated. Palpi moderate, straight, porrected, second joint with appressed scales. Forewings in male with strong costal fold. Hindwings broader than forewings, lower median vein with strong basal pecten. Forewings with 12 veins, 7 and 8 stalked, 7 to near below apex. Hindwings with 8 veins, 3 and 4 separate, 3, 4, and 5 more or less closely approximated at base, 6 and 7 stalked. Abdomen in male with genital uncus well developed.

Epalx. axenana, Meyr.

Male, female.—19–26 mm. Forewings in male with apex less produced, hindmargin more perpendicular; very variable; markings always of same form but differing much in intensity, sometimes mixed with ochreous-greenish, or partially blackish; in both males the markings are suffused with blackish towards costa; in one female the whole dorsal half of wing beneath a straight line from middle of base to apex suffused with blackish, costal half unusually light. Hindwings in male pale grey; in female often more or less ochreous posteriorly.

Seven specimens (2 males, 5 females), taken at Palmerston and Taranaki, amongst forest; in March.

CACŒCIA, Hb.

Cac. alopecana, n. sp.

Minor, alis ant. ochreo-rufis, area basali, fascia media obliqua inferius dilatata, maculaque costæ postica interdum saturatioribus, sæpius obsoletis; post. albidis, griseo-maculosis, apice rufescente; antennarum ciliis longis.

Male, female.—15–17 mm. Head, palpi, and thorax reddish-ochreous-brown. Antennæ dark fuscous, in male with joints sharply angularly dilated at apex, ciliations long, twice the width of the joint. Abdomen whitish-ochreous. Legs ochreous-brown, anterior tibiæ and tarsi dark fuscous, posterior pair ochreous-whitish. Forewings moderate, in male triangular, in female tolerably oblong, costa moderately arched, apex obtuse, hindmargin sinuate, slightly oblique; reddish-ochreous-brown, varying in intensity, with numerous small dark leaden-grey spots, which are stronger and more purplish in female; an indefinable basal patch, a central oblique fascia apparently dilated on lower half, a triangular costal spot, and a hind-marginal suffusion sometimes obscurely darker, but generally obsolete: sometimes some evenly-scattered black dots, especially towards hindmargin:

cilia reddish-ochreous-brown, becoming whitish-ochreous at tips, on anal angle dark grey. Hindwings whitish, spotted with grey except posteriorly, apex reddish ; cilia whitish, with an obscure grey basal line.

I am compelled to separate this species from *C. excessana* on account of the structural difference in the antennæ of the male ; otherwise I should certainly have regarded it as a mere variety. It is constantly much smaller than the average of that species, but *C. excessana* is occasionally quite as small ; it is also much redder, and the hindwings are more clearly whitish, but these points are quite indefinable, and would not be sufficient for demarcation ; moreover I conceive that the diminished size and the reddish colouring of both larva and imago are the direct effect of the peculiar foodplant. But the antennæ of the male are in *C. excessana* tolerably filiform, the joints hardly dilated, the ciliations not longer than the width of the joints ; whilst in *C. alopecana* they are conspicuously serrate, the joints almost triangular, and the ciliations much longer, fully twice the greatest width of the joints. These differences are quite constant, and must be regarded as sufficient.

Larva 16-legged, moderate, cylindrical, somewhat tapering at both ends ; variable, yellowish to ochreous-fuscous ; segmental incisions and sometimes sides ochreous-carmine ; spots large, pale, in some lights whitish ; head and second segment ochreous-fuscous. Feeds in spun shoots and between joined leaves of *Phyllocladus alpinus* (*Coniferæ*), in January. Pupa in the same position.

I took two specimens in the forests on the Bealey River (2,100 feet) in January, and at the same time found larvæ feeding, from which I bred three more specimens in February.

CONCHYLIDIDÆ.

This form of the name, which is orthographically the more correct, should be substituted for *Conchylidæ*.

HETEROCROSSA, Meyr.

The pectination of the lower median vein of the hindwings in this genus is, so far as I can ascertain, confined to the female ; the male does not possess any trace of it. I had originally supposed that this was due to denudation in the case of the two or three male specimens which I possessed, but having since acquired more material, I find it to be the normal structure. I think however that the point is not less valuable for generic separation ; in the female of *Paramorpha*, which is the nearest allied genus, this well-developed pecten does not exist.

Het. cryodana, n. sp.

Minor, alis ant. albis, griseo-irroratis, strigula e basi sub costa breviore, squamis paucis sparsis, interdum etiam striga disci media nigris ; post. griseo-albidis.

Male, female.—16–17 mm. Head and thorax white, slightly speckled with grey. Palpi in male moderate, in female long; lower half dark fuscous, upper half white. Antennæ whitish. Abdomen and legs ochreous-whitish, anterior and middle pair dark fuscous except apex of joints. Forewings elongate, narrow, tolerably oblong, costa moderately arched, apex round-pointed, hindmargin straight, very oblique; white, densely irrorated with pale fuscous-grey; a short black streak from base beneath costa; tufts preceded by a few black scales; sometimes a thick irregular blackish longitudinal streak in disc, extending from $\frac{1}{4}$–$\frac{2}{3}$; cilia white, densely irrorated with pale grey. Hindwings grey-whitish; cilia whitish.

Characterized by the short black subcostal streak. The arrangement of the surface tufts of scales appears to be the same in all the species.

Dunedin and Invercargill, in September; three specimens from *Leptospermum.*

Het. epomiana, n. sp.

Minor, alis ant. dilutissime griseis, partim albo-conspersis, macula costæ basali nigra, maculis costæ sex parvis, aliisque disci plerisque obscuris fuscis; post. griseo-albidis.

Female.—17 mm. Head and thorax white, irrorated with light grey. Palpi rather long, lower half dark fuscous, upper white. Antennæ whitish. Abdomen and legs ochreous-whitish, anterior pair suffused with dark fuscous, middle pair greyish. Forewings elongate, narrow, oblong, costa moderately arched, somewhat bent at $\frac{1}{3}$, apex round-pointed, hindmargin slightly sinuate, rather strongly oblique; very pale grey, irrorated with white towards costa and hindmargin, and with scattered dark fuscous scales; a blackish elongate spot along costa at base; a blackish dot above inner margin near base; costa with six small fuscous spots between $\frac{1}{3}$ and apex; discal and posterior tufts also preceded by small obscure fuscous spots: cilia pale grey mixed with whitish. Hindwings and cilia grey-whitish.

Easily recognizable by the conspicuous elongate black spot on base of costa.

Otira River; one specimen amongst forest at 1,600 feet, in January.

Art. XIV.—*Description of a small Lizard, a Species of* Naultinus, *supposed to be new to Science.* By W. Colenso, F.L.S.

[*Read before the Wellington Philosophical Society, 1st October* 1884.]

Naultinus versicolor, sp. nov.

General Colour.—Above light brownish-black or dark grey, spotted with small dark spots; six broad dark-umber zig-zag, or double VV, shaped bands across the body, and nine similar ones across the tail, 15 in all, and regularly placed, having lighter scales in the anterior angles; a dark line from the lower angle of eye to that of mouth, and another from the upper angle of eye to over the ear; a narrow dark transverse band from eye to eye in front, and a cross dark band (St. Andrew's Cross) on vertex; below of a light-greyish colour with small dark spots.

Vertex depressed; eyebrows very prominent (porrected) with 2–3 rows of dark pointed scales, upper row black: snout very obtuse; on both upper and lower lips, 11 large greyish scales on each side of the rostral ones which are much larger, but the upper rostral is larger than that of the chin, and extends to the nostrils; two large scales immediately above the upper rostral one, and four similar scales around each nostril; nostrils circular; aural apertures oblong, large. A number of small pointed simple glassy teeth in both jaws; tongue roundly-spathulate, very long and extensible, thin, deeply emarginate, red; the palate salmon-colour. Body narrow and round, back arched, not broad and flat as in *N. pacificus*. Toes all regularly barred with blackish lines; the fourth toe is the longest on each foot, and at a great distance from the fifth one on the hind feet, the soles also of the hind pair are large and flat. Its tail is very prehensile, so that it can curl its tip around a lead pencil, or a quill, and swing thereby; it can also hang by a single toe-nail (which are exceedingly sharp pointed and curved) and so remain for a short time; it also leaps well and fearlessly from a height of 2–3 feet. Length—head and body, 4 inches; tail, $4\frac{1}{2}$ inches $= 8\frac{1}{2}$ inches.

Hab. In forests near Norsewood, County of Waipawa; 1883: W.C. Also at Glenross, County of Hawke's Bay; 1884: Mr. D. P. Balfour.

Obs. I obtained two fine living specimens of this lizard last summer while in those woods; and one since, a smaller one, also living, from Mr. Balfour; this last is still living, although it has not eaten anything since I received it nearly six weeks back. It has only taken at intervals of several days a very little water, and this when I put it into a wash-hand basin to take a swim; when, on taking it out, it invariably licks up a few drops. Hitherto it has refused flies, as food, which my other lizards always greedily ate; and I have supposed such might be owing to its hybernating season not being over. It is exceedingly quiet, and rarely moves about. Their peculiar and regular double VV dark and variegated bands are the same in all three specimens; but it is not from that fact that it derives its trivial name, but from a much more strange one (though not wholly unknown to the family), viz., it often changes its ground-colour of grey to a pink-red, and this it does sometimes three or four times in a day; the cause, however, of its doing so is wholly unknown to me. I have often tried, by altering its position as to light, and to heat (sun), and also by giving it a little gentle shaking (in its glass house!) if I could cause it to change its colour, but I have never once succeeded; it seems to be entirely dependent on itself (possibly emotional), and not arising from any outward cause—nor from the time of day; neither is it regular in its changes. At first, I was a little astonished, and could scarcely believe my own eyes, until I had repeatedly proved the event; the change of colour is always equally the same, extending all over its body.

This lizard is also infested with a tiny red parasite, that sticks on between its scales in the outer angles of the thighs of its hindlegs, where it lives together in little clusters of 12–16. This parasite has a thickish body, rather soft, and is very difficult to remove entire. I suppose it to be an insect of the *Hemiptera* order. I have sent specimens of it to Professor Hutton at Christchurch, and to Mr. Maskell at the Museum, Wellington, for examination, etc.

Art. XV.—*A Description of some newly-discovered New Zealand Insects believed to be new to Science.* By W. Colenso, F.L.S.

[*Read before the Wellington Philosophical Society, 1st October*, 1884.]

INSECTA.

Order ORTHOPTERA.

Section Gressoria.

Family Phaomidæ.

Division Apterophasminæ.

Genus *Bacillus.*

1. *Bacillus coloreus*, sp. nov.

Female; General colour light green; the two basal joints of antennæ (under-surface), the throat, and the upper long curved ends of anterior femora bright pink-red.

Head oblong, rather narrow, 8–9 short scattered muricated points on vertex; occiput broad, width of prothorax; maxillary palpi finely pubescent; antennæ 12 lines long, very slender, cylindrical, pubescent, composed of 22 joints, articulations pink-red, the basal joint large broad and flattish and green on the upper surface, the second basal very small, the rest large, brownish-green with a pink tinge, increasing in size to apex.

Body mostly smooth, $3\frac{1}{2}$ inches long, stout, increasing in size to 3rd abdominal segment where it is $3\frac{1}{2}$ lines wide, a narrow slightly-winged crease or fold with a light-yellow margin extending downwards from anterior legs, giving the appearance of double side margins to the abdomen, which is 19 lines long; a small triangular central dark-brown spot at occiput, another at lower end of pronotum, with a very narrow dark line connecting them; a similar spot at lower ends of meso- and metanotum, and one at the lower end of every joint (*sternites*) of abdomen, these latter are reddish; prothorax 3 lines long, plain; mesothorax 8 lines long with a few scattered small green points and two larger ones (small spines) on the mesonotum; metathorax 7 lines long and (with mesothorax) broadest at the lower end.

Legs long, rather slender, triangular, striated; striæ pinkish-brown; 2 small spines at lower ends of tibiæ; tarsi very pubescent, tibiæ slightly so, also the anterior femora between spines; ungues large, divergent, glabrous, piceous: anterior pair, femora much shorter than tibiæ, and deeply excised at upper end for more than 2 lines; 5 coloured distant spines on lower outer margin, the upper outer margin sinuate and uneven, with a tubercle on each side under coxæ; coxæ large, stout, brownish, wrinkled: middle and posterior pairs with 4 small brown spines at lower end of femora. Ovipositor large, rounded and slightly pubescent; anal appendages thin at tips pubescent.

The *eggs* of this insect are peculiar and worthy of a full notice. They somewhat resemble the seeds of a flowering garden-pea; being slightly sub-4-angled in compressed parallelograms 2 lines long and 1 line broad, of a reddish-grey or light chocolate colour, a transverse section being linear-elliptic; their ends truncate with margins produced and rough, one end convex and one end umbonate with a little produced central boss or blunt mucro; the shell is crustaceous, slightly hardish, roughish, and much furrowed irregularly with impressed angular markings rather prettily disposed; one of the lateral edges is smooth, produced a little and thickened, having near the narrower end of the egg a large ovate depression with a raised little seam around it, resembling also the hilum of a leguminous seed: nine eggs weigh two grains.

A female, that I kept alive for some time under glass, laid 54 eggs in a fortnight, in the latter half of June; this she did by merely dropping them, without moving or showing any solicitude. She lived for three weeks, feeding on the bark of the young branches of arbor-vitæ (*Thuja occidentalis*), which she greedily ate, gnawing it off all round very cleanly. The fæces were plentiful and regularly formed in small narrow cylindrical brownish roughish rolls, 1½ lines long, somewhat resembling the withered tips of the branchlets of the shrub on which she lived.

Hab. At Pourerere, E. Coast, near Blackhead, County of Waipawa; 1884: Mr. Wm. Scott.

Obs. I. I have subsequently (two months later) received from Mr. Scott another living specimen of this insect, also a female, and precisely agreeing with the former one received from him. This second specimen, however, was not pregnant (very likely had laid her eggs before capture), she would not eat and only lived a few days. And again, since writing the foregoing, I have received from him a third specimen, this one being a male; it is smaller and slenderer and more smooth, but agreeing in every other particular.

II. As a species it is apparently allied to *B. hookeri*, but very distinct. In its many and bright colours, the configuration of its head and anterior femora, it approaches species of the allied Australian genus *Phasma* (*Diura*).

2. *Bacillus filiformis*, sp. nov.

Colour fulvous irregularly variegated with brown.

Head dull-grey, sub-triangular, broadest in front, convex at vertex, smooth; eyes very prominent at angles, neck narrow; antennæ setaceous, $1\frac{1}{2}$ inch long, very roughly pubescent, brownish-yellow ringed with 23 black knobbed joints (reminding of a miniature stem of *Dendrobium lessonii*), apical joint longer than each of the three following, and the middle joints longest, with a small whitish protuberance on each horn about the middle.

Body very slender, length 4 inches, breadth 1 line, a little more at joints of abdomen; prothorax very small, 2 lines long, smooth, with a central longitudinal ridge; mesothorax 11 lines long, with several large spines above and below; metathorax 10 lines long, one pair of spines above, four below; spines distant, stout, coarse, black; abdomen knobbed at joints, two spines below first segment, with a small tubercle under each joint on the sides; appendage broadly triangular, tips finely pilose; anal extremities obtuse, thickened.

Legs very slender, striate or sub-angular, pilose; ungues small, pubescent: anterior pair, two small spines at lower end of femora, tibiæ tetragonal, $1\frac{1}{4}$ inch long, much longer than femora: middle pair, with six stout black spines at lower end of femora, and one very small spine on the inner margin at $\frac{1}{4}$ of the length from coxæ, and a small elevated spine on outer margin of tibiæ at $\frac{1}{4}$ of the length from the basal joint: posterior pair with two small spines at the lower end of femora.

Hab. Woods, Seventy-mile Bush, Waipawa County; 1883: W.C.

Obs. A peculiar dry-looking, rigid, slender form. Apparently a scarce species; only one perfect specimen seen.

3. *Bacillus minimus*, sp. nov.

Colour light green. Body smooth, $8\frac{1}{2}$ lines long, $\frac{1}{2}$ line broad. Head 1 line long; antennæ 1 line long, pinkish, finely pubescent, composed of 9 joints, the lowest two light green, basal large flattish, the apical one longest linear-oblong obtuse. Thorax (notum) with a central pinkish longitudinal broad stripe, vanishing at sides; prothorax $\frac{3}{4}$ line long, slightly wrinkled; mesothorax $1\frac{1}{2}$ lines, metathorax $1\frac{1}{4}$ lines, long; prosternum a triangular scale with a rounded apex.

Legs finely striate; two minute spines at the lower end of femora: anterior pair of femora with a long ridge on the upper margin; tarsi and tibiæ finely pubescent; lowest joint of tarsus flat, broad. Abdomen 4 lines long; anal appendages finely pubescent. Weight barely 2 grains.

Hab. On trees and shrubs, Norsewood, Waipawa County; 1884: W.C.

Obs. This interesting, slim, delicate, and fairy-like little creature, is by far the smallest species of the genus known to me; it differs in several respects from its congeners, particularly in its antennæ. It moves very slowly. At first I had supposed it to be merely the larval state of one of the larger species, but its fully developed antennæ, etc., forbid such a supposition.

4. *Bacillus atro-articulus*, sp. nov.

Female: General colour greenish-grey blotched with brown, bearing a slight iridiscent hue. Head ochraceous, oblong, 3 lines long, wider than prothorax, genæ gibbous, vertex depressed, a sub-lunate ridge between the eyes, with two small pits (foveolæ) between ridge and base of antennæ; nine large black spines on the occiput, and a single tubercle just above each eye; antennæ slender, pubescent, 10 lines long, composed of eighteen joints, apical one the longest; palpi pubescent. Prothorax 2 lines long, two black spines at lower edge of pronotum; prosternum smooth: mesothorax 7½ lines long, six spines in three pairs on mesosternum, several scattered and one large pair of black ones central on mesonotum, and a regular longitudinal row of five small spines on the pleura extending down to intermediate coxæ: metathorax 8 lines long, two pairs of spines on metasternum and three pairs on metanotum, with a similar row of five small spines on pleura extending to posterior coxæ. Abdomen rather stout, 1¾ inches long, mostly smooth, wrinkled longitudinally below; two short blunt spines above on apical end of each segment, decreasing gradually in size downwards; two small tubercles below at apical end of the first segment, the end of the sixth segment has foliaceous sides and one large central spine below, with a thick ridge running from it to the middle of sheath of ovipositor: anal appendages large bearing scattered black hairs. Legs rather short; all having a ridge of double black spines at the apical ends of femora, and two spines at apical ends of tibiæ, and all joints black at their apical ends, but the terminal joints of the tarsi are light glaucous-green; tarsi and ungues are very hairy, the tibiæ and femora slightly so; hairs black:—anterior pair, coxæ with two black spines below; femora 10 lines long with four sharp angles deeply sulcated between, bearing a single row of six large spines on the lower edge, the upper edge sinuous and bearing three minute and distant spines; the upper excised portion 4 lines long with an elevated sharp ridge; tibiæ of equal length, very slender, smooth; the basal joint of anterior tarsi longer than those of the two posterior pairs: middle and posterior pairs, femora four-angled, narrow above broad and flat below with spines on all four edges; of the middle pair the femora and tibiæ are of equal length, 7 lines long, with an elevated spine on the outer edge of the tibiæ at the upper end: posterior pair, femora and tibiæ also of equal length, 8 lines long.

Hab. Seventy-mile Bush, near Norsewood, County Waipawa; 1883: W.C.

Obs. I may also note that this specimen had lost its anterior left leg, and that a new one was growing to replace it. This new leg is very small and slim, less than 1 inch in total length, but agreeing in all minute particulars with the right one, save that its more salient points were not fully developed. I suspect this loss of limb is a matter of rather common occurrence among the *Bacilli*,—from the great length of their slender legs, their habitat among the green leaves of trees in the exposed windy branchlets, and their known fighting and cannibal propensities. I have already noticed an instance of similar mutilation, in my description of *B. sylvaticus* (Trans. N.Z. Inst., vol. xiv., p. 278).

Section SALTATORIA.

Family LOCUSTIDÆ.

Genus *Deinacrida.*

Deinacrida armiger, sp. nov.

Male: Whole insect smooth and shining and variously coloured.

Head large, oblique, broadly ovate, 1 inch long, rather wider than prothorax, bright dark red-brown, vertex much convex; eyes prominent subpyriform; antennæ setaceous, $3\frac{3}{4}$ inches long, light brown, finely and densely pubescent; a lighter-coloured ridge between eyes and antennæ with a linear oval centre; clypeus black with a narrow white lower margin bearing two dark longitudinal streaks; genæ rugose, protuberant, black; labrum large, emarginate, brown; palpi light tawny, largely clavate, tips sub-globular, whitish, pubescent; mandibles large, black and toothed, sub-rugulose, the left mandible larger and overlapping. Thorax: prothorax 4 lines wide, concave, sub-rugulose, whitish with a slightly reddish tinge, and blackish markings resembling a shield and its two supporters, and with narrow black anterior and posterior margins, side-margins slightly reflexed; mesothorax 2 lines wide, reddish-brown, with two minute black markings and a black dot on each side; metathorax 1 line wide, of a similar colour and two black dots; sternum of thorax, coxæ, and femora below, light fulvous-red. Abdomen thick, convex, compressed, 13 lines long, much arched at second and third segments, light reddish-brown, irrorated, with blackish bands on lower margins of segments, and a reddish-pink hue on the lighter-coloured parts; anal appendages greyish, pubescent. Legs:

posterior pair very stout and long, femur and tibia each about 10 lines; anterior pairs much smaller; anterior and intermediate coxæ armed with a large light-fulvous spine; the upper surface of all femora whitish with a reddish tinge, smooth, each having three longitudinal lines of short dark-brown diagonal streaks on the outer, and two lines on the inner side, but on the posterior pair those two inner rows possess short muricated points, this latter pair is also sulcated on the lower side and black at the lower end, and bears five spines on the outer and six smaller ones on the inner edge, each row gradually increasing in size downwards; posterior tibiæ very stout, dark brown, triangular, four large spines on the outer and five on the inner edge, and five spines together at the lower ends; anterior and intermediate tibiæ 7 lines long, brown, each having five pairs of spines on the lower edge, and two spines on the upper edge at the lower end; a sunken oval depression $1\frac{1}{2}$ lines long, covered with a bluish-grey spotted and thin membrane, on both sides of anterior tibiæ near the upper end: tarsi, brown, hairy; ungues and tibiæ slightly so; pulvilli (or four cushions on sole) remarkably large, hemispherical, glabrous, bluish-grey.

Hab. Wairoa, Hawke's Bay, whence received in spirits; 1884: W.C.

Obs. This is both a peculiar and pretty species, something dapper and taking about it, from its many and bright contrast colours; the dark markings on the light ground of the prothorax are symmetrical and curious, and closely resemble a 6-angled shield with its two supporters! Hence its trivial name. It seems allied to *D.* (or *Hemideina*) *megacephala*, Buller; and possesses characters belonging to those two genera,—if they are really and naturally distinct, which I doubt.

Order NEUROPTERA.

Family Myrmeleonidæ.

Genus *Myrmeleon.*

Myrmeleon novæ-zealandiæ, sp. nov.

Body slender, densely pubescent, black above and below, sub-iridiscent, with yellowish joints to abdomen, and a broad grey lateral stripe running down each side that is less hairy; extremity of abdomen brown with whitish spots, and a tuft of longish black rigid hairs; abdomen much shorter than wings. Head, vertex and thorax glabrous, with a few longish soft hairs on prosternum and at junctions; piceous-brown above, yellowish and spotted with brown below and at base of antennæ; clypeus large and labrum yellow, with 4–5 dark hairs on the latter; mandibles large piceous; palpi light brown, dark at tips; eyes very large and prominent, metallic-greenish, shining, with innumerable facets; antennæ 3 lines long, diverging, curved, bluish-black, the two basal joints whitish spotted with brown, clavate with a mucro, annulate, about 30–32 rings, with very fine short verticillate hairs;

prothorax small; mesothorax curved upwards and projecting shell-like over prothorax, with a loose space between neck and pronotum, and a larger one between prothorax and mesothorax. Legs hairy, piceous-black, with two large spines (spurs) at lower end of tibiæ; femora yellow above, brown at lower end; ungues long, diverging and bright red-brown. Wings iridiscent, brownish, finely ciliate with dark hairs, densely reticulated, cells all shapes and sizes, but more regularly rectangular on sub-median vein, and largest between sub-costal and median veins, pilose with long dark and rather distant hairs on all veins and bands, spotted generally with brownish dots and markings, that are somewhat sub-quadrate at bands and triangular at forks (and sometimes broadly so at bands), outer edges irregular and not defined, the centre of the wings free of spots, also the costal cells from base to stigma: anterior wings (each) $1\frac{1}{2}$ inches long, 5 lines wide, sub-oblong-lanceolate, dimidiate, much contracted at base, obtuse-pointed at tip, apex inclined below; stigma oblong, whitish-yellow (or light cream-colour) with short dark hairs, a large black-brown spot at the basal end, and a brown blotch opposite between sub-costal and median veins, and another blotch directly opposite towards lower margin; costal vein yellow at base and gradually becoming brown; sub-costal vein double for about two-thirds of length of wing—from $\frac{1}{4}$ inch from base on to stigma, and without bands between,—yellow with brown dashes at junction of bands, and on sub-median vein below; ante-cubitals straight, simple; post-cubitals forked and sloping, a few in the centre forming cells: posterior wings each $1\frac{1}{4}$ inches long, 4 lines wide, sub-linear-oblong, more acute, and less and more finely spotted than anterior pair; spots mostly triangular in forks below stigma and about tips; stigma rather large, oblong, whitish; a brown blotch opposite stigma and near the lower margin.

Length of the body 16 lines; of the wings extended 38 lines.

Hab. Seventy-mile Bush, Waipawa County; (rare, like other species of the genus; three specimens only obtained with much difficulty); 1882–83; W.C.

Obs. A very elegant insect, in form, colour, iridiscence, and finely hairy and ciliated wings; in this latter respect closely approaching the next sub-order *Trichoptera.* It seems to have some affinity with our only other and little-known New Zealand species of this very large and cosmopolitan genus,—*M. acutus,* Walker, (B.M.),—judging from description only; but it is very distinct.

The *larva* is ovate, thick, fleshy, largely convex above, 6–7 lines long, 3 lines broad, of a reddish-grey hue, spotted with brown and black. Head 1 line long; mandibles $1\frac{1}{2}$ lines long, curved, hairy, grooved on lower surface, each having three large and stout curved spines on the inner margin;

antennæ very small and slender at base of mandibles. Two large brown spots sub-lateral on metanotum; two smaller ones similarly situated on mesa- and pronotum. Abdomen of a lighter colour below, with eight transverse and equal corrugations above, each having five black hairy spots running in regular lines longitudinally. Legs (and mandibles) yellowish-brown, very hairy with spreading black hairs; ungues of posterior pair large, divergent, piceous. Hairs of two kinds: (1) whitish, downy, and appressed; (2) black and bristly, and often in tufts, which are larger at the sides, the largest pair of tufts are marginal just opposite to the posterior legs.

Hab. Hampden, Waipawa County; 1882: Mr. S. W. Hardy.

Obs. This species makes its pitfalls in sandy earth, just like the European species *M. formicarum.* I kept several of these larvæ alive for some time (2–3 months) in light dry soil, they seemed to bear fasting very well. This is a much larger larva than that of *M. acutus* (?), which, I think, I knew, and often watched its habits, at the North, in forming pitfalls, etc., in sandy spots; though I never met with the perfect insect of that species.

Order HYMENOPTERA.
Sub-Order Pupirora.
Family Ichneumonidæ.
Sub-Family *Pimpilinæ.*
Genus *Rhyssa.*

Rhyssa clavula, sp. nov.

Female: Abdomen a rich dark-red-brown variegated with yellow: thorax, antennæ (basal ⅔), ovipositor and its sheaths much darker brown almost piceous.

Head: orbits of eyes and post-clypeus yellow; two vertical ferruginous lines from base of antennæ to mouth; three ocelli in dark central band a little above the eyes; antennæ filiform, curved, 13 lines long, finely annulate (above 50 joints), and under a lens covered with excessively minute whitish lines, very slightly and finely hairy, basal joints knobbed with yellow margins, the lowest the longest, apical third flavescent, the 3 apical joints light-ferruginous: clypeus dark-margined, enclosing a light-ferruginous triangular spot having a transverse red line, and a shorter brown one above it; labrum dark almost piceous (this dark band also surrounds the mouth); palpi light ferruginous.

Thorax: the mesothorax transversely and finely ruguloso-striate; a large semi-curved triangular yellow spot on pleuræ of prothorax, another below junction of anterior wings, a smaller one above the junction (transversely barred with a narrow dark band), the bases of the wings, the scutellum, post-scutellum, and the apical portion of the metathorax (encircling the insertion of the abdomen) yellow: wings, iridiscent, infumated, hairy at bases, and sparsely sprinkled with very minute hairs; principal veins reddish-brown, cross veins blackish. Legs: all the femora, and the coxæ and tibiæ of posterior pair, very dark ferruginous; the coxæ of the two anterior pairs and all trochanters yellow; all the tarsi, and the tibiæ of the two anterior pairs, light red-ferruginous; a pair of large spines at the apical ends of posterior tibiæ. Abdomen smooth and shining; at the apical ends of the 1st and 2nd segments a broad yellow fascia trifid basally, the extreme apical margins dark-coloured; the 2nd segment has also a lateral linear yellow spot; each of the four following segments has a longitudinal oblong yellow spot in the middle above, and also an elongate yellow one laterally, the lateral ones in the 3rd, 4th, and 5th, occupying nearly the whole length of the segment; the 6th has three yellow lateral spots; and the two following segments have yellow stripes extending to the apical segment, of which the margin is dark-coloured; the minute anal styles at top flavescent; the end of abdomen very thick, largely revolute, and there 5 lines in diameter. Ovipositor setaceous, stiff, slightly curved, 2½ inches long, its two sheaths ciliate and finely serrulate at margins, and coiled up (in spirits); tips sub-linear-spathulate, concave, obtuse, membranous, light-coloured.

Length, direct and plane, 18 lines; or, to extreme end of curvature, 22 lines.

Hab. High and dense forests near Norsewood, Waipawa County; April, 1884: W.C.

Obs. This fine insect is entirely new to me; and from its being so large and so striking I conclude it to be scarce. None of the many residents in that locality had ever seen one before, and were much struck with its size and handsome appearance. For a long time I have been in doubt whether it is not *Rh. fractinervis*, Vollenhoven; which species, in spots and markings, it greatly resembles, and it is only after long and close study of it, and comparing it with the description given of *Rh. fractinervis** that I have believed it to be distinct. Its much larger size, very peculiarly shaped end of abdomen and lateral yellow spots on its second segment, dark colour of its femora and posterior tibiæ, etc., striped clypeus, yellow margins of the basal joints of antennæ, iridiscent and hairy and dusky-coloured wings, 3 ocelli, etc., have caused me so to determine.

Genus *Lissonota*.

L. multicolor, sp. nov.

Ferruginous, spotted with yellow and black. Head: orbits of eyes, genæ, a narrow transverse line above labrum, and mentum light yellow;

* "Cat. of Hymenoptera," etc., by Professor Hutton, p. 128; where, however, it is named *Rh. antipodum*, Smith: this name, Professor Hutton informs me in a letter, must yield priority to the other.

a black spot on vertex, a black ring round occiput and neck; antennæ length of body, black; maxillæ and maxillary appendages fulvous. The prothorax yellow anterior edge; mesothorax, a broad black longitudinal line on mesonotum anterior end, with a yellow narrow and longer line on each side, a black lateral line from junction of anterior wing to the yellow line of the prothorax, with narrow black curved lines at lateral edges, small black spots above the junction of wings, and a small dark triangular spot at posterior edge of mesonotum, two small yellow spots beneath the junction of the wings and two larger yellow spots running diagonally towards intermediate coxæ; metathorax, a large triangular black spot on anterior edge of metanotum, with a small yellow transverse bar at its base (post-scutellum), and a large yellow lateral line diagonal towards posterior coxæ, scutellum mottled with yellow, slightly and sparsely acicular at apical end; sternum black; wings iridiscent finely hairy and ciliated, hairs black springing from minute tubercles; stigma and nervures brownish; areolet small, subquadrate. Legs ferruginous; coxæ yellow above; tarsi joints barbed and slightly hairy, the last joints of tarsi and ungues dark brown: posterior pair, coxæ black below with a ferruginous line; trochanters black; femora with a fusco-testaceous longitudinal line above: anterior pair, trochanters with a brown line; spurs long on the two posterior pairs. Abdomen ferruginous above, yellow below, a line of fuscous spots at lateral margins of the 3rd on to the 6th segments, a narrow darkish line on the lateral edges of the first three segments, and a light ferruginous one below it on the first four segments; extremity yellow, with a minute black style on each side; ovipositor 4 lines long, light ferruginous at apex, sheaths darker, ciliate. Length of body, 4½ lines.

Hab. Forests at Norsewood, County of Waipawa; 1884: W.C.

Art. XVI.—*Notes on New Zealand Fishes.* By W. Arthur, C.E.

[*Read before the Otago Institute, 14th October, 1884.*]

Plate XIV.

ACANTHOPTERYGII.

Family Cirrhitidae.

Latris lineata, Rich., variety. Pl. xiv., fig. 1.

D. 22/27; P. 16; V. 5; A. 15 remaining; C. $15\frac{4}{4}$; Br. 5; Pyl. c. 4; Lat. l. 63; trans. l. $\frac{6}{14}$.

A specimen of this fish, which is rather rare here, was given me by Mr. A. K. Smith, of Prince's Street, Dunedin, having been caught in Otago

Harbour, about the 5th January, 1884. Mr. Melville also recognized it as similar to a fish sometimes received from Stewart Island in odd specimens. It agrees so closely with *L. lineata*, or *Mendosoma lineata*, described by Professor Hutton in Trans. N.Z. Inst., vol. v., p. 260, that it must be regarded as of the same species, although by certain differences I have observed, it may possibly be more accurately called a variety of that species. These differences are greater length as compared with depth of body, a greater length of longest dorsal rays, the absence of teeth, and in being very hog-backed.

As this species might easily be mistaken for a variety of moki or trumpeter, both species of the same genus with *L. lineata*, I will note some of the main distinctions for reference. From both moki and trumpeter it differs in having fifteen longitudinal stripes or lines along trunk of a faint yellow colour, while the moki has none, and the trumpeter three stripes along side and one along dorsal ridge. Its mouth is much more protractile and has free end of maxillary ovate, while in these allied fish it is triangular. Further differences are in depression of interorbital space, arrangement of fins, with body not so deep, and form of air-bladder.

Description.—Body compressed, deepest below sixth dorsal spine. Hog-backed between head and dorsal fin; interorbital outline very depressed. Head goes $4\frac{7}{10}$ times into total length, and 4 times in length without the caudal; depth of body goes $4\frac{2}{10}$ times in total length; jaws equal and mouth very protractile and seemingly toothless; cleft of mouth oblique, free end of maxillary ovate and not extending to anterior margin of orbit; margin of opercles smooth and forming a rounded angle opposite upper origin of pectoral fins; anterior half of dorsal spinous, posterior soft, sixth to ninth spines longest; pectoral rays soft and branched except two anterior; ventrals thoracic with one spine and four soft rays; anal fin damaged, but posterior part with soft rays; tail fin bifurcate with branched rays. Lateral line continuous; scales cycloidal large and adherent on trunk and small on cheeks. *Colour*: Indigo-blue on back and sides shaded off into white on belly. There are about fifteen more or less distinct olive-yellow longitudinal stripes on sides of trunk, with an azure tinge between the stripes; dorsal fin clear without colour, also belly fins clear or slightly dusky; tail fin olive colour. Eye bluish-black, iris white—this organ being large and full. Palate covered with small dark spots.

The sex in specimen was indistinguishable, the viscera being partially decayed. Pyloric cæca short and narrow. Stomach simple, air-bladder simple and of silvery colour, intestine very long. Although not eaten by me, this fish looked firm and good for the table.

DIMENSIONS.

	Inches.		
Total length	11·7		
Length without caudal	10·0		
Depth or height	2·8		
Least depth of tail	0·8		
Head	2·5		
Eye from snout	1·1		
Diameter of eye	0·4		
Dorsal from snout	3·0	; length	5·8
Pectoral „	2·6	„	1·7
Ventral „	4·0	„	1·4
Anal „	7·0	„	1·6

References to this species.—Trans. N.Z. Inst., vol. v., p. 260. Cat. Col. M., p. 83. A specimen is preserved in spirits in Otago Museum.

Family BERYCIDÆ.

Trachichthys trailli, Hutton. Pl. xiv., fig. 2.

D. 5/13; P. 13; V. 1/6; A. 3/10; C. $19\frac{5}{5}$; Br. 6; Pyl. c. 11; Lat. l. 118.

A specimen of this rather rare fish was caught in Otago Harbour, 6th September, 1884, and handed to me by Mr. A. K. Smith, also a smaller one since that date. The only described specimen I can find is one from Stewart Island sent to Professor Hutton (Trans. N.Z. Inst., vol. viii., p. 212), but which is not figured. As this fish Dr. Günther says ("Study of Fishes," p. 420) belongs to a family of deep-sea forms, some of which do not occur in shallower water than 200 fathoms, it is of some interest that the two individuals given me were taken in the waters of the harbour here, which at low water has an average depth only of about 3 fathoms. The weather had been very stormy for some time previously, at the same time the fish under description had not passed its spawning period, but had two well-advanced lobes (apparently milts), no eggs were visible to the unassisted eye.

In *form* body compressed and armed with small adherent ctenoid scales, with a patch on the cheeks. Length without caudal 2·2 times the height of body, and 3·3 times the length of head. One dorsal fin armed anteriorly with fine strong spines; ventrals thoracic with one and anal with three spines; caudal forked. Snout blunt and terminating in two short and sharp spikes or spines; lower jaw prominent; cleft of mouth very oblique; maxillary long and expanded into a club-like flat free end covering the end of intermaxillary, which is rather longer than but has similar free end to maxillary in form. Mouth protractile. Preoperculum with two vertical ridges, the anterior being prolonged towards its inferior margin or lower end into a long sharp spine covering the branchiostegals. Another spine crosses the operculum in the direction of a horizontal line from the centre of the eye and projects over the humerus; while a third spine lies immediately above the origin of the lateral line and humerus, and points towards the tail. Striæ radiate from origin of spine on operculum, which coincides with upper end of posterior ridge, in all directions across surface of operculum. Suboperculum is narrow with a sinuous outline. Interorbital space covered by three smooth plates, the two anterior being diamond-shaped. Eye large and full, black pupil, and iris bright silvery; nostrils close to eye, large and surrounded by bright coloured plates. The keel carries eleven scales, or bony plates, terminating in sharp spines, from the ventral to the anal fin. Anal opening exactly between the ventrals, lateral line slightly sinuous. *Colour:* A silvery fish with a very faint nut-brown tint along dorsal aspect, fins all more or less scarlet. The palate of a beautiful blue streaked longitudinally with white. *Teeth* small and villiform, present on mandible, maxillary, palatines, vomer and tongue. *Scales* small, ctenoid, and covering part of caudal fin, also the cheek. Those along lateral line distinguished by small spines like needle points, of a bright silvery colour. *Stomach* siphonal; contents, remains of a small shrimp. The abdominal cavity lining of a black colour. Air-bladder black, and lying close under the vertebræ. Two lobes about 1¼ inches long, each containing a clear jelly-like substance—appeared to be milts. Pyloric cæca 11 in number, from ½–1 inch in length, small in diameter, and covered with a great deal of fat.

DIMENSIONS.

	Inches.		
Total length	7·5		
Length	6·1		
Depth or height	2·7		
Head	1·8		
Least depth of tail	0·8		
Eye (diameter)	0·6		
Eye from snout	0·7		
Dorsal „	2·6;	length	2·1
Pectoral „	2·1	„	1·2
Ventral „	2·4	„	0·9
Anal „	4·1	„	1·0

References.—Günther's Study of Fishes, pp. 420–422; Trans. N.Z. Inst., vol. vii., p. 245; vol. viii., p. 212.

In Otago Museum there is a stuffed specimen, also one in spirits.

Family CYTTIDÆ.

Zeus novæ-zealandiæ, n. s. Pl. xiv., fig. 3.

D. 1/6/31; P. 1/10; V. 1/6; A. 2/30; C. 13$\frac{2}{2}$; Br. 7; Pyl. c. 82; Lat. l. 114.

A specimen of this fish was handed to me by Mr. William Gray on September 8th, 1884 (similar in general appearance to the John Dorèe), which had been taken in the trawl of the cutter "Dauntless," in 25 fathoms of water, off Otago Heads. Two other specimens of the same species and nearly the same size as mine were about the same time given by Mr. Melville to Professor Parker as a new fish, and which had been caught in Otago

Harbour. The figure of *Cyttus australis*, No. 28, "Cat. N.Z. Fishes," 1872, is very nearly a counterpart of my specimen. The differences are that my fish has a smaller head, larger pectoral fin, one short spine at origin of dorsal fin, a series of rough small scales on a dark line along base of dorsal fin, and continued to the interorbital space, and along anal fin base, and continued to the isthmus. The scales also on the trunk are cycloid, while those of *C. australis* are described as being ctenoid. As the characters of this fish partake of those of *Zeus* and *Cyttus* I am in doubt to which genus it belongs, and propose provisionally to name it *Zeus novæ-zealandiæ.*

In *form* body very deep and compressed, eyes large and lateral; head contained 3·5 times and depth 1·6 times in length; greatest depth in vertical from fourth dorsal ray. Mouth very protractile, can be protruded nearly three inches, cleft nearly vertical; seven branchiostegals; isthmus deeply notched; keel fluted, especially from ventral to anal, where it forms a deep pocket in which the ventrals lie hidden when at rest; one short dorsal spine, one long ventral spine, and two short anal spines; rays of first dorsal and of pectorals were much broken, probably in the trawl; caudal fin, straight margin. Lateral line is gracefully curved and recurved. The coracoid bone is very large and strong. *Teeth* small and villiform, present on mandible, maxillary, and on vomer. *Scales* cycloidal, small, smooth and adherent: a series of small rough scales along dark line at base of dorsal and prolonged to interorbital space, also along base of anal fin and along keel to isthmus, but scarcely formidable enough to be called bucklers or bony plates, cheeks covered with small smooth scales. In *colour* a very silvery fish over the whole body and head; eye, black pupil, iris silvery white and brilliant; fins, first dorsal black, second dorsal, pectoral, and anal pink, ventral white with black tips, caudal crimson with white posterior margin tipped with black. The *stomach* contained white mucus; ovaries large and very full of ova the size of large pin points, ovarian duct terminating at vent; air-bladder close to vertebræ, large, simple, cylindrical, and of a silvery colour: pyloric cæca numerous and small, also covered with much fat, number 82. The condition of the ovaries was almost gravid.

DIMENSIONS.

	Inches.		
Total length	7·8		
Length	6·7		
Head	2·2		
Depth or height	4·0		
Least depth of tail	0·45		
Eye diameter	0·70		
Eye from snout	1·30		
Dorsal from snout	3·40;	length	3·40
Pectoral ,, ,, ...	2·00	,,	0·90
Ventral ,, ,, ...	3·00	,,	0·80
Anal ,, ,, ...	4·00	,,	3·00

The extraordinary protractile mouth and small teeth of this fish are suggestive of the habit of passing through shoals of minute fish-food with the mouth drawn out so as to catch large quantities.

Professor Parker has a mounted specimen in the Otago Museum.

References.—Günther's Study of Fishes, p. 451; Cat. N.Z. Fishes, pp. 19 and 112; Trans. N.Z. Inst., vol. vii., p. 247, and vol. ix. p. 465.

Family TRACINIDÆ.

Leptoscopus angusticeps, Hutton, var? Or,

Leptoscopus canis, n. s. Pl. xiv., fig. 4.

D. 32; P. 21; V. 6; A. 39; C. 14; Br. 6.

A specimen of this fish caught off Purakanui was sent me by Mr. A. K. Smith, of Prince's Street, Dunedin, as a new fish, on May 6th, 1884. Closely allied species are common enough in our fish shops. It bears a close resemblance to *L. angusticeps*, but differs in having a more pointed snout; the teeth are cardiform and in two rows in the jaws, the intermaxillary besides having two groups of canine-like teeth or fangs. Eyes nearly vertical. The first four anterior dorsal rays are only half as long as the other rays. The caudal fin has five more rays; and it differs from *L. robsonii* chiefly in the interorbital space being broad and in the length being eight times the height of body.

In *form* the trunk is long and cylindrical; head one-fourth of length without the caudal, depth of body one-eighth; one continuous dorsal fin from nearly opposite middle of pectoral to near the caudal, in length exactly one-half total length. Pectoral large broad and ovate; ventral jugular supported on six rays; anal continuous from nearly a third of pectoral from origin to opposite posterior end of dorsal, and it is five-ninths total length of fish. All the fins are soft-rayed excepting one or two spines at origin of each. The gill-covers, the sub-operculum in particular, are soft. Eyes small and on top of head, nearly vertical; interorbital space flat and broad, outline depressed. Cleft of mouth vertical, lower longer than upper jaw and projecting. Intermaxillary extends round whole of upper side of mouth, the central plate or process flat, pointed, half-inch long and fitting space between the nasal bones. Maxillary is half length of intermaxillary, superior and with a triangular or curved free end pointing downwards. Both bones are connected by a thin transparent diaphragm and form a very protractile upper jaw. Teeth cardiform on mandible and maxillary, small and sharp, with two groups of long canines on the intermaxillary, a few teeth on palatines, none on vomer or tongue and no oral filament, no humeral spine. In *colour* olive-green on back and head with numerous small dark spots particularly on anterior part of back, belly white. The sides are further marked by light transverse bands which seem to be coincident with the dermal and hæmal apophyses or with the flakes of the flesh. All the fins are clear, but are distinguished by a bright red margin. The sides of head silvery and body generally light in colour. *Scales* small, adherent and soft.

It does not look like a very edible fish, but I do not know anyone who has tried it.

The *stomach* is siphonal; intestine long and folded a number of times in short turns. Liver large; no cæca discernible. From the stomach of a larger specimen about the time I got this described one, a sprat was taken, showing the presence of these delicious fish on the coast at the time. Indeed Mr. Smith informs me he has taken them from the stomachs of cod and other fish at all seasons of the year.

DIMENSIONS.

	Inches.		
Total length	9·0		
Length without caudal	8·0		
Depth	1·0		
Least depth of tail	0·3		
Head	2·0		
Diameter of eye	0·16		
Eye from snout	0·60		
Dorsal „	3·10;	length	4·5
Pectoral „	2·30	„	1.7
Ventral „	1·70	„	0·7
Anal „	2·80	„	5·0

I have drawn this fish life size and had it reduced.

References.—Trans. N.Z. Inst., vol. v., p. 275; vol. vi., p. 104; vol. vii., p. 248; and vol ix., p. 469, where closely allied species are described.

Specimens of *L. angusticeps* in Otago Museum.

ACANTHOPTERGYII COTTOSCOMBRIFORMES.

Family PSYCHROLUTIDÆ, Günther.

Neophrynichthys latus, Günther. The Toad Fish. Pl. xiv., figs. 5 and 5A.

D. 10/13; P. 20; V. 1; A. 9; C. 10; Br. 4; gills 4.

A specimen of this fish, said by Dr. Günther to be very rare, was got in the trawl of the cutter "Dauntless," off Otago Heads, in October, 1884. Head broader than long, and being rather less than one-third of the length without the caudal. Depth of head five-eighths of its length; depth of body one-third of length. Head broad and flat, interorbital space one-half of breadth of head; mouth wide, lower jaw slightly projecting. The trunk tapers rapidly towards the extremity of the tail, while the whole fish including the fins is covered by a loose flabby naked skin. I made an incision in this skin but found no fluid beneath, and inflated it to a great extent by blowing through a quill. The teeth are very fine and in villiform bands on both jaws and pharyngeals, but absent on palatines and vomer. Lower phryngeals separate. Premaxillary slightly protractile. Eye lateral, not large. Pectoral continuous with branchiostegals which coalesce in their coverings with the isthmus, and which thus is not externally visible. No apparent lateral line. Fins have soft branched rays, the dorsal being long and continuous though divisible into two, caudal fan-shaped. Ventrals thoracic and secreted in a pocket of the skin, one simple spine in each. Vertebræ and apophyses bony. *Colour*, dark-brown on head and trunk, somewhat lighter on belly, with black more or less distinct bands round margin of the fins, which are white-tipped. The band is plainest on the caudal fin. A row of oval salmon-coloured spots round margin of posterior dorsal and pectoral fins, and numerous round, oval and crescent-shaped spots of same colour, scattered all over head, trunk, and fins, giving this fish a leopard-like appearance. Those on top of head are lighter, and have scattered through them many small black pigment spots. *Stomach.*—This organ was large and balloon-shaped, and contained two crabs an inch and a half across the tips of the claws each, also three shrimps and a stringy-like mass which I could not recognize. There was no visible outlet that I could find from the stomach to the vent, and the mouth was full of excreta. No air-bladder present.

It is probable that this species is capable of rising through the water by the inflation of the loose covering which its body possesses, and so feeds on the surface, as at other times it manifestly does on the bottom.

DIMENSIONS.

	Inches.
Total length	7·3
Length	6·0
Least depth of tail	0·55
Head	2·3
Eye diameter	0·4
Eye from snout	0·8
Dorsal from snout	2·8
Pectoral (superior origin)	2·2
Ventrals ,,	2·2
Anal ,,	4·5

Several more individuals of this species were taken by above cutter off the Heads about the same date as above-described one. One of these nine inches long came into my possession, and an examination of it was made from which I am enabled to add these remarks :—

D. 9/15; P. 22; V. 1; A. 10; C. 10; Br. 4; Pyl. cæca 4 (?).

Owing to the apparently very perishable nature of the viscera (in part) I only made out as I think a short delicate intestine, but could not discover any opening into stomach or outwards towards the vent either. The cæca situated where the duodenum usually occurs were plainer, but not so decided in character as to be unmistakable. The ovaries however were present and very full of nearly ripe ova, very red and about the size of sago piles. The roes measured in inches 2·5 x 1·0 x 0·8, the cross section being in shape a sector of a circle of which radius and arc in size are represented by 1·0 and 0·8 in dimensions just given. A distinct strong ovary duct connected the ova sacs with the vent, the external end forming that opening. The abdominal cavity was full of excreta, similar in its dark colour and offensive odour to that found in mouth of the first specimen I have described. The stomach, exactly similar in form to that above-mentioned, contained fourteen egg-like or larval bodies, almond shaped, white, and with hard cores a quarter to half inch each in length enclosed in a stringy spiny mass, with a few remains of shrimps. No air-bladder present. Liver large and heart lay right underneath the lower pharyngeals.

This species is rather loathsome-looking and has not the appearance of a good edible fish.

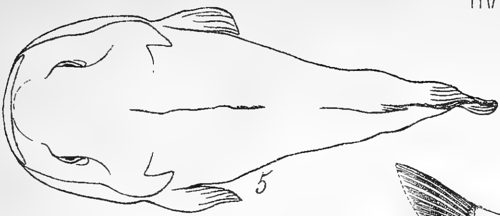
References.—Trans. N.Z. Inst., vol. viii., p. 214. Study of Fishes (Günther), p. 469. A specimen in spirits is preserved in the Otago Museum.

Family Blenniidæ.

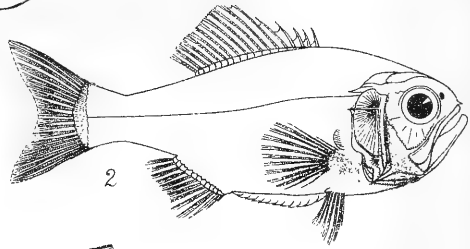
Trypterygium compressum, Hutton. The Blenny. Pl. xiv., fig. 6.

D. 4/10/12 ; P. 10 ; V. 2 ; A. 22 ; C. 11 ; Br. 6.

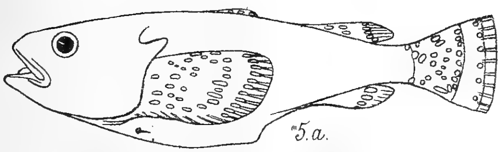
This specimen of a blenny was caught off Otago Heads, May 6th, 1884, and I have made a life-size drawing of it for comparison, by which it may be seen to differ in greater robustness from any I can find figured in the Transactions of the Institute. In *form* the head is contained a little more than four and a half times in the total length; trunk compressed slightly and deep, greatest depth goes three-and-a-half times in total length, and is in vertical from third spine of second dorsal fin. The subopercle is prolonged into a sharp spine at posterior margin, which lies exactly on origin of lateral line. Mouth protractile, jaws equal and cleft very oblique. Intermaxillary in front of and not articulated with maxillary; maxillary with triangular or club-shaped free end. Teeth villiform and fine, present on maxillary, mandible, palatines, and head of vomer. Eye large, lateral and close to interorbital space, pupil and iris dark red with a small bright silvery spot on inferior margin of iris. Membrane of branchiostegous rays confluent with opercles. First dorsal fin detached and erect like a crest above the head, second and third continuous; spines mostly soft, but not branched in dorsal pectoral and anal fins; ventrals jugular, etc., consisting only of two bare rays. Caudal



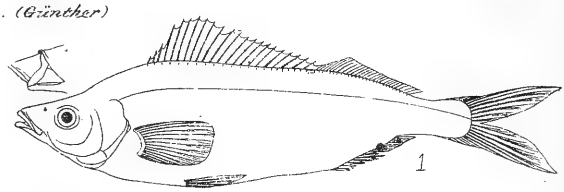
Neophrynichthys Latus. (Günther)



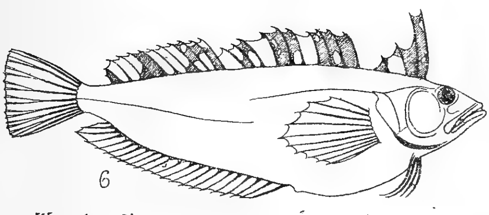
Trachichthys Traillí. (Hutton)



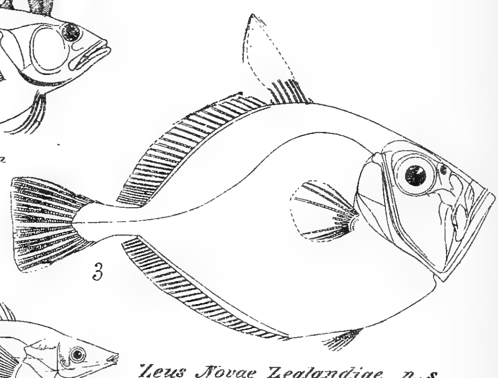
Neophrynichthys Latus. (Günther)



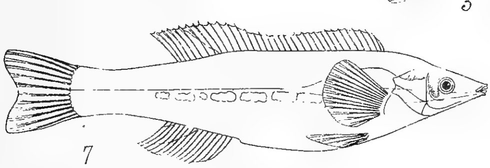
Latris Lineata. (Rich.) var.



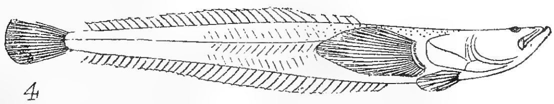
Trypterygium Compressum. (Hutton



Zeus Novae Zealandiae. n.s.



Odax Vittatus Sol.) var.



Leptoscopus Angusticeps (Hutton) var or *L. Canis.* n.s.

FISHES

WA delt.

with convex posterior margin, rays branched. Lateral line detached in two portions. *Colour*, head, trunk and fins mottled with patches of dull red on a yellow ground; most of the fin-rays variegated like tortoiseshell, forming altogether a prettily-marked fish. Scales cycloid and adherent, cheeks naked. This individual was a gravid female, its eggs, of a yellow colour and in size like sago piles, were protruding from the vent. *Stomach* continuous with intestine and both curved about the abdominal cavity; air-bladder simple.

DIMENSIONS.

	Inches.		
Total length	8·0		
Length	6·8		
Depth	2·2		
Least depth of tail	0·45		
Head	1·8		
Diameter of eye	0·3		
Eye from snout	0·6		
Dorsal „	1·1	; length	5·3
Pectoral „	1·9	„	1·6
Ventral „	1·4	„	1·0
Anal „	3·5	„	3·3
Caudal „	6·8		

This fish, although gay in colours, is not considered of value as a food fish locally.

A specimen beautifully preserved in its native tints by Professor Parker's glycerine process is at present in Otago Museum.

References.—Trans. N.Z. Inst., vol. v., p. 263; vol. viii., p. 214.

ACANTHOPTERYGII PHARYNGOGNATHI.

Family LABRIDÆ. "Wrasses."

Odax vittatus, Sol., variety. Pl. xiv., fig. 7.

D. 35; P. 15; V. 4; A. 15; C. 14.

A specimen brightly-coloured of this fish caught off Otago Heads, May 9th, 1884, was given me by Mr. A. K. Smith, fishmonger, Dunedin. The fish is occasionally caught, although not numerous seemingly, about our coast. I have called it a variety, as it differs from Professor Hutton's described specimens in the greater length of the tail portion from the dorsal to the caudal fin, and also in its colours. As to the latter, I must observe that none of the few individuals I have seen agree closely in colour, so that as a distinctive mark of this fish, that is not of much use evidently.

Form.—Head triangular, lips fleshy and movable, jaws each with a band of white confluent teeth forming rather formidable cutting edges, gape very small and contracted. Hindmargin of opercula pointed into two blunt angles, one forming posterior extremity of operculum, and the other of the suboperculum. The eye is large, and contained six times in length of head; iris yellow, with blue and red circular bands; cheeks naked, except a patch of scales on operculum and suboperculum. Head one-fifth total length, which is four and a half times the height. Body rounded, and carrying its depth well towards the tail; dorsal outline sinuous, abdominal well curved; greatest depth of body below twelfth dorsal spine. One dorsal fin long and continuous, supported on soft spines, a few at posterior end being branched. Ventrals thoracic and having four branched rays, nearly confluent at base, which is situated a little behind pectorals. Anal fin not long with first ray under twenty-fifth dorsal ray. Caudal slightly forked, truncate and carried on branched rays. Lateral line curved above pectoral and nearly straight thence to the caudal. Scales soft and adherent.

Colour.—Rather a gay and striking fish; dorsal half and head dark olive-green, and mottled with small blue spots; abdominal half of body greenish-yellow with small blue spots. A golden band runs from mouth along cheeks to pectoral fins, thence to tail it is broken into a line of broad irregular patches of a peach colour, which lie below the lateral line and terminate a little beyond last ray of anal fin. Dorsal fin dark olive except a transparent patch at posterior extremity. Pectoral and ventrals clear. Anal dark, a transparent band near posterior extremity. Caudal fin dark olive-green.

Stomach siphonal; intestine long and lying along abdomen in a number of turns. Ovaries clear in colour, ova very small. Air-bladder simple, cylindrical and silvery in colour, lining of abdominal cavity also silvery.

Dimensions.

	Inches.		
Total length	9·3		
Length	8·0		
Head	1·8		
Least depth of tail	0·85		
Height	2·0		
Eye diameter	0·3		
Eye from snout	0·8		
Dorsal from snout	2·1 ;	length	4·0
Pectoral ,, ,, ...	2·0	,,	1·2
Ventral ,, ,, ...	2·5	,,	1·2
Anal ,, ,, ...	5·0	,,	1·3

On August 30th another example of this fish was in Mr. Smith's shop, but not so brightly coloured as the above-described one. He examined it and found the vertebræ to be of a light green colour, but there was no decided sexual development. Although the above specimens have heads with sharp snouts, while *Coridodax pullus*, the kelp fish or butter fish, has a blunt snout, yet in other respects they are so like as to render it possible that the latter may be but the adult form of the former. Our local kelp fish, while it has light green vertebræ, differs from the described specimens (Cat. N.Z. Fishes) in that the posterior end of the dorsal and anal fins is abruptly lengthened outwards, making it either a different variety or it may be even species. This is correct only, however, for some specimens.

References.—Trans. N.Z. Inst., vol. v., p. 266; vol. vi., p. 104; vol. viii., p. 214; and Cat. N.Z. Fishes, p. 43.

Specimens stuffed and in spirits are in Otago Museum.

PHYSOSTOMI.

Family SALMONIDÆ.

Prototroctes oxyrhynchus, Günther. *Upokororo*—The Grayling.

D. 12; P. 15; V. 6; A. 15; C. 17; Br. 5; Vert. 70; Lat. l. 100.

The occurrence of this fish in the Mataura River is of considerable interest, as it is by no means common in Otago waters. This specimen was found dead on the Mataura river-bank at Gore, and was sent up to the editor of the *Otago Witnsss* for identification, and subsequently came into my hands on the 29th April, 1884. Gore is about thirty-five miles from the sea.

The body was long and cylindrical, total length seven times that of the head, or six times greatest depth, and covered with large cycloid scales, adherent. Lateral line barely visible, straight. Eye in diameter equal to one-sixth the length of head, and placed one-third from the snout, pupil black, iris yellow. Maxillary terminates in narrow rounded point posterior to centre of orbit; mandible shorter than maxillary and toothless. Teeth fine and comb-like even row (cardiform) along maxillary, a few on vomer and some on palatines and tongue. Operculum and sub-operculum fine transparent bones with rounded margins and much larger than pre- and inter-opercles. Fins fine, ventrals in advance of dorsal, anal in advance of adipose; caudal deeply forked. In *colour* slaty-brown along back passing into slate-blue on sides and silvery-white on belly, which had patches of azure, no spots. Fins orange colour tipped with dark slate and white; cheeks with slight golden tinge, also the belly. When fresh, it had a herring-like smell on boiling, and ate nearly as well as a herring; flesh white and delicate.

DIMENSIONS.

	Inches.
Total length	10·40
Depth	1·80
Least depth of tail	0·65
Girth	4·50
Head	1·50
Diameter of eye	0·25
Eye from snout	0·50
Dorsal "	5·10
Adipose "	7·80
Ventral "	4·75
Anal "	7·25

Abdominal cavity was black, the viscera had almost disappeared from decay, one long silvery lobe only being recognizable, probably the air-bladder. Vent situated immediately in advance of anal fin.

In form this specimen corresponded almost exactly with figure at p. 136, vol. iii., Trans. N.Z. Inst., which is an excellent drawing of the species. According to the Catalogue of New Zealand Fishes, the upokororo had not been found in the sea, but only in the rivers and lakes of both islands. Mr. Rutland's account however (vol. x., Trans. N.Z. Inst.) is, I think, conclusive circumstantially that during a portion of the year it is resident in salt water, as it is never seen in the Maitai and other neigbouring rivers of Nelson excepting during autumn and winter when spawning or getting into spawning quarters, but disappears entirely for the rest of the year. Recently, on 29th September, Mr. A. K. Smith informed me of a fish he had been keeping for me which was taken in the sea at Otago Heads off the North Spit but which I did not get—evidently a grayling. He described it as found by him among some mullet to which it had a general likeness, but on closer inspection he found the first dorsal fin was softer and had more rays than the mullets, while the second dorsal had no rays. The head was small and salmon-like, pectoral fin-origin lower than in mullet, body rounder, silvery and spotless. I have found Mr. Smith very correct and reliable in his observations on fish, so that I believe in this case also he is not mistaken, although it is not impossible that the fish may have been a spotless trout or young salmon-trout.

References.—Cat. N.Z. Fishes, 1872, p. 123; Trans. N.Z. Inst., vol. iii. p. 136, and vol. x., p. 250. Specimens are in Otago Museum.

Note.—The order of classification I have followed is that of Dr. Günther in his "Study of Fishes," 1880, as regards families.

Art. XVII.—*Notes on Moa Remains in the Mackenzie Country and other Localities.* By Frederick Chapman.

[Read before the Otago Institute, 10th June, 1884.]

I propose in this paper to give the result of some unconnected observations made during the past summer upon the remains of moas which I found in widely separate localities. There may be nothing very interesting in these observations, but I think it may be of some use to record facts gathered in this way, as they all serve in some slight degree at least to add to the accumulated fund of information on the subject. The subject is one of interest, and when it comes to be dealt with as a whole by some competent writer at a future date he will certainly have no cause to complain that the literature relating to it in this country is too copious. If upon this and kindred matters, and notably upon such subjects as the history, traditions and customs of the Maori race, colonists with good opportunities would record all the facts they observe upon their travels while these facts are fresh, much valuable matter now daily growing scarce would be preserved. It has occurred to me that it is worth while to jot down in this way observed facts relating to our gigantic extinct birds, especially in connection with their relation to the inhabitants of these islands, as the opportunities of observing these facts occur only now and then when a piece of g ound is newly disturbed, and the observations lose their value if deferred until other elements come in.

What is known as the Mackenzie Country, though somewhat undefined as to limits, is now comprised in a new county called Mackenzie County, lately cut off the large original County of Geraldine. It consists of the Mackenzie Plains and a large amount of mountain country besides extensive downs. These plains and downs occupy a central position, stretching from the Waitaki up towards the three alpine lakes, Ohaü, Pukaki, and Tekapo. The climate is cold in winter and very warm and dry in summer. The whole region is, like the central districts of the South Island generally, devoid of trees, but the mountains show signs of extensive areas of thick high scrub which has been burnt off.

When on a visit there during the past summer I was told that on a sandy flat on the banks of the Waitaki remains of moa skeletons were to be found. I accordingly visited the flat, which I found to be about ten or twelve miles down the Waitaki Gorge, starting from Mr. Sutton's Black Forest Station. I was accompanied by my brother, Mr. E. A. Chapman, of Grampians Station, and Mr. Murdoch, Mr. Sutton's manager. The ride down the bank of the river is rather rough, but the rocky scenery is very fine. A slight bridle-track among the boulders leads along the narrow margin between the steep crumbling ranges and the Waitaki, which is here a fine stream tinged with the dull colour of the glacial water. Where it is concentrated in the narrowest part of the gorge the river runs with great rapidity, and for many miles it forms an impassable barrier between Otago and Canterbury. A long way above the gorge it is fordable in winter, when the severe alpine frosts have reduced the water supply. There are no feeders for many miles, until the point is reached, where, on the Otago side, the Ahuriri pours in a considerable quantity of clear water.

Some distance below this point we came upon the flat we were in search of. It is of considerable area, perhaps fifty acres, and is merely composed of fine light material deposited there by the river. This fine soil is grassed over, with the exception of a few acres, which are in a shifting state. Before reaching the main mass, we came upon a few moa bones of large size lying in the neighbourhood of some old Maori ovens. When we came upon the ground disturbed by the wind we soon found a number of distinct groups of gizzard stones. It was impossible to mistake them. In several cases they lay with a few fragments of the heavier bones. In all cases they were in distinct groups; even where they had become scattered each group only covered a few square yards of ground, and in that space lay thickly strewn. Between the groups scarcely any were seen. In several instances they lay in close masses. Mr. Murdoch showed me one piece of ground which had recently become covered with blown sand, where he had not long before seen several groups lying in close clusters, such as I shall describe hereafter.

The peculiar feature of the stones was that they were almost all opaque white quartz pebbles. The few in the three sets I now exhibit from this spot which are not white quartz have white veins in them. In one place I found a small group of small pebbles of different colour, more like the few brown water-worn pebbles which may be picked up hereabouts. These lay with a set of bones much smaller than the very large bones I found with most of the clusters of pebbles.

I did not gather these brown pebbles, as I thought it uncertain whether they were gizzard stones or not, though it is possible that the species to which the smaller bones belonged was not so careful in selecting white stones. A glance at the pebbles lying about in the surrounding country showed that the quartz-pebbles were not collected here. In only one instance did I find the moa bones burnt, and this may have been accidental. Mr. Murdoch and I collected three sets of pebbles, and these I can safely pronounce complete, or nearly so. It is beyond question, too, that each set belongs to a distinct bird. No. 1 weighs 3 lbs. 9 ozs.; No. 2 weighs 4 lbs.; while No. 3 weighs no less than 5 lbs. 7 ozs. This giant set contains individual stones weighing over 2 ozs.; indeed, I have picked out 8 stones weighing almost exactly 1 lb.

Moa bones do not seem to be very plentiful in the Mackenzie Country, and when found seem to be old and in bad preservation. I should say from such observations as I made, that the moa had become scarce or extinct on these plains while it still flourished in many other places I have examined. The bones at this place were very friable, and generally broke when picked up. I searched in vain for foot-prints in places where the sand was blown away, though I was tempted to search by finding foot-prints of a horse standing above the general level of the surface, the weight of the animal having packed the fine binding soil and thus increased its stability in comparison with that beside the foot-prints, leaving the surrounding soil to blow away more readily. The next occasion upon which I noticed moa remains was in a bank of *débris* thrown up on the side of an old Maori chert quarry, at Gray's Hills Station, to which I propose to refer in another paper. In this bank several well-preserved fragments of bone were found so broken and so situated as to leave no doubt that they had been left there by Maoris working at the quarry. The specimen which I exhibit is manifestly broken by human agency. It may have formed part of the handle of an instrument for getting out the chert, or for splintering it when gotten; but there is nothing in its appearance to support this.

Early in March, 1884, I accompanied my brother and several others on an excursion to Mount Cook. Our first halting place was Lake Tekapo, one of the reservoirs of the Waitaki, a beautiful alpine lake about 2,300 feet above the sea on the upper edge of the Mackenzie Plain. As the lake is approached from Burke's Pass a large uninviting patch of sandy country may be noticed surrounding the woolshed of Mr. Cowan's station. A hundred acres or so of country here have a very unpleasing appearance. Something has set the sand moving in a south-easterly direction and nothing can stop it. A large part of the ground has been stripped of the loose friable soil down to a hard bed, which dries and crumbles in the sun and is set moving by the wind. The sand thus set free has then covered another large part of this sandy country, half choking the tussacs in some places and killing them out in others. Upon the hard bare part I observed what must be a rare sight. Here and there lay scattered the last remains of giant moas. I am unable to say to what species they belonged as the bones are generally too brittle to bring away, but all or nearly all appeared to be of one species. I found no less than nine specimens, not lying close together but quite isolated. In most cases the *femur* and the *tibia* of each leg remained apparently lying in the exact position in which they had fallen when the bird fell to pieces. In one or two cases I found fragments of smaller bones. In some cases even these very heavy bones had nearly disappeared. Here, as elsewhere, I noticed that the *femur* was about the last bone to disappear. In nearly every case the cluster of gizzard stones lay with the group of bones. So striking and obvious was the fact that here the remains of these great birds lay where they had died, that when I stood upon a slight eminence I could at one time see three or four of these white groups of bones at once, perfectly isolated, with no loose bones on the intermediate ground. The last I found was in a paddock which had once been enclosed in a gorse hedge. In this unused enclosure lay a few well-preserved fragments. I did not gather any gizzard stones here, as I had no means of carrying them, and on my return no opportunity offered. The remains had probably been but little noticed before, as they were quite undisturbed. The gizzard stones here were not so pure white as those down the Waitaki. In some cases the bird had contented itself with a collection of hard dark stones, among which lay here and there a white one. I suppose the pure white stones are scarce here, while down the Waitaki the birds lived nearer to Otago where quartz is more plentiful. This seems to indicate that their habits confined them to a comparatively small area, and perhaps that they were able in some way to cross the Waitaki. I saw nothing to lead me to think that the birds had been slaughtered. In one case the bones were broken, but as they were not burned, and lay *in sitû*, I concluded that they had been fractured by accident. I found one *umu* or oven on the ground. I can only express a hope that these remains may be left undisturbed until some competent person has thoroughly examined the locality, making something more than a mere cursory survey of it.

On the journey to Mount Cook, up the western bank of the Tasman, we halted for a day or two, close to Mr. Darke's out-station. Here I ascended a mountain in the Moorhouse Range, locally called Mount Peak. It rises immediately behind the hut, and terminates in a peak nearly free of snow. I make its summit about 8,400 feet above the sea, but I am not certain of this, owing to an accident which affected my aneroid. At various heights, from 1,500 up to I think nearly 5,000 feet above the sea, I found pure white quartz pebbles. They were never isolated; generally three or four lay together. In one place I found nearly 30 in a patch. Mr. F. F. C. Huddlestone, one of our party, found a similar patch. Some of these groups were far above the level where water-worn stones of this character might be found. The material was local, as at all levels I occasionally found angular fragments from the fine quartz veins which occur in the strata here. I have no doubt that these small patches of pebbles were from the *excreta* of the moa, as they were always well worn and smaller than the largest stones of the collections. Mr. Huddlestone confirmed this view, having found similar pebbles in similar places in Otago.

I now take the opportunity of exhibiting three magnificent sets of gizzard stones sent me from Lake Manapouri by Mr. Mitchell, manager of Manapouri Station. I give his own account of them: "Each lot is complete, as I gathered them very carefully. With one lot I got one or two small pieces of bone which I send also. In the case of the two large lots one or two stones were scattered while all the rest were as if in a pocket a few inches below the surface and may belong to a young bird, but I fancy it is from a smaller species."

No. 4 is a small set containing 210 small stones, weighing in all only 8 ozs. No. 5 contains 389 stones and weighs 4 lbs. 7 ozs. No. 6 contains 342 stones and weighs 4 lbs. 10 ozs. It will be observed that they are nearly all pure white and make a very beautiful collection. It is possible that No. 4 may have lost some stones. Mr. Huddlestone, who lived for many years at the head of Lake Wanaka, informs me that he often found them in pockets just as Mr. Mitchell describes them. A crunching noise told when the plough had passed through a pocket. A gentleman who occupies a large agricultural farm in Southland where moa bones in all stages of preservation are extremely plentiful, says that in his district white quartz is scarce and he finds complete sets of dark stones.

During the succeeding month, in the Easter holidays, I made an excursion with Professor Scott to the country beyond Riverton. Beautiful sandy beaches stretch for miles to the westward, broken here and there by rocky points. One of these, called Colac's Bay, is doubtless named after the old chief Korako, grandfather of Mr. H. K. Taiaroa, M.H.R., or else after a younger chief of the same name and family who died here eleven years ago. Beyond Colac's Bay is a fine beach on which is a prettily-situated *kaik* called Kawakaputaputa. This is nearly opposite Rarotoka (Rarotonga) or Centre Island. In a somewhat hurried search here we found the remains of four moa skeletons in fair preservation; at least, in each group lay a good many bones and fragments of bone, including toes, jaws, and tracheal rings. With one very large skeleton lay the white gizzard stones, rather widely scattered but quite distinguishable. Not far from this one too lay many fragments of eggshell, some quite fresh-looking and others old and worn. Two small skeletons lay twenty yards apart half-a-mile from the large ones. One of these was very interesting. The bird had died crouching, and the various bones lay almost as they had fallen, having been preserved in their positions by being covered with sand. The tracheal rings lay close together, and immediately under them were the contents of the gizzard. The stones were in a little conical heap unmixed with sand. The heap extended below the surface still unmixed with sand, but of course the mass could not be removed without also lifting some fine sand, which, however, was easily removed by washing through a sieve. They are pretty transparent flinty quartz stones, different from the white ones gathered elsewhere. This bird, evidently belonging to a small species, had no such liking for opaque white stones as the others, but had carefully selected transparent ones, which, when dry on the surface, look much darker than the others. It will be observed that these (No. 7) are all very small, and they are very numerous, the whole set weighing 1 lb. 4 ozs. The few dark opaque stones are probably intruders picked up with the sand lying about the mass. What I noticed here and in many other localities, including the sandy district near Otago Heads, satisfies me that a small moa was a regular denizen of the sea beaches, and that a large one, if not similarly disposed, often frequented similar country. The small one must have been plentiful at one time upon narrow pieces of country which could not be reached or quitted without passing through miles of bush. The finding of these fine transparent pebbles from the gizzard of one of these small ones confirms this opinion, as I think these stones were local, the country behind the beach being either dense bush or swampy peat soil.

Earlier in the summer, namely, in 1883, I had occasion to go to Porirua on the west coast of Wellington. Near the western bank of the northern branch of this harbour, are situated several old sites of pahs, famous in the old native wars, and in their early wars with the colonists. One of these was called Taupo, and not far from its site is the old stone stockade called Parramatta. The Manawatu railway crosses this harbour by a bridge, which was in course of construction when I visited the spot. I made a hasty search among the sandhills beyond the line of the bridge, a few hundred yards from the stone stockade, which is now a woolshed, and there found a piece of ground from which the sand, which must have been accumulating there for ages, had recently been blown away. Here, close to the large sandhill, upon which in 1847, a Maori was hanged by the sentence of a court-martial for rebellion, I found four beautifully-polished stone axes. Not far from these I found the neck of a moa, all the vertebræ of which lay in a string. A number of bones lay there, too, and upon them were plainly visible the marks of the stone implements which had been used to cut off the flesh. The bird had evidently been cooked and eaten, as burnt bones lay about. I saw numerous tracheal rings lying among the bones, and close by them some horny fragments like portions of the beak. I had very little time to examine these, and before I could gather them, a boat called for me, and I had to leave. Since then, a friend who lives in the neighbourhood has kindly gathered most of them for me. These bones were those of a very small bird when compared with the giant moas whose bones are so common in the interior of the South Island.

P.S.—Since the above was written, I have found what I take to be gizzard-stones on the high sand-crowned hills between Lyall Bay and the Wellington Heads.

I had originally fancied that gizzard-stones were worn somewhat flatter than water-worn stones, but abandoned this at the suggestion of a friendly critic. An examination of the beautiful set in the Colonial Museum at Wellington inclines me, however, to re-adopt this view.

ART. XVIII.—*Objections to the Introduction of Beasts of Prey to destroy the Rabbit.* By H. B. MARTIN.

(*Read before the Nelson Philosophical Society, 2nd June,* 1884.)

THIS paper deals specially with the weasel (*Mustelidæ*) and ichneumon (*Viverridæ*) families; but much that can be said against them will apply to any other beast of prey. I use the names of ichneumon and weasel to denote respectively the Indian ichneumon (mungoos) and the weasel, with all allied beasts of similar habits.

1. The introduction of these beasts of prey to destroy the rabbit is unnecessary; for poisoning with phosphorized corn succeeds well, even in spring and summer, when there is abundance of feed, while tuberculosis (which has recently broken out among the rabbits in Otago) will probably destroy them more thoroughly than any other means would. In various parts of the Auckland district the rabbits have become almost or quite extinct from natural causes; * tuberculosis was also believed to be present in the Wairau Valley, where the rabbits were beginning to decrease before the present Act was in force.

2. Having no natural enemies here, and their furs being of very inferior quality in this climate, there would be no adequate check upon them, and they would therefore increase and spread as the rabbit has done. In Canada and other northern regions the weasels are killed in great numbers for their furs, and are also preyed on by larger beasts of prey, while in more settled districts their ravages among game and poultry cause them very generally to be destroyed, yet with all this they are in no danger of extinction, even where most persecuted, the intermission caused by changes of fashion sufficing in two or three years to restore them to their former numbers; and in England the stoat and weasel are so common, though freely destroyed, that it would seem impossible to exterminate them. The beasts of prey that have been, or are being introduced are the stoat, weasel, ferret, and Indian mungoos, all very prolific, as the following facts will show. The weasel has at least 2, perhaps 3, litters annually of 4 or 5 each, the stoat has 5 at a birth, and the polecat also 4 or 5; while the ferret (at home) has 2 litters in a year of 6 to 9 each. I am not able to give the rate of increase of the mungoos, but in Jamaica, where it was introduced to destroy the sugar rats, it has apparently increased much faster than in India, having in ten years completely overrun that island, even to the tops of the highest mountains (7,000 feet), and though it has certainly reduced the rats, it kills all other animals it can (as the weasel and stoat do also), so that all species of ground birds, fresh water and sea fowl, are rapidly

*Hansard No. 7, pp. 342-3, 1883.

diminishing before it.* It would thus appear from these facts, that it has not yet reached its limit of increase, but that it must before long do so, becoming a pest which (Jamaica being a very mountainous country, well wooded and well watered) it would be impossible to extirpate entirely, and even if this were partially accomplished it is scarcely probable that it would be in time to prevent the extermination of at least some valuable native birds. It is therefore evident that these beasts being naturally prolific will in a new country be much more so; as are the hare, rabbit, and I may add the fox also, as it is said to have become already a pest in Victoria. A ferret in this district has been known to have 14 young at a birth, the number at home being, as above-mentioned, 6 to 9. It must be remembered that the destruction of these vermin is forbidden by law, and that not only will those to whom they are useless, or positively mischievous, be now prevented from destroying them, but they will be compelled when these beasts become a pest to destroy them at their own expense (as with the rabbits) in addition to whatever loss or injury they may have suffered from them, and without regard to the fact that they may not only have had no hand in the introduction of these vermin, but have been consistently opposed to it.

3. It appears, therefore, that it will be very difficult, probably impossible, to exterminate them, especially in rough or wooded country.

4. They have no marked preference for any one species of animal, but habitually live on birds and small mammals, so that being very lithe and agile, and for the most part active climbers and bold swimmers, no species of bird would escape their ravages, which would be the more destructive as both weasels and ichneumons are nocturnal animals. The stoat, for example, can climb any tree, and is so light and active, that any branch is accessible to it that will bear the weight of nest and eggs, and it is particularly destructive to game and poultry, while being an excellent swimmer it might prove very destructive to fish, especially if a good diver (like the polecat, which is able to catch eels), as it probably is.

5. The weasels habitually destroy large numbers of animals from mere love of killing, and very frequently do no more than suck the blood or eat the brains of their prey, habits which, whatever recommendation they may be in regard to the rabbits, must certainly lead to the extermination of many native birds, and those the most valuable and curious, such as cannot be adequately replaced by any foreign species. Furthermore, both "game" and "native game" would be very greatly reduced, the latter probably exterminated. The hare, too, would share the fate of the rabbit, as when it finds itself tracked by a stoat or weasel, it seems to despair of escape, and is killed without difficulty.

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* Sc. American, 24th March, 1883.

6. Being fearless and bloodthirsty above all other beasts in proportion to their size, there will be no inconsiderable danger of their killing lambs, calves, and other domestic animals, and even human beings, as the following instances from Wood's "Natural History" show:—Two martens killed in one night fourteen lambs out of a flock of twenty-one, and the next night killed the other seven. The marten is in proportion to its size one of the most bloodthirsty of beasts, though less so than the true weasels.* The marten is 18 inches long, the stoat 10 inches, the weasel 8 inches. Of the mungoos I am not certain, but the Egyptian ichneumon, which is very similar, is 18 inches long. The length of the tail is excluded in each case.

Two gentlemen who were riding together having halted, one dismounted, leaving his companion to hold his horse. Presently a weasel came out of the hedge and fastened on to the fetlock of one of the horses, retaining its hold until it was killed.

A strong man was in one instance so beset by weasels, that he had no time to kill them, but could only pluck them off and throw them to the ground, so that he would soon have been killed but for a horseman who came to the rescue with his whip.

In another case a colony of weasels attacked (without any provocation) various persons that were passing by their home.

A gentleman happening to see a couple of stoats by the road side picked up a stone and threw it at them, knocking one over, on which the other instantly calling out to its companions a number immediately came out of the hedge and attacked him; he, fortunately having a woollen comforter on, protected his throat with it and his hands, and ran for his house, a distance of nearly four miles, several stoats being taken off him when he reached home.

The ichneumons and weasels invariably direct their attacks at the throat or the back of the head, according to the nature of the animal attacked, so that a single bite is fatal, an attack by a weasel or stoat being the more dangerous, as they (and perhaps the mungoos also) aid one another at call; they possess too no inconsiderable strength for their size, as evidenced by a weasel leaping at and bringing down a partridge from a covey flying above two feet from the ground. The weasels are also very irritable, and are apt to take offence where none is intended, so that children would be liable to their attacks, the more so as the true weasels (*Putorius*) are fond of living in stone heaps and outbuildings.

It is well known that the ferret will attack infants, and shows extreme ferocity if interfered with in such cases, an instance of which is given in Wood's "Natural History." Some sheepfarmers perhaps hope that these

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* Enc. Brit., Art. Marten.

beasts will exterminate the kea, but I do not see that this will be any gain, because, in coming in contact with the kea, they cannot avoid finding wounded and dying sheep, which they would attack, and this, with the slaughtering of sheep on the out-stations, would be to them the best possible training for sheep-killing, if any is necessary; and any larger beast or any bird that would attack the kea would have no hesitation in killing sheep also. As to the question of extirpating these beasts where they may become a pest, the following example from Wood's "Natural History" is worth noticing: A number of rats established themselves by a fishpond, devouring the fish and doing much other mischief, so that the owner was much pleased when a colony of weasels came and, having killed or driven away the rats, settled in their place. For a time all went well, but presently, other food failing them, the weasels began to kill rabbits, poultry, etc., so that the owner became as desirous to destroy them as he had been the rats, but he failed to do so, and the weasels remained in triumphant possession.

Mr. T. Bent, M.L.A., of Victoria, is of opinion, as the result of information gathered on a visit to India, that the mungoos will become as great a pest in these colonies as the rabbit. This result would equally attend the naturalization of either ichneumons or weasels, as the former are practically but tropical weasels and probably resemble them in nature and habits much more than I have stated.

The importation of these beasts should therefore be stopped and those already at liberty destroyed, at whatever cost; if this be done without delay, I do not think it is now too late to extirpate them.

For further information on the *Mustelidæ* and *Viverridæ* see Wood's "Natural History" and the "Encyclopædia Britannica," Arts. Ermine, Ferret, Fur, Ichneumon, Mammalia, and those on northern countries.

Art. XIX.—*A short Description of a few Experiments bearing on the Question of Spontaneous Generation.* By Dr. J. Hudson.

[Read before the Nelson Philosophical Society, 3rd November, 1884.]

The few remarks contained in this short paper, are written with the object of eliciting discussion.

The question of spontaneous generation is not by any means a new one, nor is it confined to the learned, for I have frequently heard ignorant hospital patients account for the parasites with which they were infested, by saying that they bred them, meaning that they arose spontaneously, and that no amount of care would prevent their development. Practically, the belief in spontaneous generation is pretty general; when organisms appear in situations where they are not expected, and under ciruumstances which, to a superficial observer, would appear calculated to exclude them, the easiest mode of accounting for their presence is to assume that "they came of themselves"; and, by way of parenthesis, I will say here that, when we wish to account for or explain observed facts, we are always right to take the simplest theory, provided such theory does not clash with any other known facts.

The possibility of organisms having a spontaneous origin has been narrowed and narrowed by successive observers, until it is only the *Bacteria* which at the present day are presumed, under certain conditions, to arise spontaneously. These *Bacteria* are exceedingly minute rods and spheres that invariably appear wherever decomposition of animal or vegetable matter is going on. For instance, suppose we take any organic infusion such as can easily be made by soaking a piece of meat, or hay, or turnip in water for an hour or so; we strain off the clear liquid and set it on one side. If we examine it after a few days (a week or ten days in winter, a couple of days in summer), we shall find that the clear liquid has become turbid, and that it begins to smell offensive,—in common parlance it has turned bad, or decomposed! Why has it decomposed? Modern science tells us that organic matter cannot decompose without the presence and help of *Bacteria* of some kind or other; that a complex organic infusion, provided we rigidly exclude germs, will remain as stable as a solution of sulphate of copper. We have a practical application of the principle in the various tinned meats. The germs in or on the meats or fish are first killed by exposure to a high temperature, and then the tins are hermetically sealed so as to exclude air, or rather germs; for it is not the air that does the harm. How can we prove this?

I have here three glass tubes, which I will call Nos. 1, 2, and 3. Some months ago I put into each of these tubes some chopped hay and water. No. 1 I left untouched in a sheltered place but exposed to air and light; No. 2 I boiled; into No. 3 I inserted a cotton wool cork, quite permeable to air, but which has been found to act as a sieve to *Bacteria* and their germs, and then I boiled it for about five minutes. The steam issued freely from the cotton wool, demonstrating its perfect permeability to vapour and air. After four days I looked at the tubes. No. 1 appeared clear, No. 2 distinctly turbid, No. 3 clear. A drop of No. 2 placed under the microscope showed numerous rod-like *Bacteria*. The earlier appearance of turbidity in No. 2 is easily explained by the boiling having made the infusion quicker (and so prepared the fluid for the reception and growth of germs) than the cold water did. At the end of a week I examined the tubes a second time. Nos.

1 and 2 were very turbid, and both showed under the microscope numerous *Bacteria*, but No. 1 (the unboiled specimen) showed in addition some free swimming Infusorians, derived (they or their spores) in all probability from the hay, but possibly from the water. The boiling of No. 2 had killed these higher organisms. No. 3 was still clear. After several months (it was in July that I put up these specimens, examine them now) Nos. 1 and 2 are positively filthy, they are far advanced in decomposition, and owing to evaporation are drying up. No. 3 has diminished fully half its bulk owing to the same cause; but what remains is a clear fluid, and if we examine a drop of it under the microscope, I feel well assured will not show any living organisms. Now this is very remarkable. What is this exemption from decomposition and the associated development of organisms due to? It is not due to the previous destruction of organisms by boiling, else No. 2 would have escaped. Neither is it due to the exclusion of air, for air has been freely admitted; therefore we can only conclude that the exemption is owing to the cotton wool plug having caught and retained the germs which are ever present in the atmosphere.

I have also a specimen of a small quantity of a highly putrescible animal fluid, which has remained clear and unaltered by means of the same simple precautions.

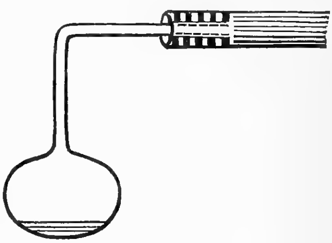
We may here for a few minutes consider what is the nature of putrefaction; putrefaction expresses the chemical change which organic matter undergoes when exposed to air, dust, etc. If we take a solution of an inorganic salt such as nitrate of potash and set it on one side and examine it after a long interval, we should find it was nitrate of potash still; similarly if we take a number of neutral salts, taking care to select only those that would not chemically react on each other, we should still find that even after a very long time they would still be unaltered; but with an organic fluid the case would be different; a solution of albumen such as the serum of blood would very soon putrefy, that is, it would undergo a chemical change, and as this change is accompanied with an offensive smell, it is called putrefaction. The process is identical with fermentation, in fact only a variety, and fermentation is a chemical change induced in an organic fluid by means of the growth in that fluid of certain definite minute organisms; thus the alcoholic fermentation is caused by the yeast plant (*Torula cerevisiæ*) the batyric fermentation by the growth of *Bacillus subtilis*; this organism grows best where there is but very little oxygen, and I may state here in parenthesis that the well known but at the same time unpleasant symptom of heartburn is caused by this particular fermentation; the lactic fermentation, or the souring of milk, by the *Bacterium lactis*, and the numerous fermentations and decompositions of organic fluids by the different species of *Bacterium*, *Torula*, *Bacillus*, and *Micrococci*. It will be well now to examine briefly some typical experiments of the leading heterogenists—Pouchet, Jeffreys Wyman, and Bastian.

Pouchet in one of his experiments introduces a flask into a vessel containing a decoction of barley which had been kept boiling for six hours; the flask being completely filled with this fluid was brought to the surface and corked, and then the circumference of the cork was surrounded by varnish. On the sixth day a deposit of yeast was seen, and the flask burst on the seventh.

Here an impure vessel, cork etc., were used, and the heat was not applied to them for a sufficient length of time. Further, the fluid cannot have been boiling when the vessel was introduced and corked, otherwise, if he had done it efficiently, the operator would have scalded his fingers. It is, moreover, noteworthy that Pouchet only got organisms in one experiment of this kind.

I may here say that Pasteur has completely upset all of Pouchet's experiments and deductions.

In Jeffreys Wyman's experiments such fluids as sugar gelatine and hay infusion, or flesh sugar and gelatine, were put into a flask, the neck of which was drawn out and bent at right angles, the extremity of the neck was inserted into an iron tube and cemented there with plaster of Paris. The iron tube was filled with wires, leaving only very narrow passage-ways between them. The general relation between the quantity of fluid and the capacity of the flask was about 20 to 500. The flasks were then boiled for periods varying between a quarter and two hours, while at the same time the iron tube containing the wires was heated to redness. On withdrawing the lamp from the flask, the air which entered passed over these heated iron wires. When cold the flasks were sealed with the blowpipe. Fourteen vessels were prepared in this way, and in ten of these, when opened after the lapse of various periods of time, *Vibriones* and *Bacteria* were found. The other four remained barren.



Curiously enough, Pasteur had made numerous experiments almost exactly similar and had obtained no organisms. Why this different result? Pasteur's flasks were half filled with fluid, while Wyman's contained only from $\frac{1}{20}$–$\frac{1}{30}$ part, so that we can easily understand that in Wyman's experiments a portion of the air and of the walls of the flask were never heated to within many degrees of the boiling point. Another source of fallacy is to be found in the fact that the air which passes through the iron tube with its contained wires is only exposed to dry heat, and it is within the experience of every one that very high degrees of dry heat can be sustained by living bodies with impunity; so that spores entering with the air through the iron tube need not necessarily be destroyed.

Any one who reads Dr. Bastian's book on the "Beginnings of Life" will lay it down feeling convinced of the possibility of spontaneous generation, and yet on close examination it is full of glaringly false facts; for instance, he states: "A closed flask containing a very strong infusion of hay, to which had been added $\frac{1}{20}$th part of carbolic acid, was opened twelve days after it had been hermetically sealed." Bastian states that this flask contained organisms of a peculiar form. Such a statement as this—that a saturated solution of carbolic acid can permit the growth of organisms—is opposed to all experience and experiment. It is usually found that so small a proportion of carbolic acid as the $\frac{1}{250}$th part effectually prevents the growth of organisms in organic infusions freely exposed to the air. The supposed organisms were probably granular deposits produced by the action of the strong acid on the glass or the hay infusion compounds. Many of Bastian's experiments were made with cheese; now, the spores of *Bacillus subtilis*, which abound in cheese, have peculiarly resisting powers, and, being contained in a badly conducting material like cheese, might easily escape the boiling point.

With regard to Bastian's experiments Dr. Roberts says: Dr. Bastian's process does not insure that the entire contents of the flask are effectively exposed to the boiling heat.

Professor Huxley states in "Nature," that he had seen Dr. Bastian's experiments and preparations, and expressed his belief that the organisms which Dr. Bastian got out of his tubes were exactly those which he put into them; that in fact he had used impure materials, and that what he imagined to be the gradual development of life and organization was the simple result of the settling of these solid impurities. For instance, he relates how on one occasion Dr. Bastian showed him a specimen of a fungus which had developed spontaneously, which Huxley recognized as a fragment of the leaf of a *Sphagnum*, and that it was so he ultimately with great difficulty convinced Dr. Bastian.

Drs. Bendon Sanderson, Ray Lankester, and Mr. Hartley have also tested Dr. Bastian's experiments, and found them wanting.

In concluding this short and imperfect paper, I would here remark that the old doctrine "*Omne vivum ab ovo*," appears to me to be the only one scientifically tenable.

P.S.—On tube No. 3 being opened, no organisms were found, and the odour of the solution resembled fresh hay, so forming a marked contrast to the other tubes, which had a very stale musty smell.

Art. XX.—*Notes on New Zealand Ornithology.* By A. Reischek. Communicated by Dr. Hector.

[*Read before the Wellington Philosophical Society, 25th November,* 1884.]

The author of this paper has had seven years' experience as an ornithologist in New Zealand, and during the last six months has undergone very severe personal hardships in his endeavour to solve some of the most difficult problems respecting the habits of our rarest birds that are found only in the most remote and inaccessible parts of the islands. In February last he arranged for an expedition to the "Sounds," to study the habits of the kiwi and kakapo, and I had great pleasure and confidence in assisting him with the knowledge of that wonderful region which I have acquired from many exploring visits during the last twenty years. His plan was to take an assistant with him in the light-house steamer "Stella" when she tendered the Puysegur light-house at the south entrance to Preservation Inlet, and there hire a small whaleboat with which to make his explorations. But at the Bluff his companion fell sick after all the arrangements had been made and six months' stores for his party's use had been purchased and placed aboard the "Stella." Nevertheless he determined to proceed alone, and in due course was landed with his supplies in Dusky Sound, at the place where Mr. Docherty, the mining prospector, has built a hut. Mr. Docherty assisted him as far as lay in his power, and with great kindness placed his hut and his canoe at Mr. Reischek's service, but having to leave by the "Stella" on a visit to Dunedin, Mr. Reischek was left to follow his researches single-handed. The canoe was a very crank craft dug out of a small log, but he lashed on each side of it logs of the most buoyant wood he could find, and so gained sufficient stability to navigate the waters of the sound when the weather was fair, which it seldom is for more than a few hours at a time, so that he was storm-stayed often for days together on narrow ledges bounded by precipitous cliffs. But Mr. Reischek's greatest feats of endurance must have been in his exploration of the alpine regions that overhang the sounds. He spent weeks in cutting tracks to reach the lofty table-lands that form the summits of the mountains, carrying up provisions sufficient to enable him to spend many nights and days in observing and recording the habits of the strange birds that inhabit these localities. Having once myself spent eight months in what was after all only a most cursory examination of these wonderful sounds, I am able thoroughly to appreciate the work of an explorer who devoted six months of earnest work to one spot of them only.

My Researches during Six Months' stay in Dusky Sound, commencing on the 10th of April, 1884.

The scenery is beautiful owing to its variety. The sound is about 23 miles long by 2 miles wide. There are several coves which give good shelter to small vessels and boats, also a few easy landings. There are a number of large and small islands, such as the Sentinel and Resolution, which are parted by the Acheron Passage from the mainland, then Long and Cooper's Island, which divide the main channel and the Nine-fathom Passage; there is also a small island in Super Cove not marked on the chart. On the tops of most of these islands there are to be found small lakes and lagoons, but the bush is very dense and the country broken. The mainland ascends from the water in terraces, interrupted by many cliffs and precipices. Near the water is heavy bush, but higher up the vegetation is smaller and denser, and on some places nearer the Alps, it is so thick that I had actually to walk on the top of the scrub, or cut my way through it. The scrub consists mostly of silver pine and hakehake, and there is an extent of grass country well watered, with plenty of rich vegetation. I think it could be used as a sheep-run if the lower land and terraces were cleared to get food and shelter in the severe winter, when the Alps are snowed over. At present they are inhabited by thousands of the wander rats (*Mus decumanus*), which were a plague to me, and very destructive to the birds. Beyond that are the rugged mountains, where the schist has disappeared and left the colossus of granite behind, some of which are covered with snow. There are many fresh-water streams in the valleys, and, on top of the mountains, lakes and lagoons similar to other New Zealand Alps. Strange to say, on some of them I could only find an outflow, but no inflow. When searching for life, I could find nothing but a few insects. The water is clear and cold. The formation is chiefly granite schist and mica schist, and I have never before noticed such a variety of accessories together in any part of this or the surrounding islands of New Zealand, as in Dusky Sound. Mr. Docherty informed me, and I have myself seen, ruby and peacock ore, yellow sulphide, molibdenite, iron pyrites, amphibole, tremolite, tourmaline, moscovite, chlorite, sphene, titanium, rutile, garnet, orthoclase, asbestos, wolfram, with black and green mica, varieties of quartz and spars and marble.

A better field could not be found for students in practical geology than this. The most of these accessories are found on the top of the Alps where Mr. Docherty has found the seven lodes; they are between two granite dykes, bounded on the west by Mount Huge; from north-east to south-west the granite cut through his lodes; to the east is a chasm which separates Mount Bender from these formations. Four lodes bearing about from north to south, underlying west, three bearing about east to west underlying north intersecting each other; all these lodes show metal on the surface over 2,000 feet high. There is a valley where these lodes could be got with very little difficulty, also there is plenty of water power for machinery and timber for tramway, and the best anchorage in Dusky Sound is right opposite Mr. Docherty's huts, from whence he has cut a good track to the lodes; also there are two tracks I have cut, No. 1 to the lake I have found and peak above (no name), No. 2 follows eye on the left side of the sound to some succession of waterfalls. This country looks very broken, but any one who is used to alpine travelling could ascend the most of this mountain and also descend on the other side if he looked for the ledges. I would have cut a track to Lake Manapouri, but as the winter was so severe, and I have been alone, I could not venture. In August I measured the ice in one of the lagoons on top of the Alps and it was 6½ inches thick, but the lakes on the eastern side of Mount Huge and the one I have found froze in much later. The heaviest frost I experienced in July, when in one night 3 inches of ice formed. Snow was lying from the 15th July to 30th September from 3 feet in depth. There are many snow-drifts and ice-fields, in getting over which I had to gain foothold by cutting steps with a tomahawk. I also experienced heavy snow-storms during the same period, but never without being accompanied by a severe thunderstorm, or *vice versâ*. On the beach the heaviest fall of snow I noticed was 6 inches, in August, but it disappeared in three days. An incessant fall of rain continued during the whole winter in the low lands and of snow on the Alps. From the 10th to end of April there were only eight days without rain, in May only four days, in June thirteen days, in July four days, in August five days, in September ten days.

The following is a list of the species met with, against each of which I have attached the word rare or common, as the case may be:—

Hieracidea ferox } Rare all along the coast.
,, *novæ-zealandiæ.* }

Circus gouldi. Rare in the Sounds, common from Martin's Bay.

Athene novæ-zealandiæ. Rare in the Sounds.

Halcyon vagans. Very rare in the Sounds.

Prosthemadera novæ-zealandiæ } Not very common in the Sounds.
Anthornis melanura. }

Xenicus longipes. Common in the Sounds, rare in Martin's and Jackson's Bay.

Xenicus gilviventris. Rare.

Acanthisitta chloris. Common everywhere.

Orthonyx ochrocephala. Common.

Gerygone flaviventris. Rare in the Sounds.

Petroica macrocephala. Common everywhere.

Petroica albifrons. Common everywhere.

Turnagra crassirostris. Rare in Dusky Sound, common in Caswell and Milford Sounds.

Rhipidura flabellifera. Common everywhere.

,, *fuliginosa.* Rare.

Glaucopis cinerea. Rare in Dusky Sound, common along the coast to Jackson's Bay.

Creadion carunculatus
,, *cinereus.* } Rare in Dusky Sound, common along the coast.

Stringops habroptilus. Common to Martin's Bay.

Platycercus novæ-zealandiæ
,, *auriceps.* } Common along the coast.

,, *alpinus.* Rare.

Nestor meridionalis. Rare.

,, *occidentalis.* Not uncommon from Preservation Inlet to Jackson's Bay.

Carpophaga novæ-zealandiæ. Very rare in the Sounds, Martin's and Jackson's Bay common.

Apteryx australis. Not very common, and only to be found from Dusky Sound to Jackson's Bay; in all other localities very rare.

Apteryx oweni. Rare in the Sounds, and small; Martin's and Jackson's Bay more common.

Charadrius bicinctus. I saw them on the Alps over 2,000 feet, by the lagoon.

Hæmatopus unicolor. Common.

Ardea novæ-hollandiæ. Very rare in the Sounds, common from Jackson's Bay to Bruce Bay.

Ocydromus australis
,, *fuscus*
,, *brachypterus.* } Rare from Dusky Sound to Jackson's Bay, where *O. australis* is common; I have found a variety or species which I must compare before deciding.

Casarca variegata. Not very common.

Querquedula gibberifrons. Not very common.

Anas chlorotis. Not very common.

Anas superciliosa. Not very common.

Hymenolaimus malacorhynchus. Only common inland.

Fuligula novæ-zealandiæ. Only common inland.

Larus dominicanus. Not common.

Larus scopulinus. Not common.

Sterna frontalis. Not common.

Diomedea exulans, Diomedea melanophrys, Diomedea chlororhyncha, Diomedea fuliginosa, Ossifraga gigantea, Haladroma urinatrix, Procellaria capensis, Prion turtur: all these species are not rare.

Notes and Observations.

1. *Xenicus gilviventris.* Rock Wren.

This harmless little bird which inhabits the higher regions on the Southern Alps is very tame, hopping about among *débris* grown over with alpine vegetation. I have found them plentiful on top of Mount Alexander, near Lake Brunner, in 1877, also on Mount Alcidus, Rakaia Forks, on the station of Mr. Neave, in 1879, not uncommon. To my surprise on the Alps in this sound they are exceedingly rare where I expected they would be very plentiful, as on many of these places there are not any human beings, or ever have been, to disturb them. By my examinations I found that the common European rats inhabit these Alps in thousands and they destroy every bird.

2. *Apteryx australis.* Roa. South Island Kiwi.

This bird, whose limits of existence are annually getting less, I met with on the 1st of June, 1884, west of Mount Bender, on the Alps over 2,000 feet high, among tussocks and low silver pine scrub. My dog got on a scent and followed it up on a well-worn track ten inches wide. As soon as he set, I examined the place and found a very large roa sitting under the scrub in a burrow, with his head under his side feathers, similar to the habits of all the species of *Apteryx.* As soon as I touched him he struck at me with his leg, clapped with his bill, and made a grunting noise. Judging from his size I mistook him for a female; but to my surprise on skinning it I found it was a male. At first I thought it was a large species which the natives have often told me about (the roaroa), but by careful observation I have found that this alpine inhabitant only differs in size from his lower ally, and never leaves the Alps in the severest winter. I have found them under snowed-over silver pine scrub, or in burrows between and under stones. Their tracks when come across are easily recognized, even without a dog. When the snow had disappeared I noticed them, especially from one lagoon to another. It is astonishing what a number of tracks one pair of these birds make. They also make their tracks in the bush, alongside of which I have often found places where they scratch with their feet and dig holes with their bills in the ground, also in rotten wood for insects, larvæ, and worms, etc. These holes are about 6 inches in depth, by 1½–2 inches wide at the top. The movements of the bird when not disturbed are very slow, the head bent down, and the tip of the bill regularly touching the ground. When they get disturbed they stand nearly upright, listen for a moment, and then run with outstretched neck, and bill pointed downwards. When they get pushed hard they go into the first burrow they come to. In October the female begins to lay one white oval egg in a nest well lined with leaves and grass, either in a fallen hollow tree, or under the roots of large trees, especially rata, and under stones. The male hatches the egg. The female is much larger, and has a larger bill than the male. The cry of the male is shriller than that of the female. This bird is to be found from Dusky Sound along the coast (and also inland) to Casket Point, but everywhere rare, as the burrows have no shelter, and the bird no means of defence against the attacks of the number of dogs and cats run wild, who prey upon them, and I fear this peculiar and interesting bird will soon disappear, even from these beautiful and lovely wilds. I found in their crops insects and their larvæ, also a number of small stones for digestion.

3. *Apteryx oweni.* Grey Kiwi.

This bird is the smallest of the four existing species of *Apteryx.* In the sounds they are not very plentiful, they prefer dry and high spurs, where plenty of dead logs are lying about. I have, however, found them both in the low lands, and at over 2,000 feet above sea-level. They like places with several openings and plenty of room, and it is astonishing what small openings they go in and out of. Some I measured were only 3 and 4 inches in diameter. With the assistance of my dog it sometimes took me half a day to secure a bird, and very often I had to give up without result.

They go about singly till the pairing begins, and then both sexes call each other, and they continue in pairs till the female lays one large white oval egg. They build their nest together out of dry leaves and grass, which they carry in with their bill. The male hatches the egg. After laying they soon separate, and I have never found the female near the nest. The young birds are soon left to look after themselves.

I am certain that this kiwi breeds twice in a year, or in different seasons, as I have found a half-grown bird on the 21st June, a six-weeks-old bird on the 14th August, and one about two months old on the 3rd September. All these birds have been left by their parents. On the 16th September I found up the mountains (no name), 1,500 feet high, a male sitting on an egg in a nest under a rata, which he broke in defending by striking with his leg in a similar manner to all species of *Apteryx.* From that time I examined several nests. In this species also the male is smaller, and has a shorter bill than the female; also the cry is different, that of the male being shriller.

In their crops I have found insects, larvæ, berries and stones for digestion. This kiwi is distributed over the most isolated and uninhabited districts of the South Island, but its circle is getting every year narrower, as where civilization and culture appear, this bird soon disappears.

4. *Eudyptes pachyrhynchus.* Yellow-crested Penguin.

This noble bird has been found on the coast of the South Island, but is most plentiful in the West Coast Sounds, especially Dusky and Milford. In Dusky Sound there are several colonies, two in Super Cove and one on the west-north-west of Cooper's Island. These birds come on shore in July, when they begin to build their nests, which consist of a few sticks and leaves, which the male brings, while the female constructs a careless nest, either in a cave between cliffs or under large stones, and lays one and sometimes two eggs, similar to those of the *Eudyptula minor*, only larger and with a bluish tint. These birds breed in colonies. I have seen as many as 24 pairs together. Both sexes assist in hatching their eggs and rearing the young birds. About the beginning of September the young are covered slightly with down, the head and back black with a greyish tinge, the throat and abdomen white. This down increases in thickness as the birds grow larger. The female stays with the young the first few days and the male brings the food, which consists of various fish, especially the rock cod (*Percis colias*), which they masticate. Afterwards they take it in turns to attend the young. It is interesting to watch these birds: some on the alert, some coming out of the water with their prey, and others searching for their prey. When they are not disturbed they walk or hop upright rather clumsily; but when they are startled by an enemy they stoop down and use their flappers as forelegs. For climbing up on the rocks they also use their bills, when they get along very quickly. When anything approaches them they make a noise similar to a goose (*Anser domesticus*), and the female goes quickly to her young, while the male, if he is near, stops by the entrance of the burrow and bites furiously at any intruder. As the caves were low and difficult to get at in my first efforts my dog and I got many bites before we succeeded in securing any. Though clumsy on land, they can be very swift in the water. When swimming the body is under water and only the head out, and they swim slow. But when they dive they go with great rapidity. I have noticed them in the severest gales of wind, and it had not the slightest effect upon their movements, so great is their power in their native element. During my six years' researches I have only found two washed ashore. I have observed a colony of about 14 journeying to their breeding places together. On disturbing them they went in a similar manner to the porpoises, jumping out of the water and then diving with great rapidity to get out of the way. When these birds get often disturbed they leave their breeding settlements and seek for more solitary places, generally nearer the ocean, and more inaccessible. Mr. Gidal told me that in Caswell Sound there have been for years colonies breeding, but we could not find any of them, as the dogs drove them away, and now people are living at the Marble Quarry. The only difference between male and female is the slightly smaller size of the latter. I have found an insect similar to the *Membranacea* inside the edges of the bill, which adhered so firmly that they parted in two on my trying to get them off. Eventually I had to poison them to succeed.

5. *Eudyptula minor.* Blue Penguin.

This little bird is not so common in the sounds. I have only found them in pairs, and they differ slightly in their habits from the larger variety. I have found their nests, which are better built, nearer the shore, and as far back as a mile in the bush; and in one instance in a burrow 12 feet long. Coming ashore in September, the male brings the sticks, leaves, etc., for the female to build, generally in a burrow under the roots of trees. Both are together in the day-time in their burrows, when they make a noise like a kitten; in the night they build their nest, and towards the end of September two white roundish eggs are laid, which are reared by both parents, and protected from any intruder, whom they pluckily attack. In the beginning of November, I have seen young birds covered with slight down, dark grey on the top of the head and the back, white on the throat, breast, and abdomen. The female is considerably smaller than the male. In the end of February and March, they leave the shore with their parents for their unfriendly element, where they are as active, but not so powerful of endurance as the larger species, as I have found many of them driven ashore after a severe gale, dead. Their food is fish and Crustacea. These birds are distributed over the North, South, and surrounding Islands of New Zealand, and where they are not disturbed they are very plentiful, especially on the Motutiri and Taranga Islands, Hauraki Gulf. Their enemies are the domestic dog and cat run wild.

6. *Nestor*, sp. Kaka.

This bird represents *Nestor meridionalis* in the sounds, but is not very plentiful. I have found them alone and in pairs or with their young, from two to four. They breed in hollow trees. The nest consists of a deepening lined with wood-dust and feathers out of the parent birds. They lay their eggs from beginning of March till April. Male and female hatch and rear the young birds together; in August the young birds are fullgrown. This bird is not so gregarious as his ally *meridionalis*, also different in plumage and construction of the skeleton and habits; the cry and whistle is shriller; the male is fiery red under the wings, the female golden yellow and a little smaller. These birds are very bold. On the 13th April, 1884, I found in a hollow tree a female with one egg and three young birds, which she pluckily defended by biting and scratching. At the cry of the female the male came swooping several times past my head. This species is the finest of the three existing species of *Nestor*.

As I have not seen any specimens of Dr. Buller's *Nestor occidentalis* nor of the *Nestor montanus* which were previously obtained and described I can only depend on my own observations, of which I am positive, and also can prove by a series of specimens I have collected of the *Nestor meridionalis*, North Island kaka—adult, half-grown nestlings, and egg—having a similar series of the above *Nestor* and also of *Nestor notabilis*.

At first I called this bird *Nestor occidentalis* according to the description Dr. Buller has in his Manual, which is similar, but I do not like to give it any name until I am sure that it is one of the previously-named species. I only hold by my own observations that in New Zealand there are three species of *Nestor*—as *Nestor meridionalis, Nestor*——? and *Nestor notabilis*.

7. *Stringops habroptilus*. Kakapo.

On my last researches in the sounds I had the opportunity to observe minutely the habits and habitat of these birds. They are common in some parts of the bush. The young ones are much duller in plumage than their parents. When hatched they are covered with white down, which in about a month's time gives place to a fledging of feathers, the down remaining upon the feathers until the birds are about three months old. In April last I found under the root of a red birch, in a burrow, two young kakapos. During the same month I found several other young birds of this species. So late in the season as the 12th May Mr. Docherty found a kakapo's nest containing a female sitting upon an egg with a chick just hatched. Mr. Docherty kindly pointed out the nest which I measured. The burrow had an entrance from both sides, and two compartments. Both entrances led to the first compartment, the second and deeper chamber being connected with the first by a small burrow of about a foot. The nest was in the outer compartment, and was guarded by very strong rocks, rendering it difficult to open up. The distance from the entrances to the nest were two feet and three feet respectively. The first chamber was twenty-four inches by eighteen inches, and twelve inches high. The inner compartment was fourteen inches by twelve inches, and only six inches high. The nest was formed by a deepening, lined with wood dust, ground by the bird as fine as sawdust, and feathers, which the female had evidently plucked from her own breast, which was quite bare. From my observations I am of opinion that the male bird takes no part in the hatching or rearing of the chicks, as in all cases the female was the sole attendant from first to last. I did not see a male near a breeding burrow, nor did I in any single instance find two grown-up birds in one burrow, though I have seen them in pairs on their nocturnal rambles. Whenever two males meet they fight, the death of the weaker sometimes resulting. The female is much the smaller (probably about three-fourths the weight), and duller in plumage. These bush kakapos are very common in various parts of the Sounds district.

The alpine kakapo—so called by me as I have never found this beautiful bird except on the high mountains—is considerably larger, and much brighter in plumage. I was under the impression before the winter set in that these birds inhabit the Alps in the summer time when there is an abundance of food; but to my surprise my later investigations proved this to be erroneous, for as I have said, I have never seen them anywhere else, though I have repeatedly seen them taking their nightly walks on the Alps, when the snow covered everything to a depth of three feet or more.

I was particularly anxious to observe the manner in which the kakapos make their tracks. I therefore hid myself on several occasions in proximity to one of the tracks, and in such a position that I could see every bird as it passed along. It was very amusing to watch these creatures—generally one at a time—coming along the track feeding, and giving a passing peck at any root or twig that might be in the way. Thus the tracks are always kept clean; in fact they very much resemble the native tracks, with the exception that they are rather narrower, being from eight to fourteen inches wide. The kakapos generally select the tops of spurs for the formation of their tracks. I was curious to know how the birds would manage when their tracks should be covered with snow. Opportunities were afforded of satifying my curiosity. I found that they travelled on the surface of the frozen snow, and that their tracks were soon plainly visible, though not more than an inch between the level of the surrounding snow. In many places the scrub, which consists of silver pine, akeake, and other alpine vegetation, is so dense that the snow cannot penetrate it. The kakapos take advantage of this to make their habitations under the snow-covered scrub, where it is both dry and warm.

The kakapo leaves his burrow after sunset, and returns before daylight. If they cannot reach their own home during the darkness, they will shelter in any burrow which may be unoccupied, as they travel long distances. They consume large quantities of food, which consists of grass, grass seed, and other alpine vegetation. In July they are in splendid condition, those found having as much as two inches of fat upon them. The young birds are delicious food when roasted in the camp oven. I prefer them to any other game. I was much surprised and interested to find in the intestines of these old alpine fat birds parasites from six inches to two feet long. These parasites are flat, about a quarter of an inch wide, milky white, and jointed very closely. I have found three of these parasites knotted together, and many single ones tied in three or four knots. I have not found any parasites in the bush kakapos, although I made many examinatious for that purpose. The alpine birds are rare, but I was fortunate in securing about a dozen of them. Amongst them was a specimen of a beautiful varied plumage. On the top of the head very light green; back, wing-covers, and tail, yellowish-green with crimson spots; round the bill crimson; throat, breast, and abdomen yellow with crimson spots; bill light yellow; legs silver-grey; eyes dark-brown.

In the spring, when the sun begins to shed its warmth, the kakapos emerge from their burrows, and select some favourable spots in the sunshine, where they crouch down and remain the whole day. In September I selected a suitable day for observing this peculiarity. The snow had disappeared from all the sunny places. I found three birds in different places, sitting upon low silver-pine scrub. They took no notice of my approach until I had them safely in my hand, when they endeavoured to release themselves by biting and scratching. The bush kakapos, like the alpine, get very fat during the winter months. They differ from their alpine allies, inasmuch as they do not retain their own burrows except during the breeding season. All the rest of the year the bush kakapos take the first burrow that is unoccupied when daylight approaches.

8. In the course of my researches I found also two species of leeches, also various parasites. When crossing a creek in Dusky Sound, in September, 1884, I felt something on my feet, and on examining them found some small leeches, so I skinned a bird, tied the body to a string, and threw it in the same creek; on returning in an hour's time I found a good many of these leeches on the body, some being quite red from sucking the blood; these have been preserved in spirits of wine. The second and larger species I found in the bush, September, 1884, on the leaves of a birch; their colour was chestnut-brown, they stuck very hard when I was pulling them off. I only found two and gave you one.

I found a species of tapeworm in the intestines, rectum, of the alpine kakapos (*Stringops habroptilus*, Gray), which I got on the 25th September—these old male birds were very fat and had as much as two inches at the abdomen. The parasites were alive, from 6 inches to 2 feet long by ¼ inch wide, closely jointed, very thin at the end; three of them I found knotted together, and many single ones tied in three or four knots; as soon as I put them in alcohol they shrunk together and sent forth a milky white substance.

Another parasite was found on the large penguin, and has been described (*vide supra*, p. 194).

Fish in Dusky Sound.

I may be permitted to mention the wealth which lies in this sound undisturbed.

It could be made by enterprising people a paying industry, as there are so many feeding grounds and plenty of fish. If any one were to go with a boat before high water to these places they could fill their boat very soon.

The fish good for eating are hapuka, *Oligorus gigas*; rock cods, *Percis colias*; tarakihi, *Chilodactylus macropterus*; moki, *Latris ciliaris*, etc., etc. There are also two species of dolphin very plentiful, which could be easily secured and used for oil and their skin for leather. In fine weather the smaller species are there in hundreds similar to the common *Delphinus delphis*. I have seen the sound alive with these fish playing.

The second and larger species similar to the *Tursio*, is not as plentiful. They go in small groups from two to a dozen steadily along, the dorsal fin the most time out of the water. They make a roaring noise like the bellowing of a bull, especially in the night.

When I paddled from one place to another these fish would follow alongside my canoe.

Art. XXI.—*Description of a new* Octopus. By James Park.

[*Read before the Wellington Philosophical Society*, 14*th December*, 1883.]

After heavy north-east gales molluscs of this class are not infrequently cast ashore between Stoke and Richmond, and during the fishing season great numbers are caught by the fishermen inside the Boulder Bank; but, except they are almost immediately secured, they are soon shrivelled up and beyond identification. In the present instance the specimen before you, which is a male *Octopus*, was captured near the Marine Baths, at the "Port," in some four feet of water, and I was fortunate enough to obtain it in a very fine state of preservation.

In general outline it somewhat resembles *Octopus tuberculatus*, but the arms are more slender and tapering and very much larger than in that species.

Class CEPHALOPODA.

Family Octopodidæ.

Octopus communis, sp. nov.

Body oval, stout, fan-shaped behind, smooth, without fins. *Head* large, long, rounded. *Eyes* large, round, prominent. *Arms* long, tapering, unequal; dorsal pair $\frac{1}{3}$ longer than ventral pair. The hectocotylus is shorter and more robust than the other arms, ending abruptly in a long, flattened process with a deep longitudinal groove. *Suckers* in two rows, not opposite, sessile, tenth sucker in row largest, gradually diminishing both ways; those on dorsal arms about $\frac{1}{3}$ larger than those on ventral arms. The suckers vary in number from 138 pairs on the longest arms to 110 on the shortest, while the male organ is furnished with only 52 pairs. *Colour*: Above dark steel grey, blotched irregularly with pale grey, almost black round the eyes. Below pale grey, blotches smaller and less numerous.

MEASUREMENTS.

	Feet.	Inches.
Length of body and head	1	1
,, dorsal sessile arms	3	0
,, ventral ,, ...	2	0
,, hectocotylus	1	6
,, other sessile arms	2	9
Circumference of body	1	5
Diameter of eyes	0	0·5
,, largest dorsal sucker	0	1·3
,, ,, ventral sucker	0	0·9

Hab. Blind Bay, Nelson.

ART. XXII.—*The Plague of Rats in Nelson and Marlborough.*

By JOHN MEESON, B.A.

[*Read before the Nelson Philosophical Society, 6th December*, 1884.]

THE plague of rats from which we at present are and have been now for some months past suffering has features which merit more than a passing notice from a Society having for one of its principal objects the discovery, corroboration, and classification of fresh facts in natural history. The magnitude of the plague is the subject of ordinary conversation. Nelson and Marlborough—in other words, the whole of the extreme northern portion of the South Island of New Zealand—is enduring a perfect invasion. Living rats are sneaking in every corner, scuttling across every path; their dead bodies in various stages of decay, and in many cases more or less mutilated, strew the roads, fields, and gardens, pollute the wells and streams, in all directions. Whatever kills the animals does not succeed in materially diminishing their numbers. Fresh battalions take the place of those slaughtered. Young and succulent crops, as of wheat and peas, are so ravaged as to be unfit for and not worth the trouble of cutting and harvesting. A young farmer the other day killed with a stout stick two hundred of the little rodents in a couple of hours in his wheat field. Plainly, the settler, for this season at all events, in addition to parroquets and blackbirds amongst his small fruit, the codlin moth, American blight, scale, etc., amongst his larger fruit, the difficulty of getting in his seed and of gathering his crops through disorganization in the central weather office, and the impossibility of getting a remunerative price for what he does succeed in bringing to market, may count upon another source of comfort and profit, in addition to all those he at present possesses, in the troublesome visitor which forms the subject of this notice.

Three questions in connection with the invasion seem deserving of consideration:—1. Whence do the animals come? 2. To what species do they belong? 3. What kills them off in such numbers?

Now, as to the first question, the local journals of the past six months seem to show that the Province of Marlborough, and in particular the district about Blenheim and Picton, first had the visitation. This was, I believe, about five months ago—that is to say, in the depth of the winter. Thence the rodents made their way in a westerly direction through the Wangamoa to Wakapuaka, Nelson, and the Waimeas. Thousands of them made a mistake while passing on the eastern coast of Blind Bay towards Nelson. They took to the Boulder Bank and travelled along that curious prong of land to its very extremity. To continue their course onwards they then boldly swam across the passage leading into the harbour, rather than lose time by retracing their steps. From the Waimeas the invading force journeyed onwards round Tasman Bay to the Motueka; took possession in countless myriads of the valley of the Motueka, spread round Golden Bay, passed Collingwood, and planted their outposts even as far as Cape Farewell. They have now completely overrun the southern shores of Cook Straits, and have even appeared in great force on D'Urville Island, which apparently they could only have reached by swimming the French Pass. How far southwards the invasion has extended there seems no means of immediately ascertaining, as a great part of the country between here and the Canterbury Plains is either very sparsely peopled or unoccupied altogether. On the Lyell Road, throughout the whole distance, they are in swarms. Probably ere this, if they have continued their disposition to travel in search of fresh fields and pastures new, they have made their way to Westland and Canterbury.

Now, this is the whole of what we know as to their march: the question "whence do they come?" still virtually remains unanswered. I think, however, if we consider where they first put in their appearance, we may fairly conclude that their previous abode was somewhere in the mountainous country around the valleys of the Wairau and Awatere,—midway, perhaps, as the bird flies, between Nelson and the little township of Kaikoura. My friend Mr. Conrad Saxton, who is very well acquainted with a great deal of the more remote country in this district, and has moreovor great natural aptitude and appetite for observing facts in natural history, tells me that he is pretty sure that these rats are the same as he used to see in large numbers many years ago round about Tarndale,—the very district that our secretary and his party of explorers visited recently. Here, or hereabouts, are the head waters of the Clarence, Awatere, and Wairau. Of course it would be absurd for me to pretend to fix the precise spot of the original *habitat;* but that it was somewhere at the head of the valleys mentioned, or on the western side of Mount Odin, in the Kaikoura Range, seems to me indisputable. What other supposition can be entertained? Consider the geography of the locality in question. It is the north-eastern corner of the island with the waters of Cook Straits and the Pacific washing its coasts on the entire east and north. To these shores trend great mountain chains, like the fingers of an enormous stony hand, slightly outstretched from a big central mass more in the interior. Between these chains lie the narrow valleys mentioned above. The rats first appeared on the shores in the north-eastern corner. How did they come there? No one will contend that they swam across Cook Straits from the North Island,—or that they came from the ocean, or that they journeyed from the middle of the island where, as far as we know, they have not even as yet been seen. Unless, therefore, we assume that they dropped from the skies, or form an illustration, like Van Helmont's mice, of the doctrine of abiogenesis, we are driven to the conclusion that their original habitat was somewhere in the high, rough, and secluded country on the western side of the Kaikoura Range, whence they descended by one of the narrow valleys that I have referred to.

They probably were driven out of their old haunts by the struggle for existence (or subsistence, if you prefer the word), even as in many cases human beings are driven to emigrate; and, if we enquire what it was that pressed so severely upon the rodents, we shall probably agree that the best explanation of the movement *en masse* is in some exceptional climatic condition. Let it be borne in mind that last summer was very wet, and last winter very cold, the amount of snow lying on the high lands in the interior having been reported from time to time to be exceptionally large. In the month of September 5,000 sheep were at one station alone, in the Kaikoura District, Kekerangu, lost through heavy snow. Under pressure of famine, therefore, the rats, though contented enough with their habitat under ordinary circumstances, naturally braved new dangers, and made their way to the more fertile and cultivated lower country in the valleys and along the coast, where food would be found more abundantly. Another supposition would be that the struggle for existence arises from excessive increase in numbers, rather than hard winters; and a third, that the animals are attracted by some particular species of food which, in this particular year, and at this particular season, their instinct or their keen sense tells them would be found hereabouts in abundance. In connection with this supposition, I have heard it suggested that, as this year the birch-trees have been seeding abundantly, and thus attracting the kakas, so perhaps the rats have been drawn down from their remote homes by the same seductive food. I incline to the opinion that the recent hard winter has procured this visitation for us.

A curious fact, if it be one, here comes in. I have examined many of these animals, and have not found a single female. One of my neighbours has examined two hundred of them; and a Maori, at the pa beyond Wakapuaka, one hundred, with the same negative result. I have not heard of many female specimens as yet being taken amongst the whole host. Some females have, however, been taken; and in one case, at Wakapuaka, they were found breeding. If it really be the case that nearly all these visitors of ours are males, we may safely prognosticate that, unless there be a fusion of this race with that of the *Mus decumanus* or Norwegian rat, which we have with us (a thing most unlikely to occur), the infliction under which we suffer will not be of long continuance. Arguing by analogy, we should say that the young males driven, or volunteering, on a dangerous foray, will not stay long from their old quarters if they be unaccompanied by the other sex. But is it possible that the weaker males have been driven out by the stronger through jealousy,—or that, through *res augustæ domi,* like drones from a hive of bees, they have decamped to escape the massacre with which they were threatened by a combination of the strongest males, and the whole body of females? It will not be safe to raise a theoretical superstructure as yet upon the evidence produced. More observation is wanted, so that we may have a foundation of fact, and then we may try to answer the above questions.

Invasions of rats, from whatever cause produced, are not by any means rare in the annals of natural history. They have occurred, I am told, from time to time in different parts of this colony; and it is quite certain that both the European species—*Mus rattus* and *Mus decumanus*—appeared in Europe quite suddenly in comparatively modern times—the black rat about the year 1500, and the brown one, stupidly called the Norwegian rat, about the year 1727; both came from Central Asia, and must therefore have travelled much further than our present troublesome little visitors here in Nelson; that is, if our supposition as to the whereabouts of their original home be accepted.

2. *But what is this rat?* Is it a complete stranger or an old acquaintance? Here is a full and particular description of the adult male.

Length of body from the tip of snout to base of tail, 4·75–5·5 inches; length of tail, 4·75–5·5 inches; length of head, about 1·6 inch; length of hind foot, about 1·25 inch; length of fore foot, about ·75 inch; measurement of ears, ·75 × ·625 inch; whisker hairs, numerous, of various lengths, largest 1·5 inch; colour of fur (which is long, very thick, soft, and glossy), except at tips, always iron or bluish-grey, intermingled with perfectly white hairs at tips; greyish-brown on back, white on belly. The ears are rounded and naked; tail long, scaly, covered with very short hairs; legs clothed in soft hair, which in the hind feet is long and covers the claws; toes, 4 in fore-feet and 5 in hind ones, each toe provided with nails which are sharp and white at tip. Dental formula, $i\ \frac{1-1}{1-1}$, $m\ \frac{3-3}{3-3}=16$; the lower incisors large, rounded, and yellow.

Now in turning over the pages of the Transactions and Proceedings of the N.Z. Institute, I see, *passim*, the following species of rats noticed as found in the colony and distinguished from one another. It is not by any means easy to gather from these scattered notices the information needful for writing a clear account. Those who have examined specimens and read papers or spoken thereon at the meetings of the Philosophical Societies have differed somewhat from one another, and in some cases later information seems to have led to the withdrawal of previously expressed opinions. This seems to have arisen partly from the fact that in most cases a solitary individual specimen has been the subject. Such an one was the rat, ochreous in colour, found in 1853 (Trans., vol. iii., p. 3), and placed in the Auckland Museum. This in size was about as big as our rat, but Dr. Hector considered that it was probably a Sydney species. Again a rat of large size, with a tail 8 inches long, was found in Tinakori Road, Wellington, in 1871 (Trans., vol. iv., p. 183). It was a female, is now in the Wellington Museum, and was regarded by Professor Hutton as a specimen of *Mus rattus.* Two or three rats, again, were found by Mr. Taylor White near Napier, in 1876 (Trans., vol. xi., p. 343), and a skin was also found at the Port, all of which Professor Hutton regards as being specimens of *Mus rattus.* Then, again, in 1870 (Trans., vol. iii., p. 1), Dr. Buller communicated a paper to the Transactions, on a specimen forwarded to him from Wangaehu, which he minutely describes, and regards as the true Maori rat—the Kiore Maori. This also is deposited in the Wellington Museum. Now some of these specimens, I submit, had in all probability been stowaways on board vessels arriving at the New Zealand ports from Europe or the Australian colonies, and the accounts given of them therefore increase the difficulty of arriving at a conclusion as to what species of rats are indigenous or acclimatized in New Zealand. However, I think these three species are and have been for some time in different parts of the colony.

1. The *Mus decumanus*—Norwegian rat—which has driven away the Kiore Maori into remote districts, if it has not exterminated it altogether.

2. A species of *Mus rattus*, of which perhaps Dr. Buller's *Mus novæ-zealandiæ* was a specimen —as indeed, he himself seems to think.

3. A smaller species—for which Professor Hutton proposes the name *Mus maorium* (Trans., vol. ix., p. 348).

Now let us first enquire if our rat is the *Mus decumanus*. I think certainly not. I have had a Norwegian rat and two of our present invaders stuffed and grouped together for exhibition in our museum. A moment's inspection suffices to show what different animals these are. The fur of the Norway rat is thinner, shorter, and different in undercolour at all events. The eyes, too, are smaller. Our new friend is more like a big field-mouse than a Norway rat; and besides being considerably smaller, he is slightly darker in colour and less malodorous. He differs also in his habits, climbs trees and flax plants, is phytophagous rather than carnivorous, prefers the field to the house, the garden to the sewer; is less sagacious and crafty in preserving himself against his enemies. Some may think him a degenerate form of his Norway congener, his degeneracy produced by bush life and scanty fare. I do not think so. The argument from difference in size is too important. Besides the *Mus decumanus*, when it takes to the bush, attains a size which is greater than that of the animal which haunts the abodes of man. Taking to the bush, for a rodent apparently does not by any means necessarily imply starvation of individuals and general deterioration of type.

In the next place we must ask,—Is our rat the same as that described by Dr. Buller and called by him *Mus novæ-zealandiæ*? Comparing the descriptions of the two animals it will be seen that although their characteristic features agree pretty well in other respects, yet in the matter of size one is a comparative pigmy. If Dr. Buller's rat was the true Kiore Maori, and there was only one species of that animal, ours can scarcely be said to be the Maori rat. But when the natives told Dr. Buller that the rat from Wangaehu was the true Kiore Maori were they right? At the discussion which took place on the subject in the Wellington Philosophical Society, (Trans., vol. iii., p. 3) the question arose "whether any native now living could really identify the native rat." And truly the point is very doubtful. I have tried by means of an interpreter to get information on the matter from amongst the Maoris who have thronged into Nelson during the last week for Land Court business. But their stories and accounts are anything but consistent with one another. They do not by any means seem to be quite clear as to there having been in olden times only one kind of rat in the country, and in all cases their information seems to be traditional, although some of them are aged men.* About one thing they are perfectly agreed; the Kiore Maori was good to eat; "bettern rabbit." As to all else pertaining to the native rodent, they are about as ignorant and indifferent as the average Englishman is to the facts of natural history in his own island.

But there is a third species of rat, for which Professor Hutton proposes the name *Mus maorium*. (Trans., vol. xi., p. 344; vol. ix., p. 348.) Does our animal belong to this species? I think it does, and I will, with your permission, give my reasons for saying so. The Professor found in Maori cooking places at Shag Point, on Mount Benger, and I think elsewhere, at various times and under circumstances which show that they had lain where gathered for many years, certain collections of bones, principally of birds, amongst which, however, were the remains and in some cases the complete skeletons of a species of rat. He has given us exact measurements of these skeletons, and his figures and accounts are extremely interesting; for after careful consideration he entertains no doubt that this animal was the true Maori rat, and perhaps identical with the black rat of Polynesia. Now in comparing Professor Hutton's measurements of the Shag Point and Mount Benger rat skeletons, with the figures that I have given above of the dimensions of our rats, it will be found that the two sets *correspond marvellously closely*. The animal recently killed gives dimensions slightly larger than the desiccated skeleton, and we should naturally expect that this would be the case. My opinion is that our rats and Professor Hutton's skeletons belong to the same species, which is that of the true and probably more ancient Kiore Maori. The question then arises, what of Dr. Buller's *Mus novæ-zealandiæ*? What was it? Are we right in supposing that there was only one species of Kiore Maori before the settlement of the British in New Zealand in 1839–41? I do not see why we should suppose so. It is possible that there are at least two species—both varieties of the *Mus rattus*, both frugivorous and dwelling in trees—but one of large size inhabiting the lower country and the other smaller occupying the highlands. It is in that case to the former that Dr. Buller's specimen, the one found in Tinakori Road and several others described—would belong; and to the latter, our visitor. Perhaps one rat was a Moriori animal, the other a genuine Maori, and if that supposition cannot be accepted—perhaps the larger variety of *Mus rattus* came over with Captain Cook in 1769, or with some earlier navigator. In that case the small rat *Mus maorium* must be accepted as the original Maori animal and of the Polynesian variety of

* One old Maori believes that in his youth there were three rats in New Zealand—the Maori, the Norwegian, and *the English*—whatever he may mean by the latter.

black rat, while the larger animal would be simply the European black rat modified to some extent by climate and other differences during the course of perhaps a hundred years.

The statement is frequently made that the Maori rat is extinct. Surely this is a gratuitous assumption. It is at all events an assertion very difficult to prove, inasmuch as it virtually involves a universal negative. That one species of the so-called Maori rat may have disappeared before the invaders, I have no difficulty in granting. But there are wide tracts in New Zealand where there is room enough for millions of rats to disport themselves without let or hindrance of pakeha or pakeha rat. Old settlers in this province who knew the interior 40 years ago, and have known it ever since, tell me that during the whole of that period a small species of rat has been commonly met with in the bush at all altitudes. One of our members (Mr. Browning) has seen it when on his professional duties at a height of 4,500 feet. Mr. Saxton says it climbs trees. Some people say it lives in them. It certainly eats fruit and vegetation, and is a very clean wholesome animal compared with the brown rat of our civilization. It lives largely amongst the fern. Why not call it by way of distinction the Fern Rat. Understand me, I do not look upon this as another variety additional to those I have mentioned, I believe this is the true Maori rat—the *Mus maorium* of Professor Hutton—the Kiore Maori—the rat with whose presence we now are so largely favoured.

It is fair to say, per contra, that Professor Haast in his "Report of Exploration in the Western part of the Nelson Province, 1861," states that although the native rat (which he calls "*Mus rattus*") was said in some places still to exist in large numbers, he failed to find any ; while, on the other hand, the Kiore Pakeha was found everywhere in large numbers and of large size.

It must also be said that mention has been made more than once of some species of rat living in communities—like rabbits living in their burrows, or ants on their hills. The deserted holes were frequently found on the Canterbury plains and in the Nelson interior some years ago, but there is no evidence to show what species of rat inhabited them.

Well then you see the opinion to which I incline is that our rat—whether the true Kiore Maori or not—is an indigenous rodent, the same which Professor Hutton calls the *Mus maorium*, and which we may familiarly name the Fern Rat, in reference to its usual habitat. So far from its being extinct, this rat, as Dr. Hector says (Trans., vol. xvi., p. 555), "is very common in the bush country," feeding on the bark of the patete, and relishing the honey of the puriri, by which it is frequently stupefied and poisoned. It descends into Wellington during hard weather, and if the Empire City is not spared, *we* must look for a like visitation from time to time.

Some say that the colour of our rat is not dark enough to admit of the opinion that it is a "Kiore Maori." But the *Mus rattus* is said by a distinguished naturalist to change from black to grey—very old individuals becoming decidedly hoary (Trans., vol. iv., p. 184). We should hesitate, therefore, before pronouncing positively as to the classification of a rat from colour alone. Anatomical structure, size, and habits seem to be more important elements to consider.

3. As to what it is that causes the death of so many of our visitors—for their corpses in various stages of decomposition lie about our properties everywhere—there need be no difficulty. Their enemies are numerous. Every man's hand is against them. Dogs and cats worry them about our houses. Native birds pounce upon them in the open fields. Their more powerful congeners—the brown rats—wage war against them *à outrance.* A survey party in Motueka the other day dug out a rat hole, and found therein a Norwegian female and her young, and by their side about twenty skins and other remains of the smaller rat. Besides these enemies they have to contend with disease, probably occasioned by change of food and surroundings. Moreover, they do not seem to have the experience or cunning of the brown rat as to the avoidance of danger; and as their numbers are so great, their slaughter is proportionately wholesale. Between them and the brown rats there will of course be a war of races. But the black rat, neither in Europe nor here, has ever been a match for the other rodent. We shall not have these interesting strangers amongst us long—already they are diminishing in numbers, and soon they will probably retire to their mountain fastnesses as mysteriously as they descended upon us. If we did not welcome their coming, I think without doubt we shall speed the parting guests.

Art. XXIII.—*Notes on the Dolphins of the New Zealand Seas.*

By James Hector, C.M.G., M.D., F.R.S.

[*Read before the Wellington Philosophical Society, 26th November,* 1884.]

In 1872* I collected all the information at my command respecting the dolphins that frequent our coasts, and distinguished the species according to the mode of classification adopted by the late Dr. Gray in his catalogue.

* Trans. N.Z. Inst., vol. v., art. xix.

In 1876, when describing the osteology of *Tursio metis*, I pointed out the importance of the palatal aspect as affording a ready means of distinguishing the skulls of our dolphins, and gave figures of this aspect for the five species of most frequent occurrence.* So far as I know, no additions have been made to our knowledge of the subject by observation in this country since then, but the general classification of the Delphinidæ has been considerably modified, so that it has become necessary to revise our lists. Unfortunately the great work of Van Beneden and Gervais, which was looked forward to as likely to afford us an authoritative settlement of many difficult questions, fails us in respect to the dolphins, owing to the death of Professor Gervais before this section of the work was written. Professor Flower has, however, taken up the subject in a masterly paper contributed to the Zoological Society,† and has done much in clearing the ground for more correct observation and study of this most difficult class of animals. The key-note of this revision by Professor Flower is that he places no dependence on the number and size of teeth, or the form and proportions of the brain-case and of the beak, all of which were the chief characters relied on by Dr. Gray, and attaches most importance to the features presented by the palatal aspect of the skull, and particularly the condition of the pterygoid bones, which, he points out, in all the Delphinidæ enclose a large air-sinus. Adopting the classification thus indicated, the following is the revised nomenclature of the New Zealand Delphinidæ:—

1. *Orca gladiator*, Gray, p. 279.

(*Orca pacifica*, Gray, Proc. Zool. Soc., 1870; Hector, Trans. N.Z. Inst., vii., 260.)

Two complete skeletons of the *Killer* are now in the Museum, one having been obtained from Tasmania and the other from the coast south of Wanganui. I consider that there is no valid ground for separating the southern from the northern species. The New Zealand species is the larger and more robust of the two specimens, and measures 21 feet in total length.

The number of vertebræ is as follows:—

Cervical	7	First 4 anchylosed.
Dorsal	11	
Lumbar	10	
Sacral	15	
Caudal	9	
	52	

The size of the skull exceeds by $\frac{1}{5}$ that of the large skull in the Otago Museum which I formerly described (Trans. N.Z. Inst., vii., 260.)

* Trans. N.Z. Inst., ix., pl. xii.

† Proc. Zool. Soc. Lond., 1884, p.

2. *Pseudorca crassidens*, Owen; Gray, 290.

(*P. meridionalis*, Flower, Proc. Zool. Soc., 1864; Hector, Trans. N.Z. Inst., v., 163.)

Professor Flower states that further examination of a complete series of adult skeletons has led him to abandon the specific distinction of the southern from the northern form of this animal. No further specimen of this rare animal has been obtained since my former notes were published.

3. *Grampus richardsoni*, Gray, 299.

Hector, Trans. N.Z. Inst., v., 163.

Nothing more has been ascertained as to the occurrence of this grampus in the New Zealand seas. It is probably identical with *Grampus griseus* of the northern seas, which Professor Flower states is remarkable for the variability of its colour.

4. *Delphinapterus leucas*, Pallas.

(*Beluga kingii*, Gray, 309; Hector, Trans. N.Z. Inst., v., 163.)

The inclusion of this animal in the New Zealand Fauna is still only dependent on the single specimen of an imperfect skull. A skull of the northern species, which I obtained for comparison, agrees so well that it is better to sink the specific distinction until definite information is obtained.

5. *Globicephalus melas*, Traill.

G. macrorhynchus, Gray; Hector, Trans. N.Z. Inst., v., 164.

A number of skeletons of this very common animal known as the blackfish have been sent by me in exchange to other museums, and Professor Flower has satisfied himself that it cannot be separated from the Caaing whale of the Northern Seas. Professor Flower considers that the skull in the College of Surgeons Museum which forms the type *G. macrorhynchus* belongs to a different animal; but the description quoted by Gray of the South Sea blackfish and its habits under that specific name so evidently apply to our common blackfish that I was misled in my former determination.

7. *Cephalorhynchus hectori*, Van Beneden.

Lagenorhynchus clanculus, Gray.

Electra clancula, Hector, Trans. N.Z. Inst., v., 160.

The common dolphin of the coast which I at first identified as this species has given rise to a most embarrassing confusion of nomenclature from its evidently having been confounded with another dolphin almost equally common and of the same size, *Clymenia obscura*. Following the nomenclature of Gervais, and guided by the character of the pterygoid bones, Professor Flower refers it to the genus *Cephalorhynchus*, which with Gray was a sub-genus of *Tursio*, and considers it barely distinguishable from Gray's *Tursio heavisidii* of the Cape of Good Hope, which is, however, described as having the teeth $\frac{25}{25}$, whereas our dolphin has teeth $\frac{32}{32}$. Moreover, the dorsal fin in the Cape species is stated to be triangular, while in ours it is rounded as shown in my original sketch. This feature has been confirmed by Van Beneden, who has founded a new species under the name of *Electra hectori* (Bull. Acad. Roy. de Belgique, 1881) on a very complete specimen presented to him by Dr. Finsch, who obtained it on the north-east coast of New Zealand.

The only discernible difference in the description of the two animals is that the nose and forehead were white in my specimen, and black in Dr. Finsch's, a character of small importance where all the other colouration is the same. According to Professor Flower, *Electra clancula* is only founded on a skull, and this skull, although agreeing in other respects, differs so materially in the form of its pterygoid—a character which Gray does not allude to—from our species that he places it almost in the same species as the Cape dolphin, distinguished by the specific name conferred by Van Beneden. The statement which I made in the first notes of this dolphin, to the effect that the "cervical vertebræ" are anchylosed, should probably have been "anterior cervical vertebræ," and I have to thank Professor Flower for pointing out the error; but, unfortunately, until new specimens have been obtained and prepared, the complete osteology cannot be compared, as both the complete skeletons which I recorded as being in the Museum have been given away, one to the "Challenger" Expedition, and the other to the British Museum, under the impression that there was a third complete specimen in store. This latter has been recently cleaned, and proves to be altogether a different species, but one with which, as already stated, the present dolphin is often confounded.

8. *Delphinus delphis*, Zimm.

D. forsteri, Gray; Hector, Trans. N.Z. Inst., v., 158.

D. novæ-zealandiæ, Q. and G.; Hutton, Trans. N.Z. Inst., ix., 349.

Comparison of these types with a large number of specimens from these seas has enabled Professor Flower definitely to determine that the above species are in every character identical, thus adding another to the list of Cetaceans that have a world-wide geographical range. In the Museum there is a fairly complete skeleton of this species, and a number of skulls and lower jaws.

9. *Tursiops tursio*, Buonaterre.

Tursio metis, Gray; Hector, Trans. N.Z. Inst., v., 162.

These species are now considered to be closely allied, if not identical. A comparison of a complete skeleton in the Museum with the descriptions and anatomical drawings of the northern species does not afford any ground for keeping them as distinct species.

10. *Clymenia obscura*, Gray.

Hector, Trans. N.Z. Inst., v., p. 160.

This species was first described as a *Tursio*, and placed in the sub-genus *Cephalorhynchus*. By Gervais it is figured as an *Electra* (*Lagenorhynchus breviceps*), and altogether its synonomy is in a very unsatisfactory state. Yet it is not uncommon, frequenting the coast in large " schools " in a similar manner to the other small dolphin (*Cephalorhynchus hectori*), from which it is easily distinguished when swimming, by its high-pointed dorsal fin-lobe. Also it is uniform black above, white beneath, with a black streak over the eye.

There is a stuffed skin, a complete skeleton, and some skulls of this species in the Museum.

The number of vertebræ is 71, viz., 7 cervical, of which the first two are united, 13 dorsal, 19 lumbar, 21 sacral, and 11 caudal.

11. *Clymenia euphrosyne*, Gray.

C. novæ-zealandiæ, Hector, Trans. N.Z. Inst., v., 159.

The skull which I described under the second of these names, I now decide, from having had access to better drawings, to refer to Gray's species as above.

In the Museum we have also skulls of *Clymenia dubia*, Cuvier, and *C. attenuata*, Gray, but there is some doubt if they were captured within the New Zealand area.

II.—BOTANY.

Art. XXIV.—*On the Flowering Plants of Stewart Island.*

By T. Kirk, F.L.S.

[*Read before the Southland Institute, 9th December,* 1884.]

Until within the last five or six years botanists have been almost entirely ignorant of the flora of Stewart Island, our knowledge being restricted to about a dozen flowering plants and a similar number of mosses and Hepaticæ collected by Dr. Lyall in 1848–49, recorded in the Handbook of the New Zealand Flora. Of late years, however, this reproach has been removed by the labours of several collectors whose work may be briefly mentioned.

Mr. Charles Traill has done a large amount of good work in the investigation of the flora and fauna of the island: I am specially indebted to him for dried specimens of about 200 species of flowering plants and ferns, accompanied in many cases by valuable notes on their habits and distribution, as well as the native names in use on Stewart Island. Mr. and Mrs. A. W. Traill have most kindly formed for me a copious collection of the plants of Ruapuke Island, numbering about 140 species, several of which have not been observed on Stewart Island proper. Mr. W. Pearson, Commissioner of Crown Lands, has laid me under obligations for numerous dried plants collected in out-of-the-way places during several visits to the island.

In 1870 Professor Black, of the Otago University, visited the island, on the part of the Otago Provincial Government, for the purpose of investigating its natural productions, but no plants of special interest were obtained. Mr. G. M. Thomson has, I believe, paid several visits to Stewart Island, during which he collected the new species of *Brachycome*, to which his name is attached, and *Myrsine chathamica*, previously known on the Chatham Islands only; he also collected between thirty and forty species of ferns, with other plants of interest. In 1880 he was accompanied by Mr. D. Petrie, who read a valuable paper on the flora of Stewart Island before the Otago Institute, and gave a catalogue of 200 flowering plants observed by him, this being the first published account of the plants of the island.* During this expedition *Actinotus bellidioides* and *Liparophyllum gunnii* were added to the New Zealand flora, a matter of great interest, as previously they were only known as indigenous to Tasmania, where they are extremely rare. In

*Trans. N.Z. Inst., vol. xiii., p. 323.

December, 1881, Mr. W. S. Hamilton and Mr. Goyen made the ascent of Rakiaua, during which they collected an *Aciphylla*, the first observed on the island, *Raoulia goyeni* and *Hymenophyllum rufescens*, the last being extremely rare and local.

I had the pleasure of examing the flora in January, 1882, when I landed on Herekopere Island; and again in January, 1884. Although my stay on the last occasion was but short, I was able to make the ascent of the Ruggedy Range, on the west coast, and of Mount Anglem, the highest peak on the island, but was unable to visit the extreme north or the extreme south. During my excursions a few plants new to science were discovered, and much important information collected with regard to the vertical and horizontal distribution of many interesting species.

Stewart Island is about 42 miles in length from north to south-west, and about 26 miles in its greatest breadth from east to west. Its area is estimated at 640 square miles. It is composed chiefly of slates and granitic rocks, the latter often in a highly decomposed condition, and in some localities intersected by dykes. In a few instances the slates are more or less metamorphosed by the overlying or interjected volcanic rocks occasionally passing into a kind of novaculite, which is utilised for whetstones by the settlers.

On the eastern side the coast is deeply indented by Paterson's Inlet, a fine arm of the sea, which extends half way across the island and includes several secure harbours—Glory harbour, Abraham's Bosom, Glory Cove, etc. At the head of the inlet a swampy valley, but slightly elevated above high-water mark, runs across the island to a point between Ruggedy on the west coast, and the Mount Anglem range, where it is abruptly closed by low hills. About six miles from the head of the inlet a break in the hills on the southern side of the valley leads into Mason's Bay, where a large extent of flat land of good quality is sheltered from the sea by hills of blown sand, now more or less covered with low forests, although in some places advancing inland. From Mason's Bay a considerable extent of undulating table-land extends southward to Port Pegasus at an elevation of from 1,200 to 1,700 feet. To the north the country is much broken and rugged, culminating in Mount Anglem at an elevation of 3,200 feet.

Between seven and eight miles from the head of Paterson's Inlet the main valley rises somewhat rapidly, and a grand system of river terraces comes almost suddenly into view; the terraces are two in number and are carried along each side of the valley; at a point where the valley is two miles wide the lower terrace is about 45 feet high and the upper about 40. Near the base of Ruggedy they form two branches, one running along the south-western flank, the other along the northern; both branches appear to terminate abruptly at the base of the low hills which shut off the valley from the sea; but I was not able to visit the termination of either. These terraces are chiefly composed of loose sand and contain water-worn fragments of slate-rocks; their faces are often covered with a dense growth of scrubby manuka. No traces of fossils were to be seen on the surface.

In its lower part the valley is traversed from east to west by low ranges of sandhills from three to six feet high which, in many cases, run parallel with each other for two or three miles and are covered with a scanty vegetation.

With the exception of the valleys already mentioned, and the elevated table-land south of Mason's Bay, there are no tracts of level land. The country is more or less broken and covered with forest. Much of the soil is of a peaty character, and not well adapted for general cultivation. Where the peat is mixed with sand, as at Mason's Bay, introduced grasses can be grown with but little trouble. Mr. Walker has utilized this part of the island for a sheep run, and, after having had to face many difficulties, is realizing a fair measure of success, which will increase with the extent of land laid down in grass. At Halfmoon Bay, Horseshoe Bay, and Port William, the chief places of European settlement, the soil is of a fertile character, and introduced grasses are easily grown. At the Neck, which forms the southern head of Paterson's Inlet, a large acreage of excellent land is cultivated by the Maori and half-caste population. Two or three families reside as far south as Bravo Island in Paterson's Inlet, the extreme southern point of permanent residence in the colony. Port Adventure and places further south have long ago been abandoned by the Maoris, although I am assured that peach trees and other cultivated plants still mark the sites of their gardens.

No observations have been recorded with regard to temperature, amount of rainfall, prevailing winds, etc., so that no precise data exist by which to compare the climate of Stewart Island with that of other parts of the colony. The abundance of luxuriant tree-ferns, the luxuriance of the varied ligneous and herbaceous vegetation, afford conclusive evidence of a mild, equable, and moist climate. In all probability the actual rainfall does not exceed that of Wellington or Auckland; but the atmosphere must be more continuously moist. It will be necessary to return to this subject before the close of the paper; but a remarkable result of the great amount of moisture in the atmosphere may be recorded here: in many instances the duramen of old trees is converted into peat, while the alburnum is still discharging its functions. Still more striking is the fact of the dense lower leaves on the stems of *Raoulia goyeni* becoming changed into peat, while the upper leaves are performing their usual functions.

So far as at present known the flora of the island comprises about 380 species of Phænogams and nearly 70 species of Ferns and allied plants. The lower Acotyledons have not been sufficiently investigated to allow of their number being estimated with any approximation to correctness. It is not my intention to present a complete list of the plants observed by me, but simply to offer a brief account of the most striking characteristics of the flowering plants, with special remarks on the endemic species.

The traveller who visits Stewart Island in December or January will have his attention arrested by the blaze of crimson presented by the rata (*Metrosideros lucida*), often flecked with the pale racemes of the kamahi (*Weinmannia racemosa*), the deep green leaves of the puheretaiko and the tupari (*Senecio rotundifolius* and *Olearia colensoi*), and the grass-like leaves of the inaka (*Dracophyllum longifolium*), all of which form a fringe of greater or less breadth at the water's edge, and (except the puheretaiko) often expand into large masses ascending to the crests of the hills. Of these however the kamahi and rata alone attain the dignity of timber trees, and are excelled in dimensions by the rimu and the totara alone. The rimu (*Dacrydium cupressinum*) is abundant at the lower levels and attains large dimensions, the specimens comparing favourably with those from the west coast of the South Island, and yielding timber of greater durability. *Podocarpus totara* comes next in order of frequency, but is much less common than the rimu, although individual specimens attain a larger size. *Dacrydium colensoi* and *D. intermedium* are abundant in certain localities and yield the "white pine" of the saw mills: the true white pine (*Podocarpus dacrydioides*) does not appear to occur on the island. *Podocarpus ferruginea* and *Griselinia littoralis*, the miro and the kapuka, are plentiful, but the matai (*Podocarpus spicata*) is extremely rare.

Amongst smaller trees and shrubs the most prominent are the horoeka (*Panax crassifolia*), and its congeners *Panax simplex* and *P. edgerleyi*, both exhibiting such excessive luxuriance as frequently to require an examination of the fruit before their identification can be determined; the rautawhiri (*Pittosporum tenuifolium*, var. *colensoi*), the kotukutuku (*Fuchsia excorticata*), the mako (*Aristotelia racemosa*), the mapau (*Myrsine australis*), the pokako (*Elæocarpus hookerianus*), also *Carpodetus serratus*, *Myrsine divaricata*, both of which are abundant. The remarkable "weeping tree," *Myrsine montana*, with its crowded recurved branches and small foliage, affords a picturesque effect of a peculiarly attractive character altogether unique amongst New Zealand plants. On the slopes of the hills *Leptospermum scoparium*, the manuka, forms a small tree, but in the lower lands it is usually scrubby. It should be observed that the trees and shrubs here mentioned form the greater portion of the forest, and with the exception of *Dacrydium colensoi*, are of general distribution in the colony. *Olearia nitida*, *O. avicenniæfolia*, and *Panax colensoi* are common by the sides of streams, or on the margin of forests. *Veronica salicifolia* occurs by the sides of water-courses, but is far from common. *Schefflera digitata* is abundant in damp gullies.

The undergrowth is often extremely dense, and consists in many places chiefly of *Coprosma fœtidissima* and *C. lucida*. *C. colensoi* is common, *C. tenuicaulis* and *C. rotundifolia* are local. *Metrosideros hypericifolia* is abundant, and is the only scandent species on the island. *Myrtus pedunculata* is plentiful, and the supplejack (*Rhipogonum scandens*) occurs in moist places, but scarcely ascends above sea-level.

Amongst the shrubs the soil is often carpeted with a compact growth of the charming liliaceous plant, *Callixene parviflora*, with its elegant drooping flowers, mixed with numerous ferns, orchids, and mosses. The orchids form a marked feature in some parts of the forest. *Corysanthes oblonga*, *C. rivularis*, and others produce their attractive flowers literally by thousands; in no other locality have I seen these interesting plants in such vast profusion. *Gastrodia cunninghamii* is rare, having been observed only on the small island of Ulva. *Caladenia bifolia* is frequent, one of its forms making a close approach to *C. lyallii*. *Chiloglottis cornuta* occurs on Ulva, the glands on the labellum vary considerably in their shape and arrangement. In the majority of cases there are five depressed coloured glands arranged in a symmetrical manner, in a few specimens they were reduced to three, and in a solitary plant numerous stalked glands were arranged in a double row down the middle of the labellum exactly as in the Tasmanian *C. gunnii*, which is probably a state of the New Zealand plant. The dwarf variety of *Pterostylis banksii*, with abbreviated sepals, is common in open places in the forest.

In addition to the terrestrial forms, the epiphytic forms are well represented, with the exception of *Sarcochilus*, which appears to be rare, and *Bolbophyllum*, which has not been observed on the island.

Arborescent ferns are abundant alike on the outskirts of the forest and in its deepest recesses, often occurring in large masses especially on sheltered slopes, where they frequently rise above the level of the surrounding shrubs and produce an effect rarely seen elsewhere in the colony. The most common species are the poka (*Dicksonia squarrosa*) and the katote (*Hemitelia smithii*); the stem and fronds of the latter are sometimes used as food for cows. The mamaku (*Cyathea medullaris*) is local, and has not been observed south of Halfmoon Bay. *Lomaria discolor* frequently developes an erect caudex 2′–3′ high. Of the numerous filmy ferns I will only mention *Hymenophyllum bivalve*, one of the commonest ferns on the island, sometimes covering moist banks with its rigid drooping fronds half hidden amongst *Dicranum menziesii*, at others exhibiting exceptional luxuriance and grace on the trunks of trees.

The most striking feature of the fern flora (next to the abundance of tree-ferns) is afforded by the numerous varieties of *Asplenium bulbiferum*, *A. obtusatum*, *A. falcatum*, and *A. flaccidum* ; in many cases these varieties are extremely beautiful and attractive, but merge into each other by such minute gradations that it is often a matter of difficulty to determine the species to which certain varieties should be referred. The occurrence of *Asplenium falcatum*, *A. obtusatum*, etc., in masses covering many square yards, to the exclusion of all other forms, is not often seen in other localities.

The trees are more or less clothed with mosses and foliaceous lichens, while terrestrial Hepaticæ are unusually abundant, and on the whole form the most striking feature in this section of the flora. The genus *Gottschea* is especially well developed. Specimens of *G. appendiculata* were collected from 7″–9″ in length : a species new to science was remarkable on account of its dichotomous branching and habit forming loose rounded patches of a yellowish-green tint.

The vegetation of the open peaty valleys between Paterson's Inlet and Mason's Bay is of a very different character. On the margins of streams a dense growth of shrubs usually exhibits great luxuriance, and consists chiefly of *Olearia avicenniæfolia*, *O. nitida*, *Leptospermum scoparium*, *Veronica salicifolia*, *V. buxifolia* : the last named exhibiting much greater luxuriance than in its usual mountain habitat, while the former is of smaller size than in the north. Under the shelter of the larger shrubs *Gaultheria perplexa* is abundant, and is frequently associated with *Gleichenia cunninghamii*.

On the open land *Gleichenia dicarpa* is abundant, varying from stunted specimens 2″ high with a single whorl of branches, to luxuriant stems 18″ high with from 6 to 9 whorls. *Lycopodium ramulosum* covers acres of ground, when growing in the open its short stout branches present a stunted appearance. In places where fire had passed over the valley, the blanched dichotomous stems with their persistent leaves presented so close a resemblance to the European *Selaginella helvetica*, that one was repeatedly impelled to examine the plant afresh. In shade the plant is extremely luxuriant, but invariably prostrate in habit. Hundreds of acres were covered with the wiry stems of *Hypolæna lateriflora*, almost to the exclusion of other plants. *Carpha alpina* was abundant as well as *Oreobolus stricta* ; but *O. pumilio* occurred only in small quantity, and in a single locality on the west coast. *Drosera arcturi* was extremely rare ; *D. binata* and *D. spathulata* were plentiful. *Centrolepis monogyna* formed rounded velvety-looking masses at the margins of bogholes, etc., the leaves being more hairy at the base than in alpine specimens. *Actinotus bellidioides* occurred plentifully in the fruiting state. *Liparophyllum gunnii* is common in all the swamps, its white roots sometimes a foot or more in length. *Potamogeton oblongus*, *Myriophyllum pedunculatum*, and *Hydrocotyle muscosa* are not unfrequent. *Schizæa australis* is plentiful in swamps, forming compact tufts 1″–3″ high. *Dichondra brevifolia* is common on moist peat, its large white flowers being conspicuous at a considerable distance. In wet places *Carex echinata* is frequently intermixed with the small bladder-wort, *Utricularia monanthos*, while *Cladium glomeratum*, *Carex ternaria* and other species fringe the margins of small streams and bogholes.

In drier places several common mountain plants may be found—*Pentachondra pumila*, *Cyathodes empetrifolia*, *Hierochloe alpina*, *Dacrydium laxifolium* varying from one inch in height to three or four feet, and in exposed places a stunted depressed form of *D. intermedium.* These montane forms are associated with the northern *Lindsaya linearis*, which is usually in poor condition, resembling specimens from the clay hills about Auckland, but in a few favourable spots luxuriant specimens were obtained.

On the sandy ridges described in a previous paragraph, *Drapetes lyallii* was abundant, with occasional patches of *Actinotus*; large tussocks of *Danthonia raoulii* served to protect many smaller plants. A curious pigmy form of *Viola filicaulis* was not uncommon. *Uncinia rubra* and *Danthonia semi-annularis* formed large patches. *Haloragis micrantha*, *H. uniflora*, *Libertia ixioides*, *Prasophyllum colensoi*, *Thelymitra uniflora*, and an undescribed species of the genus, were frequent on many of the ridges.

A few littoral plants deserve special mention. The suffruticose trailing stems of *Tetragonia trigyna*, often many feet in length, cover the rocks in sheltered places at the margin of the sea. A striking variety of *Gentiana saxosa*, distinguished by its much-branched, prostrate, or semi-erect habit, and deeply-cut calyx, with the segments subulate and recurved, is common on maritime rocks. A large *Myosotis* with white flowers, doubtless the plant described by Mr. J. B. Armstrong as *M. capitata*, var. *albiflora*, is abundant on rocks, often in situations exposed to the spray of the sea. *Brachycome thomsonii* is common on maritime banks and cliffs. *Convolvulus soldanella* is restricted to a solitary habitat in Sydney Cove. *Festuca littoralis* occurs in several localities, but is by no means abundant. *Lomaria dura* is found all round the coast, but does not extend inland. *Atriplex billardieri* is not uncommon, and *Festuca scoparia* is specially characteristic of sheltered bays. The typical form of *Poa foliosa*, a noble species, is found on Herekopere Island, and on certain headlands frequented by mutton birds south of Port Pegasus.

A brief account of the plants observed during the ascent of Mount Anglem, the highest peak of the island, will serve as a fitting introduction to the alpine portion of the flora.

Landing at Sentry Point, our track led through a swampy forest, with large specimens of red pine and other trees, interlaced with supplejack. Tree-ferns were numerous, but restricted to two species, *Hemitelia smithii* and *Dicksonia squarrosa*, their trunks often shrouded with a luxuriant growth of filmy ferns.

The ascent at first was very gentle, the supplejack (*Rhipogonum scandens*) did not ascend above 200 feet, and the tree-ferns disappeared below 400 feet. The timber gradually became of smaller dimensions, and at about 1,000 feet on the ridges the forest was to a large extent replaced by *Leptospermum* scrub, with solitary plants of *Drosera stenopetala* and *Ehrharta thomsonii* in moist places. In the gullies large timber occurred up to 1,700 feet or higher. Still ascending, *Leptospermum scoparium* gradually assumed an arboreal habit, but none of the trees exceeded 25 feet in height, although the trunks were from 1′–2′ in diameter. Progress was very easy up to 1,500 feet, when a tangled belt of *Olearia colensoi*, *Dacrydium colensoi*, and other shrubs, interspersed with inclined ratas (*Metrosideros lucida*) formed an almost impenetrable barrier, although rarely exceeding 15′–20′ in height. The branches were so closely interlaced that it was impossible to break through them, while they were so tough and elastic that our tomahawks were useless. Under these circumstances our progress was extremely slow, and in no way favoured by the continuous heavy rain. The vertical range of this belt did not exceed 800 or 900 feet, but it required four hours of excessively fatiguing work to force our way through; on the ridge of the spur the scrub was only breast high and offered less difficulty. From this point the ascent of the last slope was comparatively easy, except in a few hollows where the scrub attained 8 or 10 feet in height and was excessively dense. In many places it was varied by large patches of open peaty land studded with alpine plants—*Celmisia discolor*, *Forstera sedifolia*, *Donatia novæ-zealandiæ*, *Phyllachne clavigera*, *Dracophyllum rosmarinifolium*, and a remarkable prostrate form of *D. scoparium*, *Carpha alpina*, etc., etc.; owing to mingled hail, rain, and sleet at this elevation but little could be made out beyond the point on which we stood for the moment. At about 2,700 feet *Dracophyllum menziesii*, one of the most remarkable species of the genus, was collected; it attains the height of from 1′ to 3′ with the habit of a miniature *D. latifolium*, the native branches terminating in an almost globose head of recurved leaves with several racemes of waxy white flowers springing from beneath: the flowers are the largest in the genus. In swampy places near the crest of the slope a small rush was obtained closely allied to *Juncus antarcticus* of Campbell Island, if not identical with that species, also an undescribed species of *Uncinia* and a *Carex* new to science. Before reaching the crest we encountered a dense snowstorm, which later on was varied by fierce blasts of sleet and hail, so that hands and face were stung almost past endurance, and the use of note-book and pencil became impossible for the rest of the day.

The scene on reaching the crest was quite unexpected; right in front towered the highest peak, half-obscured by the driving snow, steep and precipitous, but between the crest on which we stood and the beetling cliffs was a crateriform hollow apparently 300 feet in depth, the bottom of which was occupied by a lake. The ridge from which we looked down to the lake sloped gradually to the water's edge, causing the hollow to present the appearance of a cup-shaped crater. I was unable to detect the outlet of the lake, but one of the party caught a view of it as the falling snow was momentarily swept on one side by a fiercer blast than usual. On its inner face the slope was sparingly clothed with scrub apparently of the same character as that amongst which we had been struggling, but time pressed too hardly to allow of its examination. On the crest itself stunted *Olearia* and *Dacrydium* were the commonest plants, but in some places a strange sight was presented: *Dracophyllum muscoides* formed a compact dark-green sward, thickly gemmed with white flowers, occasionally rising into pillar-like hummocks two feet high, and so extremely dense that it was a matter of great difficulty to thrust a knife into the woody mass; at a somewhat lower elevation short straggling branches were given off at the margins of patches, forming a kind of loose fringe. The line of ascent lay along the eastern side of the hollow, the mountain rising into a high peak not greatly inferior to the highest or northern peak. The ascent to the eastern peak was impeded by numerous patches of dense scrub of no great height but of extremely rigid habit; on the open spots several interesting plants were collected, amongst which may be mentioned a new *Aciphylla* of flaccid densely-tufted habit, which I have described as *A. traillii*, occasional specimens of *Ranunculus lyallii*, a prostrate form of *Coprosma colensoi* (identified in the absence of flowers), patches of *C. pumila*, a silvery *Celmisia*, destitute of flowers but apparently allied to *C. sessiliflora*, *Schœnus pauciflorus*, *Danthonia florescens*, and two undescribed species of the same genus. In rock crevices *Hymenophyllum villosum* was plentiful, and the curious fern usually referred to *Polypodium australe*, v. *alpinum;* but the most interesting plant was unquestionably *Ourisia sessiliflora*, its large handsome flowers were white as the snow by which it was partially hidden.

The principal plants observed on the highest peak were *Ourisia cæspitosa*, which was luxuriant and plentiful. A *Raoulia*, or *Haastia*, destitute of flowers but new to science has been provisionally described as *Raoulia goyeni*. These were associated with the prostrate form of *Coprosma colensoi* and other plants already mentioned. The rapid approach of evening prevented any detailed examination of the vegetation of the highest and western peaks as it was desirable to commence the return to camp during daylight, but we lingered sufficiently long to frustrate our wish, and had the doubtful pleasure of camping in the open.

It is obvious that under the unfavourable atmospheric conditions which prevailed during two-thirds of the ascent, and which continued until nightfall, the above must necessarily be an incomplete account of the alpine portion of the flora. Not only was investigation restricted to a comparatively small area, but many inconspicuous plants were hidden by the snow and hail, and others doubtless were overlooked, owing to the weakened condition of the observing faculties caused by our benumbed and saturated condition.

A few of the endemic and rarer plants found on the island deserve special mention.

Aciphylla traillii, T. Kirk. A small flaccid species found on Rakiaua and Mount Anglem.

Ligusticum intermedium, Hook. f., var. *oblongifolia*. A handsome plant, to some extent combining the characters of *L. lyallii* and *L. intermedium*, but distinguished from both by the narrow, oblong, erect leaves. Mason's Bay and inland base of Ruggedy.

Actinotus bellidioides, Benth., var. *novæ-zealandiæ*. At sea-level, head of Paterson's Inlet, and on Mr. Petrie's authority at Port Pegasus. On the peaks of Ruggedy, and at nearly 3,000 feet on Mount Anglem, but not observed at intermediate levels. Found also on the west coast of the Nelson district, altitude 2,000 feet. Specimens collected on the dry sandy ridges between Paterson's Inlet and Ruggedy cannot be distinguished from the Tasmanian plant, but marsh specimens are characterized by numerous short barren stems.

Aralia lyallii, T. Kirk (*Stilbocarpa polaris*, Dcn. and Pl. in part). I have elsewhere given my reasons for removing this plant from *Stilbocarpa*, and need only state here that it is altogether a littoral plant, being restricted to sea-cliffs or to small outlying islets, etc. One of the most striking plants in the flora.

Olearia angustifolia, Hook. f. Tete-a-weka of the natives. This is one of the grandest flowering plants, and was first observed by Dr. Lyall, who, however, was not fortunate enough to obtain flowers. It appears to be confined to exposed portions of the coast on both sides of the island, and to the adjacent islets, but has not been observed north of Paterson's Inlet. It varies in size from a small shrub six feet high to a tree of twenty feet, with a stout trunk and compact dome-shaped head. The leaves are of a deep glossy green, excessively coriaceous, lanceolate-acuminate with curious indurated obtuse teeth, white with closely appressed tomentum beneath. Head solitary, $1\frac{1}{2}''$–$2''$ in diameter, with snow-white rays and rich purple disc, carried on stout foliaceous peduncles crowded at the tips of the branches. It is not easy to conceive of a grander floral display than is afforded by a fine specimen of this plant when viewed from above. The regular outline of the head, the glossy green of the leaves, which, when stirred by the wind, show the white tomentum beneath; the snowy rays and dark purple discs of the myriad flower-heads form a never-tiring source of attraction, while a grateful aromatic perfume is constantly exhaled.

Olearia traillii, T. Kirk. A noble species of sparing occurrence on Stewart Island, but found also on Puyseygur Point.

Brachycome pinnata, Hook. f. A small but elegant species discovered by Dr. Lyall at Port William, but not observed elsewhere until its recent discovery on the Canterbury Plains.

Brachycome thomsonii, T. Kirk. The largest New Zealand species. Common near the sea on Stewart Island, and on Ruapuke, etc.

Cotula traillii, n. s. A handsome littoral species, plentiful near the Neck. Allied to *C. squalida*, Hook. f.

Senecio muelleri, T. Kirk. A fine species, allied to *S. huntii*, F. Muell., of Pitt Island. Only known on Herekopere Island, South Cape Island, and the Snares.

? *Raoulia goyeni*, T. Kirk. A small species only known at present from Mount Anglem and Rakiaua. Flowers not seen.

Dracophyllum pearsonii, n. s. I am indebted to Mr. Pearson for a much-branched specimen of a *Dracophyllum*, collected either on Codfish Island or in Chew-tobacco Bay. The plant is evidently erect, the leaves about $1''$ long are close-set and densely imbricating, appressed to the branches, which, with the leaves, are about $\frac{3}{4}''$–$1''$ diameter. Flowers not seen. The habit differs so widely from that of any other species known to me, that I venture to describe it provisionally in the absence of flowers, and have great pleasure in attaching the name of its discoverer, to whom I am greatly indebted for numerous specimens of Stewart Island plants.

Gentiana saxosa, Forst., var. *recurvata*. A littoral form with prostrate or suberect stems excessively branched, flowers produced in profusion. Calyx divided fully two-thirds of its length, segments thickened, subulate, recurved at the tips. Found also on the outlying islets and on the Bluff Hill.

Liparophyllum gunnii, Hook. f. Plentiful in swampy places on the low ground between Paterson's Inlet and Mason's Bay. Observed by Messrs. Petrie and Thompson at Port Pegasus.

Myosotis antarctica, Hook. f., sub-sp. *traillii*. Mason's Bay.

Myosotis capitata, Hook. f., sub-sp. *albida*. A rather coarse littoral plant which might almost claim specific honours. The radical leaves are much longer than in the type and on longer petioles; the cauline leaves are narrower and more distant, continued to the base of the inflorescence. The flowers are smaller, densely crowded, corolla white. Also on the outlying islets and on Campbell Island, but I am assured that it does not occur on the Auckland Islands.

Dacrydium intermedium, T. Kirk, var. *gracilis*. Usually a smaller plant than the type, from which it differs in its slender branchlets and monœcious flowers. Plants 3–6 feet high are often laden with flowers.

Two specimens of a small epiphytic orchid were obtained on the descent from Mount Anglem. It seems probable that they will form the type of a new genus closely allied to *Burnettia* and *Chiloglottis*.

Juncus antarcticus, Hook f. (?) A plant doubtfully referred to this species for the present was collected on Mount Anglem.

Scirpus (*Isolepis*) *muscosus*, n. s. A minute species, less than one inch in height, forming moss-like patches at the head of Paterson's Inlet. Also on the Bluff Hill.

Scirpus (*Isolepis*) *ebenocarpus*, n. s. A tufted species resembling a luxuriant state of *S. cartilaginea*, but easily distinguished by the shining jet-black nuts. The Neck.

Ehrharta thomsonii, D. Petrie. A small tufted species not uncommon in moist situations on the hills.

Danthonia crassiuscula, n. s. A sparsely-tufted rigid glabrous plant 1′–1½′ high, with a lax broadly-ovate panicle, allied to *D. ovata*, J. Buch. Mount Anglem.

Danthonia flaccida, n. s. A small slender species allied to *D. buchanani* Hook. f. and to *D. pumilio*. Mount Anglem, 2,800 feet.

Poa walkeri, n. s. A remarkable plant, densely tufted, strict, with the panicle excessively contracted. Local. East coast, Stewart Island. I have great pleasure in attaching Mr. Walker's name to this distinct species, as a slight recognition of his ready assistance during my stay on the island.

Poa foliosa, Hook. f. The typical form; a noble species, producing an immense yield of herbage. Observed only on Herekopere Island; but a native informed me that it was to be found on several headlands near the South Cape. Plentiful on the Auckland and Campbell Islands.

The total number of Phænogams observed on the island is about 380, one half being species generally distributed throughout the colony. From the small amount of variation exhibited in the plants of different districts, except under changed conditions, I see no reason to anticipate any large additions to this number, not more than from 12 to 15 per cent. at most, and in all probability less than 10 per cent.; but amongst these additions several species new to science may fairly be anticipated, as well as others at present known only from the Auckland and Campbell Islands.

The absence of many species of general distribution is most remarkable, and in most cases not easy to be accounted for. Not a single leguminous plant has yet been observed, although *Sophora* and *Carmichælia* are found on the opposite side of the strait. *Dodonæa*, *Melicope*, *Pennantia*, *Hoheria*, are altogether wanting; still more singular is the apparent absence of *Oxalis*, *Pelargonium*, *Daucus*, *Galium*, *Microseris*, *Scleranthus*, and other genera. The spear-grasses of the South Island are represented by a single endemic species only, *Aciphylla traillii*. The white pine, *Podocarpus dacrydioides*, does not appear to occur on the island, the common name being applied by the bushmen to *Dacrydium intermedium*. *Podocarpus spicata* is extremely rare, and *P. nivalis* has not been observed. More remarkable still is the total absence of the beeches, although *Fagus cliffortioides*, *F. menziesii*, and *F. fusca* descend to the sea-level on the opposite mainland. The absence of the toatoa (*Phyllocladus alpinus*) is equally noteworthy.

A striking peculiarity of the flora of Stewart Island is the occurrence at sea-level of numerous species usually restricted to alpine or sub-alpine situations. Amongst these may be enumerated:—

Claytonia australasica,	*Drosera arcturi*,
Hydrocotyle muscosa,	*Liparophyllum gunnii*,
Actinotus novæ-zealandiæ,	*Veronica buxifolia*,
Olearia colensoi,	*Drapetes lyallii*,
Celmisia petiolata,	*Dacrydium colensoi*,
Senecio elæagnifolius,	,, *laxifolium*,
Oreostylidium subulatum,	*Caladenia bifolia*,
Cyathodes empetrifolia,	*Centrolepis monogyna*,
Pentachondra pumila,	*Oreobolus stricta*,
Dracophyllum longifolium,	,, *pumilio*,
Gentiana saxosa,	*Uncinia rubra*,
Drosera stenopetala,	*Hierochloe alpina*.

The above list does not include several species which, although generally found on the mountains, are occasionally seen in littoral situations. Amongst these may be mentioned *Hymenanthera crassifolia*, *Colobanthus billardieri*, *Pimelea lyallii*, *Danthonia raoulii*, *Haloragis uniflora*, *Senecio lagopus*, *Gentiana montana*, *Utricularia monanthos*, *Herpolirion novæ-zealandiæ*, all of which are found on Stewart Island,* but there is no other locality in the colony where so large an assemblage of alpine plants can be found growing at the sea-level.

It has been hastily assumed that this remarkable feature affords direct evidence of a severe climate. Mr. Petrie, in his Notes on Stewart Island, after recording the occurrence of *Donatia novæ-zealandiæ* at sea-level in Paterson's Inlet, writes, "It is extremely remarkable that a plant which does not descend below 3,000 feet in the latitude of Dunedin should flourish at sea-level in that of Paterson's Inlet, and the fact bears emphatic testimony to the severity of the climate of Stewart Island."† Again, referring to *Senecio lyallii* at intermediate levels in Port Pegasus, he writes, "The occurrence of this alpine plant at so low a level in Stewart Island, as well as its dwarfed proportions, give additional proof of the severity of the climate in this part of the colony."‡ It may be mentioned incidentally that I was unable to find *Donatia* at sea-level, and did not observe it below 2,700 feet. *Senecio lyallii* is usually dwarfed when growing on undrained peat soil; its favourite habitat is the side of a mountain stream, where it exhibits its greatest luxuriance, while specimens growing within a few yards on undrained soil are dwarfed and stunted.

If this theory were correct it would be necessary to account for a still greater difficulty—the occurrence of a varied and extremely luxuriant arboreal vegetation, including arborescent ferns, under the conditions incidental to a severe climate. Nowhere in alpine districts are the alpine plants enumerated on the preceding page associated with a varied and exuberant forest growth, still less with tree-ferns as is the case on both sides of the low moory ground at the head of Paterson's Inlet.

All the facts of the case are opposed to such a conclusion: the climate is remarkable for its mildness, and so far from being severe that it is much more favourable to a luxuriant plant-growth than that of many parts of the South Island, for instance the Canterbury Plains. It is true that the atmosphere is almost constantly moist, but snow does not fall on the lowlands, and frosts are not felt. Not only are many plants of mild climates cultivated in the gardens of the settlers, but the *Clianthus*, karaka, nikau, and other plants from the northern part of the colony, grow luxuriantly in the

* *Olearia colensoi* and *Senecio elæagnifolius* descend to the sea-level in the West Coast Sounds.

† Trans. N.Z. Inst., vol. xiii., p. 325.

‡ *l.c.*, p. 328.

open air. The peach is never touched by frost. *Eucalyptus globulus* grows luxuriantly—but it is needless to multiply instances. Similar testimony is afforded by the robust health of the settlers, their freedom from affections of the respiratory organs, and the rarity of deaths from sickness, as well as by the vigour of the children.

To what cause then must the occurrence of numerous alpine plants at low levels be attributed? Unquestionably to the remarkable equability of the moist mild climate characteristic of the low lands. For it is especially worthy of remark that, while the majority of the alpine plants found at sea-level on Stewart Island occur also on the higher slopes of Mount Anglem, they are rarely to be found at intermediate heights below 2,000 feet.

It is to this equability of climate that the occurrence of a few characteristic northern plants in the extreme southern part of the colony must be attributed. *Lindsæa linearis*, a fern common in the Auckland District, rare and local elsewhere, and altogether absent from the eastern side of the South Island* is abundant and often luxuriant, growing side by side with *Pentachondra pumila*, *Cyathodes empetrifolia*, *Centrolepis monogyna*, etc. *Eleocharis sphacelata*, not unfrequent north of the Waikato, has a single habitat in the Taupo District: but in the South Island has only been observed at Okarito and Bluff Island. It occurs freely in deep bogholes at the head of the northern creek running into Paterson's Inlet. *Dacrydium kirkii*, only known elsewhere to the north of Auckland, occurs on Ruggedy, and, as I was informed, attains a large size in localities on the western side of the island, the trunks being 3 feet in diameter. It should, however, be mentioned that the identification is made in the absence of flowers or fruit. *Campylopus kirkii*, previously known only from the Great Barrier Island, is abundant in the low valleys between Paterson's Inlet and the west coast. *Microlæna stipoides*, a grass decidedly impatient of frost, is found at the Neck and other places.

I do not propose to include a list of the Phænogams in the present paper, as one has been already given by Mr. Petrie, and although the number recorded by him has been nearly doubled, so much of the island remains unexplored that a complete list could not be presented; but I purpose giving a detailed account of the ferns and allied plants in a future paper.

The equable character of the climate, especially in sheltered inlets of the sea, is so conducive to health, that in a few years it will doubtless attract many residents from amongst the wealthy merchants of Dunedin and Invercargill. The shores of Paterson's Inlet, Port William, Horseshoe Bay, and similar localities, will be dotted with villas, relieved by the

* It occurs in somewhat small quantity on the western face of the Bluff Hill.

crimson glory of the rata and the pale racemes of the akamai. But speaking generally the quality of the soil is not of the first class, and with the abundance of land still waiting inhabitants in both the North and South Islands, it would be most wasteful policy to destroy the fine timber of the lower levels simply for the sake of forcing settlement. Except in the localities indicated above, a wise policy would retain the island as a timber reserve, for not only is timber abundant, but it is of more durable quality than much of that grown on the west coast of the South Island. Past attempts to force settlement on Stewart Island have resulted in the expenditure of large sums of money without any return, as may be seen in the Government barracks now decaying at Port William, happily in this case without requiring the continuous annual outlay rendered necessary by premature settlement in other localities.

Art. XXV.—*On the Ferns and Fern Allies of Stewart Island.*

By T. Kirk, F.L.S.

[*Read before the Southland Institute, 13th January*, 1885.]

From the short sketch of the chief physical and climatal characteristics of Stewart Island given in a previous paper,* it will be seen that the conditions are highly favourable to the development of a luxuriant fern-flora, and such we accordingly find, whether considered with regard to the rich free growth of the individuals composing a species, or to the actual number of species found on the island. Swamp, forest and open land—sea-level, hillside and mountain-peak—alike exhibit characteristic forms, and include species whose occurrence in such high latitudes could not have been anticipated.

The chief points of general interest presented by the fern-flora of Stewart Island are—

1. The great abundance and luxuriance of arborescent ferns, which occur in nearly all situations at low levels, and exhibit an extension of the geographical range usually given in our text-books (45°·50) to 47°·20 S.

2. The large, unusually large, proportion of Hymenophyllaceæ. Of the twenty-seven species of "filmy-ferns" generally recognized by botanists in New Zealand, no fewer than twenty occur in Stewart Island. They form only one-fifth of the entire fern-flora of the colony; but rise to one-third on Stewart Island.

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* See above, Art. xxiv.

3. The excessive amount of variation exhibited by certain species, as *Asplenium bulbiferum*, *A. obtusatum*, etc., which is much greater than in any other part of New Zealand.

4. The occurrence of certain species of a northern type, as *Lindsæa linearis*, *Trichomanes lyallii.*

I purpose drawing attention to these features at greater length in the notes appended to the following enumeration of the ferns and allied plants observed on the island.

Gleichenia circinata, Swartz. Not uncommon on the margins of swampy forests.

G. dicarpa, Br. Abundant in woods. Stipes slender, wiry, sometimes 18″ high, with from six to nine series of branches.

β. alpina. Common in open moory places 1′–4″ high, often reduced to a single pair of branches. Passes gradually into the typical form. Ascends to 3,000 feet.

G. cunninghamii, Heward. Woods and sheltered places by streams; not common; and never exhibiting the extreme luxuriance of northern specimens.

Cyathea medullaris, Swartz. Port William and Halfmoon Bay; rare and local. Does not attain large dimensions. The occurrence of this species so far south is quite unexpected.

Hemitelia smithii, Hook. In forests throughout the island; sometimes attaining the height of 25′. Two principal forms may be distinguished: *a.* Segments broad, teeth acute, few. *b.* Segments longer, with obtuse teeth; much more elegant than *a.* The young fronds and the pith of the stem were formerly used by the Maoris as food, and are still collected for cattle. Ascends to nearly 1,000 feet on Ruggedy.

Alsophila colensoi, Hook. f. Two specimens observed in a deep wooded gully on Mount Anglem. Alt. 1,500 feet.

Dicksonia squarrosa, Swartz. Throughout the island, abundant. Often forming groves covering many acres under large trees. Branched specimens are occasionally seen, and in many places the stem is completely hidden by crowns of short fronds, given off direct from the stem in such a way as at first sight to suggest the idea of the stem being covered with an epiphytal growth of young plants. It is, however, easy to prove their organic connection with the stem. One of the most characteristic plants of the island, occurring in all lowland situations except open swamps.

Hymenophyllum armstrongii, T. Kirk. Rare. At the base of shrubs, etc., Peaks of Ruggedy.

H. tunbridgense, Sm. In forests and rocky places. Common.

H. unilaterale, Willd. Rare and local. Steep banks of a stream near head of Paterson's Inlet.

H. minimum, A. Rich. On rocks, trunks of trees, etc., near the sea, not unfrequent. Fronds with from two to six pairs of lobes.

H. bivalve, Swartz. Common on mossy banks, in damp situations, and in forests. *a*. Fronds rigid, decurved. *b*. Fronds slender, flat, sometimes nearly 1′ in length.

H. multifidum, Swartz. Common throughout the island, ascends to fully 2,000 feet.

H. rarum, Br. Remarkably local. Ulva. Port William.

H. pulcherrimum, Col. Observed only at the Archdeacon's Cove, Paterson's Inlet. Fine pendulous fronds measured nearly thirty inches in length.

H. dilatatum, Swartz. Common throughout the island at low levels.

H. javanicum, Spr. A solitary specimen of this species was collected on Ulva.

H. polyanthos, Sw., var. *sanguinolentum*. Most abundant, and exhibiting a wide range of variation in the shape of the fronds, caused by the unequal development of the pinnæ. Occasionally the lateral pinnæ are less than half an inch in length, while the apical portion of the frond is greatly elongated, sometimes being over a foot in length. Again, the lateral pinnæ alone are elongated so as to form a broadly flabellate frond. A diminutive form with fronds less than half an inch in length is found on the mountains.

H. villosum, Col. Mount Anglem, 3,000 feet.

H. demissum, Sw. Abundant below 1,800 feet.

H. flabellatum, Br. Epiphytic, not uncommon, ascends to 2,000 feet on Mount Anglem.

H. rufescens, T. Kirk. Rakiahua, Messrs. Hamilton and Goyen!

H. æruginosum, Carm. Abundant on trunks of tree-ferns. Extremely luxuriant at Port William.

Trichomanes reniforme, Forst. Paterson's Inlet and Halfmoon Bay. Restricted to a few square yards above high water-mark in each locality. For my knowledge of these habitats I am indebted to Mr. Walker.

T. lyallii, Hook. On inclined trunks of *Metrosideros lucida*, Mount Anglem, 1,500 to 2,200 feet. I was much surprised at the discovery of this species on Stewart Island.

T. strictum, Menzies. Extremely rare and local. Ulva. Discovered by Miss Traill.

T. venosum, Br. On stems of tree-ferns, etc. Port William, Ulva, and other localities, not uncommon.

Lindsæa linearis, Swartz. Head of Paterson's Inlet, Mason Bay.

Adiantum affine, Willd. Port William and Halfmoon Bay. Rare.

Hypolepis tenuifolia, Bernh. Not uncommon on the margins of forest, etc.

Pteris aquilina, L., var. *esculenta*. Common.

P. incisa, Thunb. Abundant: in open places forming extensive patches.

P. scaberula, Sw. Common.

Lomaria capense, Willd. Abundant in woods, etc. In deep gullies the sterile fronds are sometimes from eight to ten feet in length and two feet eight inches in breadth.

var. *minor*. Frequent in open places, and on mountains.

Lomaria fluviatilis, Spr. Moist places in woods, etc., common.

L. vulcanica, Blume. Rocky places in woods; frequent. The young fronds are of a delicate pale red colour.

L. patersonii, Br. Local. Island of Ulva. Near Ruggedy.

L. lanceolata, Spr. Abundant in woods and on the banks of streams, etc.

L. discolor, Willd. Abundant in forests. Stems erect, 1–2 feet high.

L. alpina, Br. In open swamps and on mountains; common.

L. dura, Moore. A very handsome fern, frequently forming a dense fringe above high water-mark, but never found inland. Fronds 1–2½ feet long: pinnæ frequently dense and overlapping.

L. banksii, Hook. Littoral; rare. Paterson's Inlet, etc.

Asplenium obtusatum, Forst.

α. Pinnæ, thick, fleshy, entire or serrate, obtuse. Fronds one inch to two feet long. Common near the sea.

β. scleropium. More or less finely serrate, the teeth varying in length in different specimens; sometimes extending nearly to the midrib of the pinna. Near the sea. Forming large patches on Herekopere Island.

Note.—Fronds with the pinna entire are frequently found on the same plant, with deeply-serrated fronds.

γ. lyallii. Fronds with pinnæ pinnate or pinnatifid at the base. Mason Bay.

δ. pseudo-falcatum. Fronds greatly elongated, 3 feet long or more, drooping, coriaceous; pinnæ broad at the base, suddenly acuminate, coarsely toothed. Mason Bay; in forests.

A. falcatum, Forst. Common in forests, epiphytal. Forming extensive patches on open land. Herekopere Island.

A. bulbiferum, Forst.

α. vera. Common.

β. laxa. Common in deep gullies.

γ. tripinnatum. In forests. Less common than the preceding.

δ. *integra.* Pinnæ nearly entire—or with shallow lobes or teeth. Resembles some states of *flaccidum*; but bulbils are always developed. Island of Ulva.

ε. *pseudo-lucidum.* Fronds oblong-lanceolate, stipes short, pinnæ nearly entire or deeply toothed, lobed or almost pinnatifid; coriaceous; bulbils of large size. Island of Ulva.

decomposita. Fronds 1–3 feet long, drooping, coriaceous, 3–4 times pinnate, segments narrow-linear, acute, sori marginal. A beautiful variety; the most highly divided form of the species. Island of Ulva.

A. flaccidum, Forst.

α. In forests.

β. In forests and on rocks.

γ. Cliffs by the sea.

Aspidium aculeatum, Swartz., var. *vestitum*. Common. A form approaching *A. angulare*, Willd., occurs on Ulva. Another scarcely to be distinguished from the European typical form is found at the Old Neck. The caudex is frequently erect, and much branched. The scales on the rhachis vary greatly in size and density. The non-indusiate form was not observed on the island.

A. capense, Willd. Common in forests, etc.

Nephrodium hispidum, Hook. In forests. Common.

Polypodium rugulosum, Lab. Common.

P. grammitidis, Swartz. Common on trees and rocks.

P. serpens, Forst. Abundant on trees and rocks.

P. pustulatum, Forst., vera. *P. billardieri*, Handbook N.Z. Flora. On rocks and trees, abundant, but always less luxuriant than in the north.

P. australe, Mett. Common. Ascends to 2,000 feet.

P. crassium, MS. A singular little plant usually confused with *P. australe*, var. *alpina*, but differing in the elongated flexuous or twisted rhizomes; 1″–3″ long; fronds narrowed into a distinct stipes, broadly ovate, coriaceous, unisoriate; sorus attached to the centre of the frond. The fronds are arranged in three series along the rhizome, and are never tufted. Bare rocks on the highest peaks of Mount Anglem; 3,000 feet.

Todea hymenophylloides, Presl. In forests, local. The Old Neck, etc., etc.

T. superba, Col. Local, but not unfrequent. In deep woods; head of Paterson's Inlet, Ruggedy, the Archdeacon's Cove, etc.

Schizæa fistulosa, Sw., var. *australis*. *S. australis*, Gaud. Forming small dense tufts in swamps. Head of Paterson's Inlet, etc. Fronds 1″–2″ high. In a few places on the terraces larger specimens were found showing a direct transition to the typical form.

Lycopodium selago, L. Port Pegasus, Mr. Petrie!

L. varium, Br.

L. ramulosum, T. Kirk. On open peaty land and in swampy woods. Stems excessively branched and prostrate, densely matted. Head of Paterson's Inlet.

L. clavatum, var. *magellanicum*. Common; ascends to 3,000 feet.

L. scariosum, Br. Low sand ranges and terraces between Paterson's Inlet and Mason Bay. Island of Ulva.

L. volubile, Swartz. In forests; not uncommon.

Tmesipteris tannensis, Sw. On rocks and trees, frequent.

Azolla rubra, Br. Ruapuke Island. A. W. Traill!

It is not easy to account for the apparent absence of several species, such as *Dicksonia antarctica, Hymenophyllum scabrum, Aspidium richardii, Nephrodium glabellum, Polypodium pennigerum*, and especially *Asplenium hookerianum*, and *A. colensoi*. In all probability several of these will be discovered before long.

This paper may be fittingly concluded with brief descriptions of two natural "ferneries" on Stewart Island.

The first is a narrow gully, or deep ravine, in the forest on the island of Ulva. At the head of the ravine is a small cascade, which gives rise to the stream flowing through the gully. The whole is shut in by large trees so that direct sunlight is excluded, and the sides of the gully, at first steep, are gently rounded-off in the upper portions. The conditions are eminently favourable for luxuriant fern-growth.

At first the visitor's attention is arrested by large masses of tree-ferns, *Dicksonia squarrosa*, the stems of which are partly shrouded by the persistent dead fronds. These are most abundant in the flat ground at the lower part of the gully, and as they ascend the banks become reduced to solitary specimens, here and there intermixed with the more graceful *Hemitelia*, which becomes more abundant in the upper parts of the gully and attains large dimensions.

Interspersed amongst the scattered tree-ferns are gigantic specimens of *Lomaria capensis* which considerably overtop the visitor as he passes beneath them; as they ascend the banks they gradually diminish in height until they pass into the var. *minor*. *Lomaria patersoni* is plentiful and luxuriant near the head of the gully. The spaces between the larger ferns are occupied with a dense growth of *Lomaria lanceolata*—*Pteris scaberula* in the drier places. *Hypolepis tenuifolia, Lomaria discolor, L. vulcanica*, and other common species forming a series of contrasts in colour and habit.

The trunks of the tree-ferns are clothed with *Hymenophyllum æruginosum* in the most luxuriant condition, while *H. flabellatum, H. tunbridgense*, and *Trichomanes venosum* occupy similar habitats, and the translucent *H.*

dilatatum covers fallen logs with its delicate tracery. Numerous epiphytic species are to be seen on the higher portions, amongst which may be mentioned *Asplenium falcatum*, *Polypodium serpens*, and *P. pustulatum* (verum).

One charming feature remains to be stated—the profusion of mosses and Hepaticæ, large frondose species of the latter being everywhere conspicuous, their greenish-yellow tints harmonizing thoroughly with the bright green leaves of *Hookeria cristata*, which in these deep gullies exhibits its highest luxuriance.

The "Archdeacon's Cove" is a delightful nook on the south-eastern side of Paterson's Inlet, and can only be approached by water. On stepping out of the boat the visitor observes luxuriant plants of *Lomaria dura* and *L. banksii*, but for some time sees no indication of the rich treat awaiting him. Proceeding for a few chains along a narrow creek, *Lomaria capensis* is found in great luxuriance, and almost suddenly daylight is diminished by the narrowing width of the ravine and the increasing height of the cliff, all being overshadowed by a dense growth of gigantic forest trees, thickly clothed with epiphytes so that the direct rays of the sun are excluded, and a constant drip falls from the branches. The eye is bewildered by the multiplicity of fern forms which emerge from the partial obscurity as it becomes accustomed to the diminished light. High up amongst the branches of an inclined trunk hangs a pale green mass, which seems strangely familiar, but which from its large size fails to be recognized until a tedious climb of the wet slippery trunk reveals it as *Hymenophyllum pulcherrimum*, with fronds between two and three feet in length. *H. bivalve*, *H. multifidum*, and many other congeners whose names need not be given, are found on adjacent trees, while *H. dilatatum* exhibits great luxuriance at their base. Presently the gully widens out and numerous tree-ferns are to be seen; but the glory of the gully consists in its grand specimens of *Todea hymenophylloides* and *T. superba*, both of which are plentiful, but the latter especially exhibits its most graceful habit and its most luxuriant growth. From a stout stem some 18″ high, a dense crown of nearly erect fronds with drooping tips is given off. They must be counted by scores: some of them are three years old, and between four and five feet in length, of a deep blackish-green. It is impossible to conceive of a more attractive fern than this, or of a greater contrast than is presented by the same species when spreading its yellowish-green fronds in open woods. Numerous specimens were observed, but only one exhibited the extreme beauty or attained the large dimensions stated.

ART. XXVI.—*New Species of Plants.* By T. F. CHEESEMAN, F.L.S., Curator of the Auckland Museum.

[*Read before the Auckland Institute, 7th September*, 1884.]

1. *Ranunculus tenuicaulis*, n. sp.

VERY slender, sparingly pilose or nearly glabrous, 6–18 inches high. Rootstock long, rather stout, sending down numerous fleshy fibres. Leaves few (1–4), all radical, very variable in size and cutting, about reniform in outline, cut to the base into 3 (rarely 5) broadly cuneate divisions, which are deeply and irregularly 2–3-lobed; lobes narrow, often again toothed; texture thin, herbaceous; petioles very slender, variable in length, 1–4 inches. Scape slender, grooved, one-flowered, usually with three variously cut or lobed bracts about the middle. Petals not seen. Achenes 8–20, loosely packed and spreading on all sides, $\frac{1}{4}$ inch long, shortly stipitate, somewhat fusiform, gradually narrowed upwards into a long spirally recurved style.

Hab. Canterbury mountains above Arthur's Pass, altitude 4,000–5,000 feet. *T.F.C.*

A very distinct and well-marked plant. In habit and appearance it is perhaps nearest to *R. geraniifolius*, but it differs from that plant, and from all the other New Zealand species, in the stipitate and fusiform achenes, with spirally recurved styles.

2. *Myosotis* (*Exarrhena*) *concinna*, n. sp.

An erect or diffuse perennial, 6–18 inches high, branched from the base, covered in all its parts with fine closely-appressed silky hairs. Flowering stems or branches numerous, rather stout, leafy. Radical leaves usually many, 2–4 inches long, from linear- or lanceolate-spathulate to narrow oblong-spathulate, acute or obtuse, gradually narrowed into long petioles, covered on both surfaces with fine closely-appressed silky hairs. Cauline leaves sessile, lanceolate or oblong-lanceolate, acute. Racemes large, simple or branched, usually forming a rather dense many-flowered head, rarely elongated. Flowers large, bright pale yellow, sweet-scented, shortly pedicelled. Calyx $\frac{1}{3}$ inch long, 5-partite, lobes covered with appressed silky hairs. Corolla broadly funnel-shaped or almost campanulate, $\frac{1}{2}$ inch long; tube very short, limb large, deeply lobed, lobes oblong or ovate, acute or obtuse. Filaments very slender, elongate; anthers linear-oblong, exserted far beyond the corolla. Nuts ovoid, red-brown, but not seen perfectly ripe.

Hab. Nelson, abundant on the *débris* of limestone rocks on Mount Owen, altitude 3,500–4,500 feet; also on Mount Arthur, altitude 4,000 feet. *T.F.C.*

This, which is an exceedingly handsome plant, is at once distinguished from *Myosotis* (*Exarrhena*) *macrantha* by the more silky indumentum, colour of the flowers, and particularly by the shape of the corolla, which has a short tube and large deeply divided limb; whereas in *M. macrantha* the tube is very long and the divisions of the limb comparatively shallow. From *M. lyallii* it is separated by the leaves, indumentum, calyx and corolla.

In the Wairau Valley, Nelson, I have gathered immature specimens of a plant agreeing with this in the structure of the flowers, etc., but with the habit and foliage of *M. saxosa*. I am tempted to consider it a hybrid between the two species.

3. *Myosotis* (*Exarrhena*) *læta*, n. sp.

Stems slender, simple or sparingly branched from the root, hispid, erect or ascending, 6–12 inches high, sparingly leafy. Radical leaves variable in size, 1–3 inches long, linear- to obovate-spathulate or obovate-oblong, gradually narrowed into long or short petioles, obtuse, rather thin, hispid on both surfaces with short white hairs. Cauline leaves smaller, sessile, lanceolate or oblong. Racemes terminal, elongate, hispid, many-flowered. Flowers on slender pedicels, white with a yellow eye, or altogether yellow. Calyx 5-lobed to near the base, lobes narrow, erect, covered with simple or occasionally hooked hairs. Corolla rather large, $\frac{1}{3}$–$\frac{1}{2}$ inch long, $\frac{1}{3}$ inch in diameter, nearly campanulate, tube short, limb with short, rounded lobes. Stamens with long filaments, the anthers nearly or quite exserted. Style exserted. Nuts ovoid, pale-brown, shining.

Hab. Apparently not uncommon on the Nelson mountains, altitude 2,000–4,000 feet. Red Hills, Wairau Valley; Mount Arthur Plateau; Mount Owen, etc. *T.F.C.*

In habit very close to *M. australis*, with which it has probably been confounded. It is usually smaller, more slender, much more sparingly branched, and not so hispid. The flowers are altogether different, being larger and more campanulate; the anthers are on long filaments, so that they stand nearly on a level with the top of the corolla, and the style is altogether exserted. The nuts are also broader, and appear to be pale-brown when ripe. In the true *M. australis* the filaments are shorter than the anthers, which are included in the tube of the corolla, their tips just appearing above the scales; and the style is hardly longer than the calyx.

A plant common in many places in the Canterbury mountains, and which at present I include as a variety of *M. australis*, has a broad almost campanulate corolla nearly as large as that of *M. læta*. But the anthers and style are precisely those of *M. australis*.

ART. XXVII.—*A Description of some newly-discovered and rare Indigenous Plants; being a further Contribution towards the making known the Botany of New Zealand.* By W. COLENSO, F.L.S.

(Read before the Wellington Philosophical Society, 13th February, 1885.)

Class I. DICOTYLEDONS.

ORDER I.* RANUNCULACEÆ.

Genus 3. **Ranunculus,** Linn.

1. *Ranunculus amphitricha*, sp. nov.

A LOW perennial, perfectly glabrous, slender, creeping herb, stolons very long, rooting at nodes, rootlets very long. Leaves rather distant, generally two from a node, erect, orbicular-cordate in outline, 7–9 lines diameter, ternisect, the two lateral lobes bisected nearly to base, each lateral lobe having 3–4 laciniations, middle lobe always cuneate and trifid, with a minute laciniation or notch on each side, and mostly very regular; petioles slender, fistular, 2–3½ inches long, winged and clasping at base. Scapes or peduncles rather stout, 1–2 inches long, springing from node on the opposite side to the leaves, 1–3-flowered; flowers single, on long pedicels, 3 lines diameter; sepals 5, shorter than petals, orbicular, greatly concave, inflated, erect, obtuse, sub-papillose, one sepal always deeply emarginate or sub-bifid; petals 5–6, spreading, narrow, linear-oblong, obtuse, 2 lines long, yellow, shining, simple veined; vein forked at apex; unguiculate, ungues nearly as long as the lamina, the gland at base of lamina large, extending nearly across, erect, thickened, slightly toothed at top; stamens numerous, filaments long, anthers round bright yellow; styles erect when young, long recurved and subulate when mature; stigmas pubescent; achenes turgid and subpapillose when young, sub-globular and rugosely-papillate when mature, 12–15 collected in a globose head as large as a small pea; receptacle (ripe) largely echinately chaffy or squarrosely-hairy at base; hairs flat, translucent, bordered.

Hab. In muddy watercourses, edges of woods near Norsewood, County of Waipawa; 1880–84: *W.C.*

Obs. I have long known this plant, it has given me no small amount of yearly consideration and labour. I had long supposed it to be a variety of *R. rivularis* and of some allied Australian species; but on closer examination in its living state, and noting its differential (? specific) characters (*supra*), which are permanent, I cannot but conclude it to be distinct.

* The numbers in this paper attached to both orders and genera are those of the "Handbook of the N.Z. Flora."

ORDER X. MALVACEÆ.

Genus 2. **Hoheria**, A. Cunn.

1. *Hoheria sexstylosa*, sp. nov.

Tree erect, 12–14 feet, fastigiate, much branched; bark scaly with many small cracks and a whitish epidermis; branches long, slender, glabrous, roughish, bark dark reddish-brown; branchlets puberulous, with star-like pubescence. Leaves rather distant, glabrous, very variable in size and shape, mostly, however, lanceolate on the main and flowering branches, 2–2¾ inches long, acuminate, sometimes truncated at tips, cuneate, very finely reticulated and dotted, sub-membranaceous, light green above and lighter green below, sharply and deeply serrate, teeth acute; petioles ½ inch, flat above, and (with peduncles and calyces) thickly clothed with star-like pubescence. Flowers numerous, white, 1 inch and more in diameter, axillary and lateral, fascicled, mostly 3–4 together, sometimes 2, and also only 1; peduncles ¾ inch, jointed about the middle; calyx cup-shaped, 5-lobed, lobes large, deltoid-acuminate, acute with a knob at tips, 3-nerved, purplish-green; petals 5, connate at base, oblong, 7 lines long, 3 lines wide, oblique, obtuse, each petal deeply one-notched on the right side near tip, veined, glabrous, hairy within near base, spreading, incurved; filaments 5-adelphous, spreading, 2 lines long; anthers (filaments and styles) white, reniform, sub-versatile; styles 6–7, stout, flexuous, shaggy; stigmas capitate, large, flattish at top, papillose, slightly coloured, yellowish; ovary included sunk, 6–7 ridged, pubescent.

Hab. Skirts of woods and thickets, Norsewood, Matamau, and Tahoraiti, County of Waipawa; 1883–84: *W.C.* Flowering in March and April.

Obs. No two trees can be more unlike in their foliage than this is in its young and in its mature state; and not only so, but the same tree in the leaves on its older and flowering branches, and in those on its younger and lower branches; these latter, like those on the young trees, are under an inch long, rhomboid, trilobed, sub-orbicular, etc., but always deeply serrate and sub-fascicled, generally four together and all of various sizes. On the flowering branches also, the lowest leaves are invariably small. I have long known this plant in its young and leafing state, and had always supposed it to be a variety of *Plagianthus betulinus*, A. Cunn., which it much resembles. When in flower it has a striking and elegant appearance, and it remains a long time in full blossom; it will make a handsome garden tree or tall shrub. Not unfrequently 5–6, or more, standards rise from the one root, all about the same size, forming a little compact clump. The bark of the older trees is often completely covered with handsome crustaceous lichens.

ORDER XXXIII. UMBELLIFERÆ.

Genus 1. **Hydrocotyle,** Linn.

1. *Hydrocotyle concinna*, sp. nov.

Plant creeping, slender, pilose, soft, forming dense beds. Stems 2–3 feet (and more) long, rooting at nodes. Leaves membranaceous, green, distant, generally 1, sometimes 2, springing from a nóde, sub-orbicular, 8–10 lines diameter, roughish above with glandular pubescence of large flattish white and pink hairs, with a few larger and pink coloured ones scattered on the veins, deeply 5-lobed, lobes regular, broadest at apices, sub-tri-laciniate and sharply toothed, teeth long and curved; petioles 3 inches long, slender, finely striate; stipules large, broadly ovate, laciniate. Peduncles axillary and lateral (from nodes), erect, slender, much longer than the leaves, 4–6 inches long, pink-striped, thickly clothed with weak curved hairs; umbels 20–22-flowered; flowers radiate on long glabrous pedicels sub 2 lines long, each bearing a few scattered erect hairs and mostly in a single line; involucral leaves and bracteoles numerous, ovate-linear, laciniate and pointed; flowers greenish-white tinged with pink, red-striped on the outside; petals ovate, obtuse, spreading; calyx tube raised, tuberculate, dark-red; styles diverging, sub-clavate; stigmas capitate, red, minutely pencilled. Fruit orbicular, at first semi-transparent, echinate, light brown, carpels with one rib on each face.

Hab. In dense rather dry forests, on the ground. Seventy-mile Bush, County of Waipawa; 1878–84: *W.C.* Flowering in March.

Obs. This is a truely graceful species, neat, pretty, and uniform in all its parts. I have long known it, and though I had early considered it to be new, and often brought away specimens, I never found time to dissect, examine and compare it, until the autumn of 1884, when I did so leisurely in its native forests. Sometimes the young immature and unfolded leaves present a highly curious appearance; sessile at the nodes in small globular woolly masses, with their green cut and plaited margins fringing their tops; reminding one of young hazel-nuts. I believe it to be the work of some insect, having found the darkish-yellow larvæ snugly ensconced within.

2. *Hydrocotyle uniflora*, sp. nov.

Stems creeping, rooting at nodes, whence also spring the leaves and peduncles fascicled. Leaves glabrous, entire, orbicular-truncate, or oblong-orbicular, always truncate at base, 5–7 lines long, rounded at apex, finely and regularly crenately toothed (3–4) towards base, and often with one small acute tooth at or below the two corners, 5-nerved, green, often purple above and covered with very minute white dots as if stippled, margins purple, sometimes largely and loosely hairy below at base and on the nerves, veinlets closely anastomosing; petioles 1½–3 inches long; stipules large, membranous, veined, entire. Peduncle 1–1½ inches long, slender (two are often united below near base, and thus become bi-peduncled), sometimes largely pilose. Involucral leaves two, sub-orbicular or orbicular-ovate, sessile and half-clasping, glabrous, veined, purple stained or margined, very membranous. Flowers single, sessile (rarely two together, and when so then one is shortly pedicelled), petals rather large, ovate, sub-acute, purple, reflexed. Fruit large, sub-orbicular, compressed, 2 lines diameter, obsoletely 3–4-ribbed, tops purplish with a few loosely scattered hairs.

Hab. Wet sides of slopes, gullies near Norsewood, County of Waipawa; 1884: *W.C.* But not common.

Obs. A species having pretty close affinity with *H. asiatica*, Linn., but differing in several particulars.

3. *Hydrocotyle intermixta*, sp. nov.

Plant very small; stems short, creeping and rooting interlaced underground. Leaves orbicular with a narrow deep sinus, 3–4 lines diameter, thickish, much veined, dark green, sparsely pilose on both sides with long succulent scattered hairs, 5–6-lobed, lobes short, broad, sub-tri-laciniate, cut, obtuse; petioles 4–5 lines long; stipules delicately membranous, reticulated, sharply laciniate. Flowers in small globose heads, 9–10 (*sub* 12), minute, red, sessile, petals incurved, obtuse; styles short; peduncles 7–8 lines long, erect, striate; involucral leaves small, obovate, obtuse. Fruit very small, shortly pedicelled, glabrous, turgid, broader above than below, shining, dark brown; carpels sharply keeled on back, 1 rib on each face, and a deep hollow between the two lateral ridges.

Hab. On dry open hills near Matamau, Seventy-mile Bush, County of Waipawa; forming thick little patches among short grasses and mosses, and other small plants, scarcely visible without close search; 1880–84: *W.C.*

Order XXXIV. ARALIACEÆ.

Genus 2. **Panax,** Linn.

1. *Panax microphylla*, Col.*

Flowers axillary, in 2–4 small umbellate panicles, conjoined at base and wearing a fascicled appearance, each sub-panicle containing 2–4 flowers—in all 3–14, small and inconspicuous, 1½ lines diameter, pedicelled, each pedicel surrounded by many minute stipellæ; petals broadly ovate, sub-acute, darkish-red on the outside greenish-red within, spreading, slightly recurved, deciduous; calycine teeth minute, acute, purple; filaments short,

* For description of this plant (without flowers), see "Trans. N.Z. Inst.," vol. xvi. p. 328.

alternate with petals; anthers sub-orbicular, bright yellow; disk green, convex; styles long, divergent, recurved, stout, obtuse, arising from an elevated base; stigmas slightly pencilled, purple.

Obs. Flowering in February. Each panicle almost invariably bears one large fruit before the other flowers are open. I have recently detected some larger shrubs, in those same localities, 5–7 feet high.

ORDER XXXVI. LORANTHACEÆ.

Genus 1. **Loranthus**, Linn.

1. *Loranthus polychroa*, sp. nov.

A glabrous spreading shrub of irregular horizontal growth; branches extending 2–3 feet. Leaves 2–2½ inches long, 7–10 lines broad, narrow-oblong and oblong-lanceolate, very obtuse and rounded at apex, sometimes (rarely) apiculate, tapering at base and narrowed into a rather long petiole 4–6 lines long, coriaceous, sub-glaucous-green, veins obscure when fresh, very apparent in dried leaves, 5–7 diverging from near base, margins thickened, sub-revolute, coloured red, and regularly and finely tuberculated. Racemes erect, about 1 inch long, 12–16-flowered; peduncle quadrangular, stout, tapering; pedicels decussate 2 lines long; flowers bright orange-red, 7-8 lines long; corolla slender, straight, swollen about the middle at base of filaments; petals linear-spathulate, sub-acute, longer than anthers, combined to below the middle, recurved and appressed from middle, darkish-coloured on outside at tips; anthers linear; style filiform longer than anthers; stigma dark red, globular, finely papillose; calyx rather deep, margin uniform, even; tube cylindrical, oblong, length of pedicel.

Hab. Parasitical and high up on trunks of *Fagus solandri*; woods near Norsewood, County of Waipawa, but scarce; March, 1884: *W.C.* Specimens, flowers, and leaves picked up.

Obs. A species near to *L. flavidus*, Hook. fil., yet distinct (*vide descript. supra*), as well as from the many other described species (nearly 200!) of this large genus.

ORDER XXXVII. CAPRIFOLIACEÆ.

Genus 1. **Alseuosmia**, A. Cunn.

1. *Alseuosmia pusilla*, sp. nov.

A small glabrous shrub, 5–8 (rarely 10) inches high, erect, simple, sometimes bearing 2–3 very short branches, and also other plants once forked from the base.

Leaves few, 8–12, distant, spreading, petiolate, 1–2½ inches long, oblong and obovate-lanceolate, obtuse with a small mucro, with 3–6 minute and fine distant teeth, sometimes quite entire, sub-coriaceous, green splashed and spotted with red, obsoletely veined, margins red; petioles 3–4 lines long, rather stout. Flowers few, scattered, single, lateral from near base or near top, rarely axillary, drooping; peduncle stout, glabrous, spotted and striped with red (also the calyx and corolla without), bearing two small alternate bracts, and 3–4 red bracts together at the base with red spreading hairs within; calyx glabrous, 5-lobed, lobes deltoid acute; corolla 4–5 lines long, 5-lobed, lobes thickish, revolute, of a light straw or pale primrose colour, velvety, not veined, sides ruguloso-fimbriate to base, each lobe bearing 3–4 rather long cylindrical white obtuse fimbriæ at tip; anthers large, orbicular, 2-lobed, lobes turgid, shorter than corolla-tube, and longer than the style; stigma large, globose. Berry large, 8–9 lines long, ellipsoid, thickest at apex, succulent, smooth, shining, bright red, containing 9 (or more) dark brown seeds, 2 lines long, oblong, slightly curved and obtusely angled, finely striate, shining.

Hab. In shady forests near Norsewood, County of Waipawa; 1884: *W.C.*

Obs. I. The unexpected discovery of this little shrub pleased me much: (1) from the genus being very scarce in this part of the island, though common in the woods at the north (Bay of Islands, etc.); I had only once before (in 1848) fallen in with a species* so far south, and then only in one spot, in the dense forest between the rivers Manawatu and Ruamahanga: (2) from the distinctness of this species: (3) from the small size of the shrub—a little erect hard-wooded tree in miniature; and (4) from its very large and bright red fruit (which indeed was the cause of my detecting it, hidden among the dense undergrowth of ferns and small herbaceous plants); it bears the largest berry of the known species of the genus.

Obs. II. I brought away living four shrubs, each 5–6 inches high; and planted them here at Napier in a large flowerpot. These are all healthy, and are now flowering (September), although they have not yet fully evolved a leaf; some of the flowers are about 1–2 inches from the base, and all from old wood. From its delicious odour (common to the genus) this species being so small will make a suitable pot plant.

Order XXXIX. COMPOSITÆ.

Genus 1. **Olearia**, Mœnch.

1. *Olearia multibracteolata*, sp. nov.

A shrub about 6–7 feet high of dense foliage and thick compact growth; "bark on trunk rough grey and somewhat scaly, wood hard, and leaves in age acquiring a brown colour." Branchlets long slender, dark brown, sulcated, villous with brown and grey pubescence. Leaves 1–$2\frac{1}{2}$ inches long, $\frac{1}{2}$–$\frac{3}{4}$ inch wide (decreasing in size towards ends of branches), linear-oblong, obtuse with a tooth, alternate, distant, coriaceous, incurved, deeply

* This, also, I had only found in fruit, in the autumn; Sir J. D. Hooker, in the "Handbook N.Z. Flora," has placed it under *A. quercifolia.*

and sharply serrate, or bi-serrate—the serratures having small teeth in the sinuses, margined, bases dimidiate and sub-truncate, glabrous and shining on upper surface, clothed below with fine appressed golden silky hairs, midrib stout, keeled below, costal veins forming obtuse angles with midrib, greatly and finely reticulated on the upper surface, almost tessellated with minute squarish dots that are sometimes crescent-shaped; petioles $\frac{1}{2}$ inch long, stout, deeply channelled, dark brown, largely decurrent slightly winged or ridged extending to next leaf below. Flowers whitish, in small rounded terminal corymbose-panicles, arising from axils of leaves; panicles long slender, 1–2 inches long, leafy; sub-panicles with 2–4 flowers; flowers rather distant, but together form a close compact corymbose head; peduncles slender, each with a small leaf at its base; pedicels about 3 lines long, slender; peduncles, pedicels, and involucres thickly covered with viscid glandular pubescence, odoriferous. Head of flowers small, about 2 lines long, 2–3 lines diameter, sub-cylindrical or infundibuliform, few-flowered, soon expanding; involucre with 1–2, or more, leafy bracteoles at its base; involucral scales in two rows, brown with a dark centre, outer shorter and ovate-acuminate, inner long linear obtuse, fimbriate at tips with brown curly tomentum. Florets of the ray white, 7–9, largely revolute, nearly twice as long as the involucre,—of the disk 5–6, reddish, pubescent without; pappus short, rather shorter than florets, not thickened at tips, of a light-brownish colour (*ochroleucus*); achenes small, sub-linear-obovoid, somewhat flattened, ribbed and very hairy; receptacle very small, somewhat irregular and ridgy.

Hab. Forests about Woodville, River Manawatu, North Island; 1882–84. Flowering February and March: *Mr. S. Hutching.*

Obs. A species closely allied to *O. dentata* and *ilicifolia*, with which I was at first inclined to place it; but a closer examination of better and flowering specimens has yielded important characters possessed by neither of those species. It has a very strong and not unpleasant smell, particularly the clammy glandular pubescence of its heads of flowers. Mr. Hutching informed me that, during several years residence there, he had only noticed this one plant, which he had early removed into his garden. I think it will make a neat garden shrub.

2. *Olearia populifolia*, sp. nov.

Branchlets slender, bark brown, striate, thickly hairy with brown and grey hairs. Leaves alternate, rather distant, 2–3 inches long, $1\frac{1}{2}$–$2\frac{1}{4}$ inches broad, membranaceous, broadly ovate, acute, acuminate, sometimes sub-orbicular and dimidiate, sub-truncate at base, sinuate, toothed, teeth few distant and (apex) knobbed, glabrous above, clothed below with densely appressed short pale greenish-white wool of a satiny appearance, midrib prominent below and densely covered with brown hairs; petioles 5–9 lines long, rather slender, brown, hairy, deeply channelled above, dilated at base but not decurrent. Flowers sub-terminal in long slender sub-corymbose and axillary panicles, 4 inches long, panicles and sub-panicles each with a single small obtuse densely-haired brown bracteole at base; heads few, broad, spreading, 4–5 lines diameter, rather distant, on slender pedicels 5–6 lines long; involucral scales in three rows, brown with a dark mid-line, outer short sub-ovate, acute, densely hairy on the back, inner longest, linear, obtuse, glabrous on back, densely fimbriate at edges and tips; florets few, tubes glandular-pubescent, thickened downwards; florets of ray broadly lanceolate, tips obtuse and very slightly emarginate; stigmas much exserted, long, narrow, acute, spreading; pappus short, acute, dirty-white, tips recurved reddish; receptacle small, convex, ridgy; achene very small, less than 1 line, nearly linear, broadest at top, sub-cylindrical and very slightly angled, very hairy.

Hab. Woods, east side of the Ruahine Mountain range, County of Waipawa, North Island; January 1884: *Messrs. H. Hill and A. Hamilton.*

Genus 14. **Gnaphalium,** Linn.

1. *Gnaphalium adhærens*, sp. nov.

Plant a diffuse bushy perennial herb; main stems woody, as thick as a goose-quill, climbing, adhering closely by long lateral rootlets to perpendicular clayey cliffs. Branchlets sub-secund, patent, drooping, 9–14 inches long, stoutish, covered with floccose silky hairs; leaves alternate, scattered, distant, 2 inches apart on stems, $1\frac{1}{2}$–$2\frac{1}{4}$ inches long, 6–8 lines broad, obovate, acute, apiculate, sessile, half-clasping, margins entire, glabrous above, woolly below, with closely appressed floccose white hairs, membranaceous, flaccid, strongly tri-nerved, light green. Flowers terminal in loose bracteate corymbose panicles, 2–3 inches long, containing 12–13 heads, mostly 3 heads on each sub-panicle or lower peduncle; peduncles and pedicels long, bracteolate, densely woolly like branchlets; bracts and bracteoles foliaceous, margins waved; heads 4 lines diameter; outer involucral scales densely floccosely silky; inner involucral scales 2 lines long, linear, clawed, spreading, lamina white as ligulate florets but narrower, claw green shining thickened at base; ligulate florets white, spreading acute and obtuse, laciniate-toothed at tips; pappus few, slender, scabrid, spreading, not thickened at tips; achenes very small, linear, somewhat subquadrangular, obtuse with a central depression or corona at base, glabrous: receptacle small 1 line diameter, flat, subdepressed, alveolar, full of circular holes with raised margins.

Hab. Damp cliffy clayey sides of the River Mangatawhainui (a feeder of the River Manawatu) near Norsewood, County of Waipawa; 1883: *W.C.* Flowering in December, with the dead leaves and flowering panicles of the former year still strongly adhering.

Obs. A species allied to *G. lyallii*, *trinerve*, and *keriense.* From its diffuse flourishing growth, peculiar habit, and numerous heads of pure white flowers, this plant looks exceedingly well in its native home. It clings strongly to the cliffs, like ivy, only its rootlets are very much longer, extending some inches each way.

2. *Gnaphalium sub-rigidum*, sp. nov.

Plant bushy, loosely spreading; stems many from one root, woody, ascending, very slender, 12–20 inches long, 1–1½ lines diameter, of uniform thickness, brittle, branched and naked below, simple and leafy above, scarred throughout; bark dark brown. Leaves rather closely-set, scattered or somewhat whorled, patent, sub-coriaceous, linear, 8–12 lines long, 1–1¼ lines broad, sub-acute and apiculate, flat, sessile and half-clasping, glabrous, shining and reddish above, white and cottony below; margins entire, recurved, very thick and shining; midrib stout and prominent below; veinlets anastomosing. Heads of flowers white, numerous, 10–20 at tips of branches, in lax sub-fascicled corymbs, on slender nodding white and cottony peduncles and pedicels of various lengths 3–9 lines long, some 1-, others 2- and 3-flowered, all with long foliaceous narrow bracts, often each pedicel is bibracteolate; heads ½-inch diameter; involucral scales white and spreading, oblong, obtuse, rarely notched at tips, margins entire, claw short, greenish-brown, glabrous; florets very numerous, at first yellow, afterwards with a dull reddish tinge; receptacle flat with a raised flat centre, densely and minutely rugged; pappus few, very slender, weak, slightly scabrid and jointed. Achene short, linear, sub-acute at tip, glabrous.

Hab. Dry hilly country west side of Ruataniwha Plains, County of Waipawa; 1884: *Mr. H. Hill.* Flowering in September.

Obs. A species pretty near to *G. keriense*, A. Cunn., var. *linifolia*, J. D. Hooker.

ORDER LIII. SCROPHULARINEÆ.

Genus 4. **Gratiola,** Linn.

1. *Gratiola glandulifera*, sp. nov.

Plant creeping at root, glabrous, stems erect and ascending, 6–12 inches high, simple and branched, stout, semi-succulent, sub-quadrangular, obtusely-angled, deeply channelled on two sides, purple-red, with a few weak and short scattered hairs. Leaves ovate, 4–6 lines long, 2–3 lines wide, obtuse, sessile, half-clasping, thickish, 3-nerved, serrate, sub 6 (generally 4) teeth, teeth and tip dark purple. Flowers few, axillary, solitary, peduncled, peduncles about 1 line long: calyx 5-leaved, leaves linear-acuminate, 1-nerved, green, longer than capsule, obtuse, somewhat knobbed and purple-tipped, each leaflet having a row of sub-succulent white hairs down the nerve on the outside: corolla ½ inch long, pubescent, limb white; upper lip 2-lobed, sometimes purple-margined; lower lip 3-lobed, lobes all very obtuse; tube yellowish, purple-striped, throat above thickly clothed with golden glandular hairs, and on each side a single row of similar hairs. Capsule broadly-ovoid.

Hab. In boggy spots, edges of water-courses near Norsewood, County of Waipawa; 1884; but very local; flowering in March: *W.C.*

Obs. A species having pretty close natural affinity with *G. sexdentata*, A. Cunn. (? *G. peruviana*, Benth.), but apparently differing in several characters, the chief one being the thick glandular pubescence lining the corolla.

Genus 9. **Ourisia,** Comm.

1. *Ourisia robusta*, sp. nov.

Erect, glabrous, scape, sparingly pilose.

Leaves radical broadly-ovate, obtuse, deeply crenate or sub-crenate-serrate, teeth apicular, each with a gland-like circular brownish dot on upper surface within margin, triple-ribbed, veins very stout and prominent below, lamina 6 inches long, thickish, slightly decurrent; petioles same length, thick, sub-succulent, deeply canaliculate, edges purple and slightly hairy. Scape 1½–2 feet high, very stout, 5 lines diameter, septangular and sulcated, purple-striped, bearing long white jointed and weak hairs scattered on its angles. Bracts, or floral leaves, on the scape all whorled, lowermost 5–8 (generally 8), broadly lanceolate, 2½ inches long, serrate, margins purple, 5-nerved to base of petiole; petioles long broad and flat, edges hairy; upper whorls of bracts very numerous (00), serrate, decreasing gradually in size to the apex. Flowers umbelled in distant whorls, generally nine; pedicels 1½ inches long, rather slender, sub-angular, purple-striped, covered with thick glandular pubescence; calyx 5-partite, glabrous, purple-striped, lobes linear-subulate, 1-nerved, 5 lines long, obtuse and thickened at tips; tips recurved, margins purple; corolla large 11 lines diameter, white within, purple and purple-striped on the outside; throat yellow-green, densely clothed with numerous jointed and sub-clavate succulent hairs of the same colour; tube short 3 lines long; lamina spreading 5 lines long, lobes large, retuse, veined; veins obtusely angled and rounded. Capsules orbicular-oblong, broadest at base, turgid, glabrous, purple-spotted on top, much smaller than calyx lobes.

Hab. In gullies on the high lands west of Napier, between Napier and Taupo; 1883: *Mr. H. Hill.*

Obs. I. This species has close affinity with *O. macrophylla*, Hook., but differs from it in several particulars; the sepals are narrower longer glabrous and coloured, and only 1-nerved; the corolla is coloured within and there clothed with densely glandular pubescence, and the tube is much shorter, and in the venation of the limb, which is also larger, the angles are rounded at apices, and not acute as in that species, and the pedicels are densely glandular-hairy: the leaves also are different, both in their shape and in their curious little gland-like openings or depressions on their margins; and the scape is very much stouter and 7-angled, with its lower floral leaves much more numerous, larger and petiolate.

Obs. II. From Sir J. D. Hooker's "note"* on an imperfect specimen of *Ourisia* of possibly an additional species allied to *O. macrophylla* which I had early "gathered near Taupo;" I am of opinion that this may very likely be identical with that plant.

ORDER LXX. CUPULIFERÆ.

Genus 1. **Fagus**, Linn.

1. *Fagus apiculata*, Col.† (Fruit.)

Fruiting involucre or cupule, green, ovate, obtuse, 4 lines long, 3- (sometimes 4-) sided, with four imbricated tomentose ovate scales on each side, edges scarious and brown, shortly pedicelled, pedicels pilose; nuts 2–3, broadly ovate, sparsely pilose, outer one (or two) sharply ridged down the centre on one side, inner (or middle) one flat, thin, sub-erose at edges above, tips deeply bifid; styles persistent.

Class II. MONOCOTYLEDONS.

ORDER I. ORCHIDEÆ.

Genus 10. **Microtis**, Banks and Solander.

1. *Microtis longifolia*, sp. nov.

Plant variable in size, and in the number of its flowers; tall, erect, 1 foot 3 inches to 2 feet 3 inches high; leaf solitary terete tubular, with 3 longitudinal furrows from base to tip, 2–3 inches longer than scape, and an open oppressed bract at base 1–2 inches long. Scape stout, 2–3 lines diameter, cylindrical below sub-angular above; raceme 3–6 inches long, many flowered (25–40), flowers pedicelled, small, distant, 2–6 lines apart; bracts 2 lines long, broadly ovate-acuminate, transversely rugulose and decurrent; upper sepal boat-shaped, sub-cucullate, acute; lower pair largely divergent sub-revolute, obtuse; petals free, recurved, obtuse; lip oblong, laciniate or sub-lobed, much crisped at margins; tip broad and bifid; the two lumps at base very large, dark green, smooth and shining; the lump near tip tuberculate or crisped, commonly in two ridges; ovarium stout, 3 lines long, finely papillose, flat beneath, very turgid and gibbous above.

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* "Flora Novæ-Zelandiæ," vol. i., p. 198.

† For description of this plant (without fruit) see "Trans. N.Z. Inst.," vol. xvi., p. 335.

Hab. Skirts of woods near Norsewood, County of Waipawa; flowering in February and March; 1883–84: *W.C.*

Obs. A species allied to the common *M. porrifolia*, but differing in several characters (*vide descript. supra*); and also from its flowering in the autumn. It is nearly allied to some of the Australian species.

Genus 11. **Caladenia**, Br.

1. *Caladenia variegata*, sp. nov.

Plant erect, 6–12 inches high, glandular-pubescent; pubescence pink-tipped; scape red, sub-rigid not succulent, slender above leaf, stoutish below, arising from a thickened node, having three clasping membranous acute sheaths, one at base enclosing scape and leaf, one at middle 6–8 inches long, and one close under ovarium; root rather long, stoutish, ending in a long white tuber as big as a pea. Leaf single, ½–1 inch from base, 6–8 inches long, 1–2 lines wide, linear-acuminate, thickish, glabrous, channelled, green on upper and purplish-red on under surface, slightly ciliate at edges, and very sparsely pubescent underneath on the lower portion with long weak glandular hairs. Flower single on top of scape, (one specimen only, out of nearly forty obtained, bore two flowers, both springing from within the upper sheath and pedicelled,) perianth spreading, more than ½ inch diameter; dorsal sepal green, arched, sub-oblong-obovate, obtuse and apiculate at apex, produced, glabrous above; lateral sepals pinkish, oblong, apiculate, larger than petals, 3-nerved; petals pink, oblong-lanceolate, apiculate, falcate; lip sessile; disk with two longitudinal rows of bright-yellow stipitate glands having large globular heads, extending from inner part of middle lobe down into the throat, with smaller glands scattered on each side, and one or two at the margin of extreme base of the middle lobe; the two lateral lobes are transversely banded with light-purple, margins white, rounded at tips; middle lobe deltoid, deeply crenulate, recurved, bright yellow; column winged throughout, green, pubescent at top, transversely banded below with light purple, similar to lateral lobes; anther acute, tip subulate, margin finely fimbriate. Ovary 8–9 lines long, linear-obovate, sulcate, densely glandular-pubescent.

Hab. Plentifully, but only in one spot, among mosses on fallen and rotten *Fagus* trees, and on the ground alongside, in rotten vegetable soil, shady woods, top of a high hill near Norsewood, County of Waipawa; December, 1883: *W.C.*

Obs. A species closely allied to the two known New Zealand species, *C. minor* and *lyallii*; and also to several Tasmanian and Australian species—*C. carnea*, *alata*, and *angustata;* but while serving naturally to unite them differing from them in all important characters. *C. minor*, which is so common at the north (Bay of Islands), on clayey open hills among fern (*Pteris esculenta*) and *Leptospermum* scrub, I have never met with in these southern parts.

Genus 15. **Thelymitra,** Forst.

1. *Thelymitra nemoralis*, sp. nov.

Plant stout; tubers large, oblong, narrow. Leaf (occasionally two) variable, 6–17 inches long, 6–9 lines wide, linear-acuminate, acute, broadest at base, green, glabrous, thick, strongly 3- (obsoletely 5-) nerved, keeled. Scape stoutish, 8–16 inches long, bibracteate, bracts equidistant, sub-foliaceous, clasping, acute; raceme 2–8- (usually 7-) flowered; flowers distant, bracteolate on rather long pedicels; bracteoles obovate-oblong, acuminate, acute, obsoletely 5-nerved; perianth spreading $\frac{3}{4}$ inch diameter; sepals pale green with broad white margins, narrower than petals; dorsal sepal much larger than laterals, obovate-oblong, obtuse with a mucro; lateral sepals ovate-lanceolate, acuminate; petals white, sometimes pinkish, broadly elliptic, acute with a mucro; lip similar to petals but narrower and not so highly coloured; column with stout deeply emarginate tip, pinkish below, umber-brown above, edged with bright yellow, margins incurved; appendages produced, rather shorter than column and inclined at top towards it, densely globosely-plumose at tips, white; the base of wings in front of column sub-two-lobed and two-toothed; stigmatic gland bilobed at base, trilobed at apex including rostellum.

Hab. Dry *Fagus* forests. Seventy-mile Bush, County of Waipawa; 1881–83: *W.C.* Flowering in December.

2. *Thelymitra purpureo-fusca*, sp. nov.

The whole plant exceedingly slender, of a dusky purple-brown or purplish-red colour; tubers narrow, oblong. Leaf narrow, $1\frac{1}{2}$–3 lines wide, 7–10 inches long, thickish, channelled, glabrous. Scape erect, very slender, almost filiform, bibracteate, 8–10 inches long; raceme 3–5-flowered (occasionally only one); flowers rather distant, bracteolate on long slender pedicels; perianth $\frac{1}{2}$ inch diameter; sepals dark purple-brown edged with a bright green line, a yellow central stripe and broad white exterior margins, sub-ovate-acuminate, much concave, dorsal one largest, the two laterals with a long mucro; petals light pink, sometimes white, elliptic-oblong, obtuse, broader than sepals; lip the smallest; column pink dashed with blue, apex stout, much emarginate, incurved, dark and edged with bright yellow (as in *T. nemoralis*), but the plumose appendages are more produced and rise above the column; anterior base slightly erose; stigmatic gland similar to that of *T. nemoralis;* anther very acuminate, tip subulate.

Hab. In *Fagus* woods on dry hills with the preceding species, but usually higher up; 1881–83: *W.C.*

Obs. I have both sought and watched this plant very closely; from the fact of its widely different general appearance at all stages from *T. nemoralis*, and yet, on examination and dissection, I find it possessing such scanty differential characters; the principal ones consisting in its plumose staminodia rising *above* the tip of the column—its narrower and variegated sepals—its slenderer proportions, dusky aspect and fewer flowers. In all these however it is very uniform; as I have seen and examined (through patiently waiting for their development) some scores of flowers and plants. It has also a peculiar habit of growth, being often found in little clumps (like crocuses and jonquils), from which arise 6–12 scapes. It wears a very striking and elegant appearance, when its dark perianths with their segments edged with white are about expanding, from their contrasts in colour. Notwithstanding the column-appendages being produced beyond its tip, while in *T. nemoralis* they are below it, this species is naturally very closely allied to that one.

Order VII. LILIACEÆ.

Genus 2. **Callixene**, Comm.

1. *Callixene melantha*, sp. nov.

Perianth darkish-green, 1¼ inches diameter; segments obtuse, 3 outer ovate-acuminate, thickish, obsoletely veined longitudinally; 3 inner narrower and thinner, broadly-linear, incurved, venation netted; filaments brown, stout, broad at base, longer than anthers; anthers bright yellow, sub-linear-ovate, 3 lines long, tips emarginate, base sagittate, extrorse; style brown, sub-angular, tapering; stigma ochraceous, small, papillose.

Hab. East sides of Ruahine mountain range, County of Waipawa; 1883: *Mr. Hamilton.*

Obs. I. The anthers and stigma of this species more closely resemble those of *C. polyphylla* (a South Chilian plant) than they do those of *C. parviflora*, the only known New Zealand species.

Obs. II. I have received but a single unexpanded flower! all that was by chance obtained; fortunately it was mature, uninjured, and fresh. It appears that Mr. Hamilton, on his return from the forests, was clearing out some mosses, leaves, etc., from the outer pockets of his coat, and found among them this one flower-bud (*alabastrum*), and kindly gave it to me. For some time it puzzled me, its dark green colour, so unlike that of a flower, and its being closely shut up, helped to disguise it; it more resembled a caper bud than anything else; but on soaking, dissection, etc., I found out what it was, and believe it will prove to be a new species of *Callixene*. It is allied to *C. parviflora*, which bears a much smaller and white flower and has a very different stigma; this latter, however, grows on the same range at a much higher altitude.

Genus 5. **Astelia,** Banks and Solander.

1. *Astelia microspermum,* sp. nov.

Leaves coriaceous, sub-linear-ovate, lanceolate, very acuminate, 2 feet 3 inches to 2 feet 6 inches long, $1\frac{1}{2}$–$1\frac{3}{4}$ inches wide at the broadest part above, rather suddenly and much dilated at base and there 4 inches wide and greatly overlapping and triquetrous, light yellowish-green, glabrous and shining particularly at bases, but the innermost leaves have a narrow band of white hairs at their bases on the outsides, the extreme base somewhat fleshy and succulent, gummy, with a white transverse band 1 inch wide, above that it is black for 2 inches or more; under a strong lens the surface below is closely cottony appressed in minute squares, sub-incurved, deeply channelled, slightly keeled below in the centre of the leaf but not so at base, 2 prominent and stout nerves equidistant from midrib, with many finer nerves; offshoots around the base of scape sharply triangular. *Female* scape terminal very stout, sub-triquetrous, 9 inches long, densely clothed throughout with white silky hairs that are very long at base; panicle nodding, 6–7 inches long, composed of seven slender sub-sessile racemes 4–6 inches long and about 1 inch apart, each with a very long sessile foliaceous bract sub-ovate-acuminate, half-clasping, not cordate, 16–18 inches long, $1\frac{1}{2}$–$1\frac{3}{4}$ inches wide at base; flowers very small, about 1 line long, excessively numerous, compact, light yellow; pedicels sub-fascicled, 2 lines long, slender, woolly; bracteoles linear, 2 lines long, white with a brown central stripe; perianths woolly on the outside, closely embracing ovary, and nerved below to anthers; segments sub-linear-ovate, obtuse, reflexed, nerveless; ovary ovate, half or more exserted; stigma sessile, spreading, trilobed, papillose; anthers linear, very slender. Fruit small, $1\frac{1}{2}$ lines diameter, sub-globular, somewhat obtusely triquetrous, with a long produced sub-angular beak, greenish; seeds very small, 14–18 in a berry, black, shining, sub-lanceolate, convex above flattish below, produced at one end. *Male* (whole scape not seen), sub-peduncle thickish, obtuse, cylindrical, single raceme 3 inches long, 10 lines wide; flowers light brown, densely compact, sub-fasciculate, pedicelled; pedicels 2–3 lines long, stoutish, shaggy, with an excessively narrow linear bracteole near the base, longer than pedicel and nerved; perianth large spreading, about 1 inch diameter; segments cut to base, 4 lines long, shorter than anthers, deflexed, sub-linear-ovate, obtuse; outer 3, broader, 3-nerved, tips woolly on the outside; inner 3, 1-nerved, tips thickened; filaments 3 lines long, stout, cylindrical; anthers 2 lines long, linear, obtuse, largely hastate; ovary small, sub-triquetrous, spotted white; stigma sessile, tri-orbicular, finely papillose.

Hab. Epiphytical on high trees in forests, Seventy-mile Bush, between Norsewood and Danneverke, County of Waipawa; 1884: *W.C.* Flowering in January.

Obs. A very peculiar, fine and distinct species; of which, from its growing so very high up in the trees, it is difficult to obtain good specimens.

2. *Astelia albicans*, sp. nov.

Leaves linear-acuminate, 1 foot 3 inches to 2 feet 6 inches long, ¾ inch wide at broadest part, tips much drawn out, obtuse and hairy, drooping, stout, glabrous and green above, closely appressed with short white hairs below mixed with minute dark green dots, sub-8-nerved, edges ciliate, slightly keeled, of a blackish colour for about three inches from base; base thick, dilated, 1½ inches wide, satiny within and densely shaggy on outside with long white hairs. *Male*, scape flexuous, erect or slightly cernuous, 4 inches long, very stout, obtusely triquetrous, densely silky; panicle short, stout, 6–8 inches long, composed of 6 stout short obtuse sub-sessile spikes, each 2 inches long and 1 inch wide, with a broadly ovate and very acuminate bract at the base of each spike, the lowermost bract 1 foot long; perianths sessile, densely crowded, white, ¾ inch long, with a single very narrow linear-acuminate light brown bracteole at base, shorter than segments of perianth; segments cut to base, glabrous, shaggy at bases, distant, 6–7 lines long, longer than anthers, narrow-linear-acuminate, very membranous, transparent, obsoletely 3–nerved, at first erect, afterwards wholly reflexed; filaments 3 lines long, white, very stout, broad and red at base, tapering, arising from bases of segments; anthers 2–2½ lines long, linear-acuminate, hastate, light brown; stigma plumose, sessile on a beak-like projection of disk. *Female* scape much smaller and more slender than male, slightly drooping; panicle composed of 4 (sometimes 5) rather distant racemes, each 2–2½ inches long, ½ inch wide; bracts same as in male but narrower; perianths free, shortly pedicelled, closely enclosing ovary below; segments cut half-way to base, very small, reflexed, with here and there minute rudimentary anthers; stigma sessile, somewhat trifid, papillose; ovary ovate-acuminate, cylindrical, glabrous, greenish-yellow.

Hab. Epiphytical on trees, east slopes of Ruahine mountain range, County of Waipawa; January, 1884: *Mr. A. Hamilton.*

3. *Astelia fragrans*, Col.* (Fruit).

Fruit large globular, orange-coloured with puckered sub-angled red tips (stigmatic points); calyx persistent, 6-lobed, large, free, thickened, saucer-

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* See "Trans. N.Z. Inst.," vol. xv., p. 333, for a full description of this species, without its fruit.

shaped, spreading, orange-coloured with dark margins; lobes very obtuse; 8 seeds in each berry; seeds black, smooth, shining, gibbous, curved, 1–1½ lines long, sharply and obsoletely and variously angled.

Obs. The coloured thick and spreading calyx of this species when the fruit is ripe has a very peculiar and novel appearance.

Order IX. JUNCEÆ.

Genus 1. **Juncus**, Linn.

1. *Juncus macrostigma*, sp. nov.

Plant large, loosely cæspitose in rather small isolated clumps, erect, dull green, sub-glaucescent, glabrous but not shining. Culms 3–5 feet high, cylindrical, stout, ¼-inch diameter, tips acuminate and sharp, very finely striate, pith continuous, each culm with several (4–5) membranaceous sheaths at the base, outer ones very small, innermost 8–10 inches long, appressed, very obtuse with a long hair-like mucro 2–3 lines long, sulcate, pale green above dark brown below; flowers lateral, numerous, pale, pedicelled and sessile, in close cymose heads and in sub-panicles on long sub-compressed and rigid peduncles, generally 3–4 main ones, one being much longer (2–3 inches) than the rest; bracts long, awned; bracteoles numerous, short, broadly obovate, sub-acute, sometimes acuminate, clasping, rugulose, pale; perianth lobes acute sub-acuminate, pale green with white membranous margins; stamens 6, anthers bright yellow; style short, distinct; stigmas 3, very long, stout, erect, twisted, spiral, plumose, light reddish-pink; capsule ovoid, pale, reddish at tips, shining, longer than perianth; seeds numerous, small, brown, turgid, oblong, irregular in shape, somewhat sub-lunate and gibbous, very finely striate and reticulated, testa produced at each end.

Hab. Sides of water-courses, Seventy-mile Bush, between Norsewood and Matamau, County of Waipawa; 1882: *W.C.* With other *Junci*, but not like them plentiful; flowering January and February.

Obs. In the flowering season its head of flowers presents a striking and pretty appearance, from their large and coloured pink stigmas and bright yellow anthers; very different from all our other *Junci*. Its affinity is, I think, with *J. vaginatus*, Br., and *J. pseudo-cyperus*, Linn.

Order XI. CYPERACEÆ.

Genus 13. **Uncinia**, Persoon.

1. *Uncinia nigra*, sp. nov.

Plant large, densely cæspitose. Culms stout, erect, 3 feet long, triquetrous, smooth. Leaves of equal length, ¼ inch wide, squarrose, very acuminate with hair-like tips, many nerved, margins finely and closely serrulate, glabrous below, scaberulous on upper surface, keeled, generally 4 leaves on a culm, sheathing below 6–12 inches from base; colour light green, brown towards base; spurious ligula bi-lunate or kidney-form. Spikelet 6 inches long, slender, upper portion 1½–1¾ inches male, bracts (often 3) leaf-like, long, outer 12–16 inches long 1 line wide, very filiform at tips, scabrid, crumpled towards top, fugacious; utricles decussate, distant on rhachis about 1 line apart, squarrose, black, 2½ lines long, spindle-shaped, truncate and striped at base, acuminate, shining; bristle 3½ lines long from tip of utricle, greenish; hook long, light brown, thickened and black at curve; glume narrow, narrower than utricle, linear-ovate-acuminate, 5½ lines long, obtuse, glabrous, shining, light brown with a thick central nerve, tri-nerved at base, fugacious; stigmas long, slender.

Hab. Skirts of low woods near Norsewood, County of Waipawa; March, 1884: *W.C.*

Obs. This plant wears a striking appearance when its fruit is ripe, widely different to that of its ripening state; for the light-coloured and long glumes having fallen away, the black and distant utricles stand out patent on the rhachis, which, in clear tranquil and undisturbed situations, arrests the eye immediately from their extreme novelty. The fruits, however, fall off at a very slight touch, often clinging disagreeably by their hooks to clothing, hair, etc.

Genus 14. **Carex**, Linn.

1. *Carex quadrangulata*, sp. nov.

Plant large, tufted, diffuse, dark green. Culms rather slender, 3 feet 6 inches long, drooping, smooth, glossy and finely striate, trigonous but 4-angled owing to the lower angle being double or channelled throughout, and scaberulous on both edges. Leaves shorter than culms, 2 feet 6 inches long, ¼ inch wide, channelled, linear, acuminate, margins and upper-surface finely scabrid, keeled, keel scaberulous. Spikelets few, under 1 inch long, the lower 2 single, distantly spiked along the culm, the upper and terminal one a short compound panicle, bearing the male spike at top, slender, 1 inch long; peduncles 3, 1½–2 inches long, erect and nodding, filiform, compressed, scabrid, with 2 small adpressed sheathing brown bracteoles; the 2 lower bracts very long, 12–15 inches, foliaceous, sheathing, with a small transverse scarious bracteole below aperture of sheath on the outside. Glumes as long as the utricles, broadly ovate, bicuspidate, awned with a stout central nerve, membranous at margins, light coloured minutely striped with red. Utricles short, about 1 line long, broadly ovate, turgid above, flattish beneath, bicuspid, scabrous on both margins near tip, glabrous, shining, dark brown. Stigmas 3.

Hab. Sides of water pools, open parts of the forest, Norsewood, County of Waipawa; 1884: *W.C.*

Class III. Cryptogamia.

Order I. FILICES.

Genus 5. **Hymenophyllum,** Smith.

1. *Hymenophyllum melanocheilos*, sp. nov.

Plant very small, creeping, glabrous, very thin, light green, cellules large; rhizome filiform. Fronds rather distant on rhizome, upright, simple and bifid, elliptic, linear and spathulate, obtuse, $\frac{1}{4}$–$\frac{3}{4}$ inch high, about 1 line wide, margins often thickened, black and shining; laciniate-serrate, serratures distant, sometimes dark and rigid, and shining like margins; midrib thick, glossy, dark like stipe, no lateral veins; stipe short, 1–2 lines long, not winged, glabrous, dark brown. Involucre single at tip of frond, elliptic, free, less than 1 line long, flattish, slightly convex; valves free to base, margins entire, black bordered; borders shining; receptacle included; sori few, large.

Hab. Woods, Whangaroa, County of Mongonui; 1884: *Mr. R. W. Rowson.*

Obs. A very peculiar little species, and one of the smallest known of the genus. Its affinity is with *H. marginatum*, Hook. and Grev., of Port Jackson, Australia (a scarce and little-known fern), from which species, however, it is very distinct. It has also some affinity with *H. parvifolium*, Baker, an East-Indian fern of about the same size, but is, also, quite distinct.

2. *H. lophocarpum*, sp. nov.

A climbing fern, mostly pendulous from upper parts of trees. Rhizome creeping, long, branched, hairy. Fronds rather distant on rhizome, glabrous, spreading, flat and slightly waved, transparent, light green when young darker in age, elastic and curled up when dry, rhombic- or ovate-acuminate, apical portion often narrow-elongate, usually dimidiate at base, 2$\frac{1}{2}$–4 inches long, twice the length of stipe, 3-pinnatifid; pinnæ alternate, sometimes very close and sub-imbricate, the lowest pinna solitary and very short; rhachises, main and secondary, dark, flexuose, finely tuberculate and striate, winged; wing wide and mostly waved; secondary segments, sub-flabellate, not branched on the lower or outer side; veins dark; ultimate segments or lobes rather long, linear, obtuse, apices rounded, nerves green not extending to margin; margins entire; cellules large, of various shapes and sizes, mostly sub-orbicular and oblong. Stipe stout, 1–1$\frac{1}{2}$ inch long, blackish, shining, striate, roughish, narrowly winged to base, and (with rhachis) slightly hairy (very hairy when young); hairs scattered, long, brownish, tortuous, jointed and transparent. Involucres free, large, sub-orbicular, loose, rumpled or bladdery, wider than lobes, turgid, much larger than sori, confined to upper portion of frond and extending to tip, but always supra-axillary and not terminal on lobes; valves free to base, convex, entire, sometimes slightly sinuate or uneven at tip, not toothed, largely crested, the upper one most so, with 3–4 erect lamellæ that are often high and nodding, and wider at apex than at base, not "spinulose" nor "spinuloso-dentate." Receptacle very short, ⅓ length of involucre, peduncled, clavate, finely puberulous, with sporangia only around the tip; sporangia few, very large, sessile; sporules globular, green, and enclosed in a fine transparent white membrane, separate from the sporangium.

Hab. On trunks and main branches of trees, hilly forests in the interior, Seventy-mile Bush, County of Waipawa; 1860–84: *W.C.*

Obs. I. This fern has the same peculiar and strong though not unpleasant odour that pertains to a few other of our New Zealand ferns, and to some of our foliaceous *Hepaticæ*, which odour it long retains, as well as its elasticity. It also stains paper, leaves of a book, etc., in which it is kept, of a dark colour, often leaving a faithful outline impression. In exposed dry situations, in hot dry weather, this fern will be seen dry and completely rolled up; but on rain falling it again recovers and expands, like some mosses. It is generally found much gnawed and eroded by insects, more so than other species of the genus (allured, probably, by its powerful odour), so that it is rather difficult to obtain fully-developed uninjured specimens.

Obs. II. I have long known this fern, and had early supposed it to be distinct from *H. polyanthos* and *sanguinolentum* (possibly merely as a variety or "sport," but still very distinct). During the last two years, however, I have been induced to pay more attention to it; to study and to examine it closely and repeatedly in the living state and in all stages in its native woods. An extra inducement thereto arose from my obtaining (in addition to the "Flora Novæ-Zelandiæ," and the several commoner works or compilations of ferns,) Hooker and Grev. Ic. Filicum, Swartz (original) Synopsis Filicum, Beddomes Ferns of British and Southern India. Van den Bosch Hymen. Java, and Clarke's Review of Ferns of Northern India, drawn up and aided at Kew (Trans. Linn. Soc. Lond. 1880: Botany, vol. i., part vii.), in all which works *H. polyanthos* and its allies and synonyms are particularly described and investigated. And the conclusion I have come to is, that this fern (*H. lophocarpum*) is really distinct from *H. polyanthos* and *sanguinolentum*, and also from their synonyms included as above. Indeed, in my opinion, there is no near affinity between this fern and *H. polyanthos*, Sw. (as that is fully given in description drawing and dissections by Hook. and Grev. in their Ic. Filicum, vol. ii., t. 128, which I take to be a type specimen of that species); *H. polyanthos*, Sw., being also a West-Indian (Jamaica) fern. Neither is there any close relationship between this fern (*H. lophocarpum*) and *H. protrusum*, Hook.; which species Baker has more recently (in his "Synopsis") united with *H. polyanthos*. While from *H. polyanthos* and *H. polyanthos*, *β. minor* (Bedd. Ferns Brit. India, tt. 280 and 306), *H. blumeanum*, *pycnocarpum*, and *integrum*, (Van den Bosch, Hymen. Java, tt. 36, 37, 38), which ferns Clarke unites with *H. polyanthos*, as being one species (?) and not even sub-varieties, —this fern of mine disagrees still more strongly. Of *H. sanguinolentum* I might say the same; but seeing it is not now recognized as a distinct species or variety by modern authorities, and omitted altogether by Baker from his "Synopsis;" while Swartz himself observed of it, that it was very near to his *H. clavatum* (another Jamaica fern), differing only in form and colour,—and both of these ferns were long ago included by Sir W. J. Hooker, in his "Sp. Filicum," as forming but one species with *H. polyanthos*—I have no need to remark especially upon it.

In fine: this species (*H. lophocarpum*) differs from *H. polyanthos* and its several synonymous allies (*supra*), in outline, in appearance, in colour, in substance both of stem and lamina of frond, in shape of segments and lobes, in position form and appendages of involucre, in the receptacle and sporangia, and in its peculiar hairs. In its fresh natural and perfect state, it is one of the very handsome New Zealand species of this lovely genus of ferns. I have thus written largely on it, after a prolonged and patient investigation, for the sake of future working botanists.

Genus 22. **Polypodium,** Linn.

1. *Polypodium rupestre*, Br., var. *sinuatum*, Col.

Rhizome long, rather stout, creeping, branched, climbing trees, scaly; scales ovate-acuminate, light brown, fixed by centre. Fronds scattered but not distant, erect, of 2 or more forms tapering into long and very slender stipes, somewhat coriaceous, margins recurved, veins largely anastomosing and visible between eye and the light, densely covered with white stellate hairs; hairs 10–11-rayed with brown centres, giving the plant a finely spotted appearance; barren fronds 4–5½ inches long, 1–1¼ inches wide, rhomboid- and oblong-lanceolate, coarsely sinuate, almost crenate; fertile 8–8½ inches long, 8 lines wide, broadly lanceolate, margins sinuate, tips sub-acute; stipes of both barren and fertile fronds 2 inches long, with a thick cluster of imbricated scales at bases; base-scales ovate-acuminate, minutely tuberculate. Sori rather small, often oblong, and distant.

Hab. On living trees, woods, Seventy-mile Bush, between Matamau and Danneverke, County of Waipawa; 1883–84 (also in woods, East Coast): *W.C.*

Obs. A very fine and striking variety (as I take it) of the well-known and common *Polypodium rupestre*; it is not only a much larger plant than that, but it is also thinner, and sori smaller often oblong and less prominent, more hairy on both surfaces, and stellate hairs with a larger number of rays; the copious scales too are different. When I first detected this plant in the woods on the East Coast in 1846, I noticed only a few specimens, and I thought it was only a "sport" of *P. rupestre*; but where I lately found it, it was very plentiful.

Order IV. MUSCI.

Genus 41. **Bartramia**, Hedwig.

1. *Bartramia readeriana*, sp. nov.

Stems densely tufted, tall, robust, ascending, $\frac{1}{3}$-inch diameter, $1\frac{1}{2}$–$3\frac{1}{2}$ inches long, vaguely dichotomously branched, thickly tomentose with red branched and implexed tomentum; branches above fascicled, strict, almost glabrous, red. Leaves spreading (some are truly divaricating, at first spreading then bent downwards), pale yellow-green, shining, with a short sheathing base, ovate-lanceolate, acuminate, gradually narrowed into a very long hair-like point, serrulate to tips, plaited, minutely papillose, twisted (to the right) when dry contorted; nerve slender, percurrent; cells dense, linear, the marginal at the base larger oblong and translucent; perichætial leaves broader with lax cells. Fruitstalk 1–$1\frac{1}{2}$ inches high, erect, red, shining. Capsule large, inclined or horizontal, ovoid, grooved when dry; operculum convex, apiculate; teeth red; spores very minute. Calyptra 2 lines long, narrow, blackish at tip, apiculate. Inflorescence diœcious; antheridia capitulate.

Hab. Among *Hepaticæ* on dry elevated ridges, open woods, Seventy-mile Bush, between Norsewood and Danneverke, County of Waipawa; 1882–84: *W.C.*

Obs. I. A species allied to *B. pendula*, *sieberi* and *comosa*; differing from *pendula*, mainly in the very long points of the leaves, that are twisted when dry and papillose, and in the erect capsule; from *sieberi*, in the shining long-pointed and twisted leaves; and from *comosa* in the long-pointed, twisted and broader leaves, which are serrulate throughout, its densely tomentose stems, and apiculate operculum; and from all three species, also, in the translucent marginal cells at the base of leaves. It appears, however, to be nearest to this last species—*comosa*.

Obs. II. This species seems to be scarce; hitherto I have only detected it in two similar open ridgy spots, growing two-thirds concealed among dense and erect pale *Hepaticæ* (*Mastigobryum*, sp. nov.?); and then only in small quantities, and rarely found in fruit, although I have visited those places some twenty times in hopes of finding good fruiting specimens. From its dense and shaggy tomentum, and intermixed habit among the *Hepaticæ*, and aged appearance, it seems to be of very slow growth.

Obs. III. I have with pleasure named this species after Mr. F. Reader (formerly of Blenheim, New Zealand, but now of Victoria), an amiable, persevering and unassuming young botanist, and diligent collector of plants, especially mosses; which Order he has long made his particular and close study, and that from pure love of nature, and not for mere pecuniary gain.

Genus 71. **Hookeria**, Smith.

1. *Hookeria trichophora*, sp. nov.

Plant small, under 1 inch high, densely tufted, stems erect; branches red, stout, $\frac{1}{2}$–$\frac{3}{4}$ inch long, simple and branched above, rooting below. Leaves minute, $\frac{1}{3}$ of a line long, sub-quadrifarious, oblong-orbicular, acuminate, serrulate half-length down from tip, nerve about half-through; crisp when dry; cells very small above, increasing in size downwards from apex of nerve and very large at base; perichætial erect, sub-ovate-lanceolate, acuminate. Fruitstalk erect, $\frac{1}{2}$–$\frac{3}{4}$ inch long, longer than stems, flexuous, smooth, red, springing from below the base of a branch, thickened and rooting at base. Capsule oval, inclined or horizontal, sub-apophysate, reddish, beak long, curved upwards. Calyptra white, fimbriate at base, tip black and hairy; hairs loose and very long,

Hab. In patches on rotten trunks, deep and wet forests, Norsewood, County of Waipawa; 1884: *W.C.*

Obs. A species having some affinity with *H. apiculata* and *rotundifolia;* differing from the former in its nerve and small cells; and from the latter by its small cells and white and hairy calyptra.

2. *Hookeria sciadophila*, sp. nov.

Plant 1–1½ inches high, sub-flabellate, bipinnately branched, thickly tomentose below on main stems with branched red-brown hairs; branches flat, compressed, 3–4 lines wide, slightly concave, dark below, branchlets and leaves closely imbricate. Leaves sub-quadrifariously disposed, broadly elliptic, round at tips, above 1 line long, spreading, flat, light green, nerve extending nearly to margin, margin entire and very thin; cells small in regular hexagons in the upper portion, and in very large oblong-hexagons at lower half of nerve and base of leaf; perichætial small, ovate, nerve stronger and cells larger. Fruitstalk lateral, springing from base of branchlets, 3 lines long, black, flexuous, shining, incrassated at base with a sheathing ring; 2–3 together on a branchlet. Capsule oblong, sub-erect, regularly and finely reticulate; operculum conical, beak long. Calyptra small, glabrous, very acuminate, tip black, slightly and finely lacerate at base.

Hab. On the ground, sides of deep narrow watercourses, dark forests near Norsewood, County of Waipawa; 1883–84: *W.C.*

3. *Hookeria luteo-vivens*, sp. nov.

Plant largely gregarious, stout, sub-erect, 2–2½ inches high, dichotomously branched above, branches sub-compressed, 5–6 lines wide, stem stout, dark brown. Leaves sub-quadrifariously disposed, oblong-orbicular, 2 lines long, obtuse and rounded at tip, dorsal and ventral smaller and more orbicular, minutely papillose, thin, margins entire, light green, whitish and yellowish at tips, slightly convex, densely imbricated; nerve short, forked, slender, green, largely cellular; cellules (of leaf) large, sub-orbicular, smaller at margins and apex, larger and oblong at base; perichætial erect, small, sub-rhombic, nerveless. Fruitstalk stout, 1¼ inches long, smooth, flexuous, twisted, slightly sulcate, dark brown, thickened at base. Capsule oblong, reddish, smooth (minutely reticulate under a lens), cernuous, slightly tuberculate at base; tubercles few and mostly above, round, smooth; cells of capsule large, oblong; external teeth 4-lined longitudinally, pretty closely trabeculate, strongly denticulate, reddish. Calyptra large scabrid, whitish, ragged at base.

Hab. Sub-pendulous on sides of shaded cliffs, in large patches, but rarely fruiting, in forests, Seventy-mile Bush, County of Waipawa; 1883–84: *W.C.*

Obs. A fine species having affinity with *H. quadrifaria*, but differing in several particulars.

4. *Hookeria lophophora*, sp. nov.

Stems simple and slightly once-branched, flat, sub-erect, 1½ inches high, 4 lines broad, thickly clothed between leaves with large red branched transparent and jointed hairs. Leaves pale, densely imbricated, sub-quinquefariously disposed, the lateral ones spreading, crisp when dry, broadly oblong-apiculate, 2 lines long, very thin, transparent, margined, upper portion sharply serrulate; nerve forked; dorsal and ventral similarly shaped but smaller; cells lax, orbicular-hexagonal in the upper part of leaf, larger and oblong-hexagonal in the central and lower part; perichætial oblong, very acuminate. Fruitstalk springing from near the top of stem, 2½ lines long, stout, pale, hairy; hairs short, patent; much fimbriate at top; fimbriæ erect, crest-like, nodding over apophysis. Capsule apophysate, inclined or horizontal, sub-obovate, turgid, red, finely reticulated, shining, tuberculate at base; apophysis dark brown. Calyptra not seen.

Hab. In dry woods, hill country near Napier.

Obs. A species allied to *H. cristata.*

Order V. HEPATICÆ.

Genus 25. **Noteroclada**, Taylor.

1. *Noteroclada perpusilla*, sp. nov.

Plant very small creeping, densely compact, under 1 inch long, 2 lines wide, branched, branches very short about ½ inch long, deeply pinnatifid or sub-pinnate, glabrous, glistening, light green; midrib or stem stoutish, and clothed beneath with purple-brown rootlets ; leaves or lobes, sub-flabellate, under 1 line diameter, very thin, transparent, minutely crenulate on upper margin, closely imbricated at base free above ; involucral leaves paler, longer, and lacerate at tips ; areolæ minute but prominent, sub-rhomboid-orbicular, more oblong in involucral leaves ; stipule 0 ; perianth terminal and sub-terminal on short lateral branchlets, cylindric, oblong, whitish, mouth gaping, jagged, often two together closely adjoining at tip ; peduncle rather stout, striate and septate, 3 lines long ; capsule globular, minutely pitted, at first purple afterwards brown, bursting irregularly, 3–4 valves ; valves sub-rhombic-ovate, lacerate, minutely reticulate.

Hab. Among mosses, etc., shady banks, Scinde Island, Napier ; August, 1883 : *W.C.*

Genus 26. **Petalophyllum**, Gottsche.

1. *Petalophyllum australis*, sp. nov.

Rhizome short, stout, fleshy, with fine hair-like rootlets. Frond single, procumbent, sub-rotund, 6–8 lines diameter, reflexed, sub-bilobed, largely lamellate waved and crisped above, nerved below, margin sinuate and finely crenulate, colour bright light green with reddish-brown margins ; perianth large, bell-shaped, open, crisped, mouth much laciniate ; peduncle stout, 1¼ inches long, white, succulent, very tender ; capsule large, globular, more than 1 line diameter, dark brown, finely pitted, bursting irregularly and raggedly, bearing large brown tessellated markings ; sporules circular and tuberculated ; elaters geminate, twisted and truncate.

Hab. Among mosses and *Hepaticæ*, Petane, near Napier ; 1883 : *Mr. Hamilton.*

Obs. A rather scarce, or, from its smallness, overlooked plant, possessing pretty close alliance with the single British species *P. ralfsii*, which it also resembles. I have only seen 3 specimens that I picked out from among mosses and *Hepaticæ.*

Genus 30. **Symphyogyna**, Mont. and Nees.

1. *Symphyogyna crispula*, sp. nov.

Plant terrestrial, single, stipitate, erect, dark green. Frond dichotomous, flabellate, 6–8 lines long, 9–12 lines broad, segments broadly-linear, 2 lines wide, very obtuse, deeply emarginate, distantly serrate above and in sinuses but not below, undulate and crisped, wide at base and broadly decurrent on stipe ; cellules large, elliptical, nerves dark brown, stout, extending to base of apical notch. Stipe dark brown, ½ inch long, stout, flexuose, with fine rootlets at base. Involucral scale on upper surface at main forks and scattered on nerves, several on a frond, middle size, 1¼ lines wide, papillose, very laciniate ; laciniæ irregular and transversely barred. Calyptra stout, 2 lines long, shortly peduncled, sub-clavate, finely papillose, light green, largely fimbriate at mouth ; fimbriæ red, stout, truncate, barred.

Hab. Bases of wet and shaded cliffs, sides of the River Mangatawhainui, near Norsewood, County of Waipawa; May, 1884: *W.C.*

Obs. A species allied to *S. melanoneuron* and *vulgaris* ("Trans. N.Z. Inst.," vol. xvi., pp. 351, 352), but distinct from both.

2. *Symphyogyna flavo-virens*, sp. nov.

Plant terrestrial, densely gregarious and compact (like moss), stipitate, erect, single, very light green. Frond small, once forked, diverging and irregular, 3–4 lines long, 6–7 broad, sub-flabellate, each fork having 2–4 short segments, segments narrow, linear, about 1 line wide, round at tips and deeply emarginate, slightly and distantly serrate, much undulated and crisped, truncate and incurved at base concealing scale, not decurrent on stipe; cellules large, sub-quadrate-orbicular; nerves same colour as frond and not extending to base of notch. Stipe stout, flattish, sub-succulent, light pink, $\frac{3}{4}$–1 inch long, very flexuous, 2-nerved, thickened and rooting at base. Involucral scale on upper surface at main forks, 1–2 on a frond, very small, ovate, laciniate. Calyptra large, erect, 4 lines long, cylindrical, whitish, generally extending beyond margin of frond, mouth laciniate and fimbriate. Seta slender, 1 inch long. Capsule linear-oblong, apiculate, 2 lines long, dark brown, finely longitudinally striate.

Hab. Shady sides of hills, west side of Ruataniwha Plains, County of Waipawa; 1884: *Mr. H. Hill.*

Genus 32. **Aneura**, Dumort.

1. *Aneura polyantha*, sp. nov.

Plant green, small, creeping, spreading, very flat, effuse, but often forming a circular patch about 1–1½ inches diameter, radiating from the centre: fronds flattened, thickish, scarcely branched, pinnatifid, lobes rounded, obtuse, crenately cut, generally broadest at apices and sub-flabellate. Calyptras very numerous, 20–40 close together, arising from the centre of the plant, sometimes 2–3-fascicled, above 1 line in height, brownish-white, cylindrical, minutely and much tubercled. Seta nearly 1 inch long; capsule linear-oblong, brown, smooth, segments rather long with numerous and large elaters at tips.

Hab. On denuded rotten branches, in dense wet woods near Norsewood, County of Waipawa; May, 1884: *W.C.*

Obs. A pretty and very distinct little species: its numerous upright calyptras standing so close together give it a curious sub-coralloid appearance.

2. *Aneura biflora*, sp. nov.

Plant spreading, effuse, crisp, waved and rumpled, sub-imbricate; branchlets 1–1½ inches long, sub-obovate, somewhat pinnatifid, lobes sub-rotund, round at tips, finely and regularly denticulate, with numerous short brownish rootlets beneath. Calyptra 5 lines long, cylindrical, slightly rugulose, broader towards top, hairy about tip; hairs short, patent; mouth small, contracted, much tuberculated at base, springing from frond in pairs, greenish-white at first, brownish-white in age.

Hab. Epiphytical on *Hookeria* (sps.) and other mosses and *Hepaticæ*, but easily separated; growing low down in sides of dark water-courses, hill forests, near Norsewood, County of Waipawa; 1883–84: *W.C.*

Obs. A species near to *A. orbiculata*, and *imbricata*, MIHI: "Trans. N.Z. Inst.," vol. xvi., p. 359.

Genus 39. **Anthoceros,** Micheli.

1. *Anthoceros pellucidus*, sp. nov.

Plant prostrate, spreading, effuse, 2–6 inches diameter, densely imbricate, thin, transparent, fragile, crumpled, minutely tuberculate, light green, cells large, nerveless, with a few very fine rootlets at the extreme base: fronds $\frac{1}{2}$–$1\frac{1}{2}$ inches broad at top, mostly narrow at base, sub-flabellate, more or less branched or deeply laciniate at top, irregularly lobed; lobes largely crenate or rounded at tips, margins free, sub-erect, finely and irregularly torn and sub-fimbriate; some fronds are very narrow, $\frac{1}{2}$–2 lines wide, pinnatifid (like *Aneura multifida*). Involucre stout, conical, finely tuberculated near base, generally 3 or more arising from centre of a frond, 1–2 lines high, lips sub-bivalve, scarious. Capsule linear very narrow, almost filiform, arcuate, 3 lines long, light brown, dehiscing centrally on both sides and then margins reflexed, cohering at tips; columella exceedingly fine; spores light brownish-green; elaters large, numerous. Gemmæ, little oblong dark green bodies immersed and scattered in the frond. Apparently the seeds and filaments are at first contained in a thin transparent membrane around the columella, which is soon ruptured.

Hab. On rotten logs in dark wet woods, spreading over and adhering to other small *Hepaticæ*, mosses, dead twigs, etc., near Norsewood, County of Waipawa; 1882–84: *W.C.*

ORDER VII. LICHENES.

Genus 5. **Sphærophoron,** Persoon.

1. *Sphærophoron vividulum*, sp. nov.

Thallus sub-cæspitose, with a few small scales at the base, erect, flat, 1–$1\frac{1}{2}$ inches high, main stem 1–3 lines wide and unbranched below, sub-palmate and dichotomous above, very smooth and slightly convex on the upper surface, rugulosely pitted on the lower, edges entire, whitish beneath, light green above when living, but a dull olive-green when dried; upper branchlets numerous, very narrow $\frac{1}{30}$–$\frac{1}{40}$ inch wide, sub-linear-clavate, ultimate segments cuneate-truncate, obconic, and spathulate, narrower at bases, having a sub-articulated appearance like some species of *Corallina*. Apothecia very small on slightly raised hemispherical receptacles just below the edge of the ultimate segments, usually two apart—one at each angle, sometimes three on a broad, and one only central on a narrow, segment; at first light brown, closed, with a finely puberulent covering, afterwards the minute ostiole opens, and the black shining capitulum is protruded.

Sometimes the thallus is largely coloured bright red on both surfaces, as if red ink had been splashed over it; this colour is permanent.

Hab. On trunks of *Fagus solandri*, forests near Norsewood, County of Waipawa; 1880–84: *W.C.*

Obs. I have known this pretty species for many years, but always (until this year) barren. Specimens that I had long ago sent to England in that state, were supposed to be small ones of *S. australe*, Laur. (*S. compressum*, Ach.), but I never could bring myself to believe it, the difference being so great between them, especially when closely compared together in a living state. It is, however, very rarely found in fruit, like some of its European congeners.

2. *Sphærophoron* (?) *stereocauloides*, Nyl.

Plant ascending, bushy, diffuse, 8–10 inches diameter; height 4–5 inches; main stems very stout, sub-cylindrical, ½ inch circumference near base, 6–8 springing separately from one root-stock or thick and flat broad disc 1 inch diameter; spreading, prostrate, naked below and adhering by fresh large rooting discs; much and thickly branched above, transversely and finely fissured; branches flattish, sub-flabellate, and dichotomous, naked here and there on upper and under surfaces but not on the sides; general colour greyish-white, stems more white with a light pinkish tinge; branchlets numerous crowded, densely covered with many short compound spurs or branchlets, composed of cylindrical and sub-angular obtuse and clavate fibrils that are patent sessile and fascicled, and sometimes coalescent, bearing at tips small black circular soredia. Apothecia large, globular, 1–3 lines diameter on tips of branches, mostly solitary sometimes 2–3 together, much broader than branch or peduncle, which is naked, sub-terete and lacunose, 1–2 lines long; receptacle cernuous, smooth and naked or slightly lacunose on the outside, bursting irregularly, containing numerous globose black rough spores entangled in a mass of thin flat hairs; "diameter of spores ·01 mm" (Dr. Knight). *Sph. robustum*, Col.

Hab. Stony declivities in hilly forests, west side of highway, Seventy-mile Bush, County of Waipawa; 1882: *W.C.* And on east slopes of Ruahine Range (same county): 1884: *Mr. A. Hamilton.*

Obs. This fine Lichen has given Dr. Knight and myself some study and research. Believing it to be another new species of this small and peculiar genus, I early referred a specimen of it to Dr. Knight's superior judgment, who agreed with me that it was a new species, and closely allied to *Sphærophoron stereocauloides* of Nylander. Subsequently, however, on my forwarding larger and better specimens to Dr. Knight, and on his re-examination of them, he found the plant to be identical with the species named by Nylander (*supra*), which Lichen Dr. Knight had himself sent in 1868 from New Zealand to Nylander, and it was published by him in the "Flora," No. 5, 1869 (a French serial). Notwithstanding, from that work being so little known here (Dr. Knight, the original publisher of the plant, not having republished it), and the plant itself so fine and rare and new to us—with, also, some differences as to size, etc., between Dr. Nylander's and my own measurements and descriptions—I bring it now forward, together with Dr. Nylander's description, kindly transcribed for me by Dr. Knight, from the foreign botanical work above-mentioned.

"*Sphærophoron stereocauloides.* Thallus ei pallidus v. albidus, dendroideo-ramosus, teres, (altit. 10–12 centimetrorum et trunco primario basi crassit. circiter 2 mm.) cortice sat conferte transversim supra diffracto, ramis et ramulis fibrillis teretibus, divisis vel ramosis conferte minutis; apothecia in receptaculis subglobosis inclusa; sporæ globosæ vel subglobosæ, diam. 0·008 ad 0·01 mm. Legit *Dr. Knight.*"

Order VIII. FUNGI.

Genus 69. **Xylaria,** Fries.

1. *Xylaria polytricha,* sp. nov.

Sub-succulent, fleshy, black and densely hairy; hairs rigid, patent. Stem 1 inch long, cylindrical, rather stout. Receptacle obovate, and spathulate, 6–7 lines long, 3–4 lines broad, thickish, margins sinuate above, tip obtuse, deeply and broadly grooved on one side, obtusely keeled on the other: some specimens are shortly 2-lobed at top, lobes cylindrical, tips round; others have a small obovate and sessile head, or lobe, springing laterally from stroma low down; perithecia not visible; hairs (*sub lente*) brown-black, lanceolate, twisted, acute.

Hab. On the earth among mosses, etc., at Glenross, near Napier; 1884: *Mr. D. P. Balfour.*

Obs. A species having affinity with *X. castorea,* Berk., originally discovered in forests in this same locality; and also with a few of Montagne's South American species.

Art. XXVIII.—*A List of Fungi recently discovered in New Zealand.*

By W. Colenso, F.L.S.

[*Read before the Wellington Philosophical Society, 1st October, 1884.*]

Last year (1883) I detected several peculiar and interesting Fungi in the woods and glens of the Seventy-mile Bush, Waipawa County, that were new to me; these, with a few others already known but rare, I exhibited at two of the ordinary meetings of the Hawke's Bay Philosophical Institute held in 1883; and although I knew the genera of some of them, yet in order the better to ascertain their generic and specific distinctions and positions in this very intricate *Order* of plants, I forwarded specimens to Sir J. D. Hooker at Kew. From him I have lately received a list of them, kindly drawn up by that eminent fungologist, Dr. Cooke, which list I now give, together with a few brief and plain popular notes concerning those species now for the first time found in this country.

And here I may observe, that out of 26 distinct species forwarded in this little lot to Kew, 21, belonging to 20 genera, have been now detected in New Zealand; yet of these no less than 19 species are known from other countries, mostly the Old World; so that there are only two really new species in the whole lot!

This circumstance, however, is neither strange nor unexpected; for in the *Annales des Sciences Naturelles* an account has been given by M. Montagne of the Fungi transmitted from Juan Fernandez by Bertero, consisting of 56 species; of these there is scarcely more than a third which are not referable to well-known European species,—and only one which requires the formation of a new genus for its admission. So, also, of those numerous species of Fungi described by Sir J. D. Hooker in the "Handbook of the New Zealand Flora," a large proportion of them are European and cosmopolitan.

Sir J. D. Hooker, in his accompanying letter to me, remarks on this curious incident, saying:—"While many of them are already well-known to science from other countries; on the other hand, almost all the species you have now sent are new to the islands of New Zealand, and thus give an idea how vast a number of widely distributed forms remain to be collected."

1. *Polyporus exiguus*, sp. nov.

A small semi-stipitate flabellate whitish fungus, of horizontal growth, among mosses, on the bark of old trees near their bases; wet woods near Norsewood, Waipawa County; 1883: *W.C.*

2. *P. fomentarius*, Fr.

This species of fungus is the real *Amadou* or German Tinder, and is very generally distributed over the globe. Berkeley says of it (*Introduction to Crypt. Botany*) that "it is one of the few undoubted instances of fungus occurring in a fossil state. . . . In the Kew Museum a British specimen may be seen together with one from Sikkim, the accordance of the two being quite perfect" (p. 252). Again: "*P. fomentarius* not only supplies *Amadou*, but has been manufactured into coarse clothing" (p. 364). And, such being the case, it almost leads me to doubt the specific identity of the New Zealand plant, because this plant is excessively hard and tough to cut or break—requiring an axe; and while it grows to a tolerably large size, 5–7 inches, flat, irregular, and overlapping (*stratum super stratum*), it is not very thick; evidently of slow growth, perennial and aged, of a bright yellow-brown colour, and somewhat resembling a slab or cake of gingerbread. Owing to its excessive hardness, I could only with my knife secure a small portion as a specimen. On trunks of *Fagus solandri*, but not common; dry hilly woods near Norsewood; 1883: *W.C.*

3. *Hydnum alutaceum*, Fr.

A tawny prostrate effuse plant, growing in large patches on bark of trees; woods, with No. 1; 1883: *W.C.*

4. *Irpex zonatus*, B. and Br.

A small tawny-orange semi-stipitate sub-flabellate fungus, often gregarious and imbricate, and sometimes prostrate and effuse (apparently 2–3 vars.), growing among mosses and dead logs, same forests with the preceding (Nos. 3 and 1); 1883: *W.C.*

5. *Stereum lugubris*, sp. nov., Cooke.

This is a most peculiar and elegant plant; pileus 1–3 inches broad, sessile, lateral, thin, rumpled, and zoned above with alternate grey and black bands, growing profusely and closely imbricated, sub-horizontal and pendulous—resembling small epaulettes,—a pretty sight. On dead trunk of *Fagus solandri*, in river bed (high and dry) near Norsewood; but though very plentiful there, only noticed on that one tree*; 1883: *W.C.*

6. *Dictyonema æruginosa*, Ag.

A small effuse horizontal species, over-running mosses, etc., belonging to a curious and tropical genus, long considered to be an *Alga*. In woods, with Nos. 1 and 2; 1883: *W.C.*

7. *Cyphella discoidea*, Cooke.

A small circular fungus adnate on long-rooted cat's-ear (*Hypochæris radicata*), in fields, Napier; 1881–83: *W.C.*

8. *Clavaria acuta*, Sow.

A curious minute stipitate white clavate fungus, growing in little patches among *Hepaticæ*, but not common; on earth, sides of shady cuttings near Norsewood; 1883: *W.C.*

9. *Tremella albida*, Huds.

A small erect white foliated gregarious fungus, gelatinous when fresh; on rotten logs, in wet dark woods near Norsewood; 1883: *W.C.*

10. *Puccinia malvacearum*, Corda.

On leaves of mallow (*Malva sylvestris*), in my paddock, Napier; 1881–83: *W.C.*

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* As this is a species nova, and possibly but little known here among us, I may remark that, in form and appearance, it is much like those *sp. nov.* of the same genus from Queensland, recently described by Berkeley and Broome in "Transactions Linn. Soc. London," 2nd series, Botany, and figured in tab. 46, vol. i., and in plate 14, vol. ii.

11. *Tilmadoche nutans*, Pers.

A curious minute simple stipitate fungus bearing a globular head of perithecia, having a greyish semi-metallic appearance when fresh and before bursting; growing in small patches among *Hepaticæ*, etc., on rotten logs, open skirts of woods near Norsewood; 1882: *W.C.* Glenross; 1883: *Mr. D. P. Balfour.*

12. *Aspergillus glaucus*, Lk.

On fruit of black currant (*Ribes nigrum*); gardens, Waipukurau; 1882–83: *W.C.*

13. *Fusisporium miniatum*, B. & C.

A minute cinnabar-red fungus, sessile, gregarious in round dots, on dead logs of *Fagus solandri*, in river-bed near Norsewood; 1883: *W.C.*

14. *Peziza* (*Hymenoscypha*) *scutula*, P.

A minute stipitate fungus, parasitical on leaf of *Knightia excelsa*; wet woods with No. 9; (apparently very scarce); 1883: *W.C.*

15. *Solenia candida*, Fr.

A peculiar looking small horizontal effuse scurfy whitish fungus, full of transverse fissures, spreading on rotten logs; woods, with preceding; 1883: *W.C.*

16. *Xylaria filiformis*, Fr.

An extraordinary plant! at first horizontal, of effuse pink or pink-red hyssoid growth, and forming vermicular-like markings, adhering closely to dead leaves (matrix); afterwards erect long wiry black and flexuose (like stout hairs), bearing large moniliform perithecia: originally found on west flank of Ruahine mountain range, emerging from dead leaves of *Coriaria ruscifolia*, but barren; 1850: *W.C.*: and in fruit at Glenross; 1883: *Mr. D. P. Balfour.*

17. *Sphærostilbe cinnabarina*, Tul.

A minute orange-red circular and convex sessile fungus, found growing gregariously in little scattered masses about roots of living trees, woods near Norsewood; a curious and elegant plant; 1883: *W.C.*

18. *Valsa* (*Fuckelia*) *turgida*, Fr.

A peculiar looking large prostrate spreading whitish fungus, the stroma (resembling the crustaceous thallus of a lichen of the *Graphidei* tribe) having scattered dark-umber linear perithecia, 1–2 lines long, erumpent and bursting; on the bark of a dead tree, dry hilly woods near Norsewood; (only one large patch noticed); 1883: *W.C.*

19. *Antennaria scoriadea*, B.

This peculiar fungus assumes two forms:—1. When young, spreading in long dark ribbon-like lines over mosses, etc., as if laid on with a brush; very plain when wet but scarcely visible when dry: 2. On bark of living trees, bristly, black, horizontal, 1–1½ inches long, of dense bushy growth, perennial, bearing moniliform fruit. Woods near Norsewood, also near Matamau; 1883: *W.C.*

20. *Hemiarcyria serpula*, Rtfi.

This is a most curious small fungus; a substance that, at first sight, might well be taken for some small smooth worm, coiled up and hybernating; it is orange-coloured, smooth, vermicular (in size, like small pieces of vermicelli, or coloured silk cord), soft and tender, so as to make it difficult to preserve a good specimen. Found under large foliaceous lichens (*Stictæ*), on rotten logs, dry elevated woods near Norsewood; (but scarce); 1883: *W.C.*

21. *Chroolepus aureum*, Ag.

A curious small reddish woolly convex and spreading fungus, forming little cushions, adnate on lichen (*Thelotrema*) on bark of living *Dacrydium cupressinum*; forest between Matamau and Danneverke, Waipawa County; 1883: *W.C.* (N.B.—The colour changes to light green in drying and keeping.)

The following more or less rare Fungi (but already collected in New Zealand, see "Handbook of the New Zealand Flora"), were also in the lot, viz.:—

Polyporus australis, Fr.
Thelephora pedicellata, Schw.
Stereum lobatum, Kze.
Guepinia spathularia, Fr.
Secotium erythrocephalum, Tul.

Art. XXIX.—*Description of new Species of Native Plants.*

By D. Petrie, M.A.

[*Read before the Otago Institute, 11th November, 1884.*]

Coprosma rubra, n. sp.

A laxly or densely branched shrub, 4–10 feet high; branches slender divaricating, marked by numerous transverse rings; bark of younger branches reddish-brown, smooth; the ultimate twigs pubescent.

Leaves variable in size, ¼–¾ inch long, ⅙–½ inch wide, rounded-oblong, acute, thin, pale below, veins and reticulations evident, narrowed into a rather long flat glabrous petiole.

Stipules minute.

Flowers lateral on the branchlets.

Males solitary or fascicled: calyx absent, but replaced by a cupular membranous unequally four-lobed involucel: corolla bell-shaped, four-partite.

Females solitary or loosely aggregated; calyx adnate to the ovary, tubular, limb shortly 4- or 5-toothed; corolla tubular below, 4-partite, the lobes recurved; styles rather slender.

Drupe rounded-oblong, $\frac{1}{4}$ inch long, pale yellow when ripe.

Hab. Dunedin, mostly in woods.

In woods this species resembles in foliage and habit *C. rotundifolia*, A. Cunn. In open situations the leaves are always much reduced in size, and are of a darker hue. Many twigs are in the latter situations almost destitute of leaves, but produce a profusion of flowers. The prevailing forms in open situations are of a much more decided divaricating habit than the lax forms occurring in shady situations.

I think the species has hitherto been confounded with *C. rotundifolia*, A. Cunn.; but its berry is never didymous and the bark and foliage are different. Some of the forms appear also to have been included in the group of species and varieties that goes by the name of *C. divaricata*, A. Cunn.

Lepidium kawarau, n. sp.

An erect much-branched leafy species, 5–12 inches high, diœcious, glabrous or with sparse whitish hairs.

Radical leaves numerous, 3–5 inches long, primatisect, on short flat petioles, the segments distant linear lobed above and rarely below also.

Lower cauline leaves similar to the radical but smaller, passing gradually into linear, sessile toothed or entire forms towards the top.

Racemes terminal; flowers imperfect, minute, on short slender pedicels.

Males somewhat larger than the females, with four small petals and a mere rudiment of an ovary without style or stigma.

Females usually apetalous and with rudimentary stamens.

Pods ovate-orbicular, $\frac{1}{8}$ inch long, emarginate; style distinct.

Hab. Kawarau River, near Victoria Bridge, Cromwell; "Earthquakes," near Duntroon. The Duntroon forms are almost pubescent.

This species has been erroneously included by Mr. T. Kirk, F.L.S., in his *Lepidium australe*, which he describes as having perfect flowers. My species is, however, diœcious. The error has no doubt arisen from the very imperfect condition of the specimens I was possessed of when his Review of the New Zealand *Lepidia* was being prepared. Since then I have procured excellent specimens, and have grown the Duntroon form in my garden. The seedlings of the Kawarau form have all been male, and have borne no fruit.

This species of *Lepidium* is greedily eaten by sheep, and it is only in spots to which sheep cannot get ready access that specimens are now to be gathered.

ART. XXX.—*Description of three new Species of* Uncinia.

By D. PETRIE, M.A.

[*Read before the Otago Institute, 12th August*, 1884.]

1. *Uncinia laxiflora*, n. sp.

A DENSELY tufted species.

Culms 14 inches to 2 feet high, slender, trigonous, scabrid towards the top.

Leaves as long as or rather longer than the culms, very narrow ($\frac{1}{32}$–$\frac{1}{12}$ inch wide), flat or concave, slightly scabrid, the expanded bases sheathing the lower part of the culm.

Spikelet very lax-flowered, slender, $2\frac{1}{2}$–$3\frac{1}{2}$ inches long; bract leafy, setose, or none.

Glumes distant, green, lanceolate, sub-acute, shorter than the utricle.

Utricle plano-convex, linear oblong, tapering at both ends, with numerous faint nerves; bristle half the length of the utricle.

Hab. Owake Flat near Catlin's River (P. Goyen); Stewart Island; Buller Valley (T. F. Cheeseman).

This species is closely allied to the next *U. rigida*, mihi. It is also allied more remotely to *U. filiformis*, Boott, and *U. cæspitosa*, Boott. The latter as described in the "Handbook" appears to include several distinct forms, of which this is probably one. *U. cæspitosa*, Boott, is there said to be very variable, but I do not find it so. I have never gathered specimens of it in Otago, or indeed elsewhere than in the North Island.

2. *Uncinia rigida*, n. sp.

A densely tufted species.

Culms 16–30 inches high, rather stout, terete, slightly scabrid towards the top.

Leaves as long as or rather shorter than the culms, flat or trigonous, $\frac{1}{16}$–$\frac{1}{12}$ inch broad, strongly keeled, scabrid.

Spikelets very uniform, 2–$2\frac{1}{2}$ inches long, rather slender, bract leafy, twice as long as the spikelets.

Glumes ovate-lanceolate, obtuse or acute, laxly imbricate, brownish, with scarious margins.

Utricle slightly longer than the glumes, fusiform, plano-convex, tapering at both ends, brownish, with numerous faint nerves, the bristle nearly as long as the utricle.

Hab. Blueskin, Waitahuna, Lawrence, Roxburgh.

This species has very close affinity with *U. laxiflora*, mihi. It differs in habit, in the shorter, more uniform, stouter and less lax-flowered spikelets, and in the size of the utricle. Intermediate forms may connect these two species into one variable series. This appears to form part of *U. cæspitosa* of the Handbook.

3. *Uncinia purpurata*, n. sp.

A species of sparse growth.

Leaves much shorter than the fullgrown culms, grassy, concave or flat, $\frac{1}{20}$–$\frac{1}{15}$ inch wide, slightly scabrid.

Culms twice as long as the leaves or more, rather slender, wiry, terete, smooth.

Spikelets $\frac{3}{4}$–$1\frac{1}{2}$ inch long; bract none.

Glumes closely imbricate, broadly ovate, obtuse or subacute, dark brown with white margins, strongly keeled, shorter than the utricle. Utricle ovate-oblong, plano-convex, tapering above, dark brown but paler at the top, with numerous faint veins; bristle incurved as long as the utricle.

Hab. Signal Hill, Dunedin.

Var. *robusta*. Leaves as long as the culms, flat, scabrid.

Culms stouter, shorter, slightly scabrid towards the top.

Spikelets with male portion shorter, very variable in length $\frac{1}{2}$–$2\frac{1}{2}$ inches.

Glumes and utricle as in typical form.

Hab. Maungatua, Taieri.

This very distinct species stands close to *U. rubra*, Boott. The forms which I have placed under var. *robusta* differ widely in habit from the typical form of the species, and may yet prove sufficiently distinct to be worthy of specific rank. In the meantime, relying on the likeness of the spikelets, I prefer to regard them as a variety of the species described.

Art. XXXI.—*Description of a new Species of* Carmichælia, *with Notes on the Distribution of the Species native to Otago.* By D. Petrie, M.A.

[*Read before the Otago Institute, 12th August*, 1884.]

Carmichælia compacta, n. sp.

A low dense much-branched somewhat spreading shrub, rarely exceeding 4 feet in height, the ends of the stouter branches giving off a profusion of slender wiry terete leafless grooved twigs.

Leaves not seen.

Flowers abundant, $\frac{1}{5}$ inch long, in compact glabrous 3–8-flowered racemes, the peduncles 4 or 5 times the length of the calyx, springing from the axil of a subulate scale, and bearing two acuminate bracts a little below the calyx.

Calyx tumid 5-toothed, with a wide shallow sinus between the teeth.

Corolla white and pink, rather large.

Ovary glabrous. Pod boat-shaped, obovate in outline, $\frac{1}{5}$ inch long, nearly twice as long as broad, flattened, transversely wrinkled, upturned at the tip, which suddenly contracts and ends in a short semi-erect subulate beak; grey or brownish-grey, when quite ripe.

Seeds small solitary (rarely two in a pod), reniform, grey mottled with dark brown or black.

Hab. Kawarau Gorge and Dunstan Gorge, Clutha River, Otago.

This species has close affinity to *C. juncea*, Col.

The species of *Carmichælia* native to Otago appear to be the following:—

1. *C. crassicaulis*, Hook. f.
2. *C. nana*, Colenso.
3. *C. grandiflora*, Hook. f.
4. *C. odorata*, Col.
5. *C. flagelliformis*, Col.
6. *C. juncea*, Col.
7. *C. kirkii*, Hook. f.
8. *C. uniflora*, Kirk.
9. *C. compacta*, mihi.
10. *C. enysii* (?), Kirk.

Of these *C. crassicaulis* appears to be confined to the Hawkdun and Mount Ida Ranges, and a triangular area extending southwards from them to the Lammerlaw. I believe it grows also on the Waitaki side of the ranges named. I have never seen it elsewhere in Otago. It is a common plant in the localities where it is met with.

C. nana has a wide range in the north and interior of Otago, and extends to the coast in the Kakanui and Waitaki River valleys. It grows chiefly in shingly and alluvial flats, where it is often very abundant, and its strong matted roots and creeping stems form an obstacle to breaking-up the ground.

C. grandiflora is reported from the Lake District by Hector and Buchanan, but I have never gathered it there, or indeed elsewhere in Otago. My visits to the interior have, however, always been late in the season.

C. odorata is common in the Maniototo and Manuherikia Plains and also in the central and higher parts of the Clutha Valley. It grows up to 2,500 feet in the neighbourhood of Naseby.

C. flagelliformis is the usual form in the south of Otago and near the coast from Oamaru to Foveaux Straits. It is very plentiful in the Tuapeka District and also on the ridges north of Balclutha.

C. juncea extends inland from Palmerston South to the Lake District, It grows chiefly in alluvial tracts, and not rarely in almost pure shingle. Its specific name is a very appropriate one.

C. kirkii I have gathered at Otepopo and in valleys of the Rock and Pillar Range near Hyde. Mr. Kirk's discovery of it in Cardrona Valley shows that it has a wide range. No doubt it will ere long be found in other intermediate stations.

C. uniflora is reported from the Lower Waitaki Valley by Mr. Buchanan.

C. compacta I have seen only in the Clutha Valley, between Lake Wakatipu and Clyde, where it is the commonest species.

C. enysii (?) I believe grows on spurs of Mount Ida and near the Eweburn Creek, but, as I have no specimens in my herbarium, this point must remain for the present unsettled.

I quite agree with Mr. Kirk's opinion that *C. australis* does not occur in Otago. At any rate I have never gathered any form which I could refer to this species, and I have collected assiduously.

It is a characteristic of several New Zealand genera of plants that two or more species often grow side by side in the same locality. This may be well seen in the genera *Coprosma*, *Olearia*, *Celmisia*, *Epilobium*, and *Veronica*, among others. It holds to a certain extent in *Carmichælia* also.

In the Maniototo Plain *C. crassicaulis*, *C. odorata*, and *C. nana* grow side by side, while *C. juncea* and *C. enysii* (?) both grow in suitable localities in the same district. Many a square mile could be selected there containing all of the foregoing. So *C. odorata* and *C. compacta* grow side by side throughout the area in which the latter is known to occur.

Near Otepopo *C. kirkii* and *C. flagelliformis* flourish in the same locality, the former being, however, much the rarer.

Of the Otago species *C. flagelliformis* is the most isolated, and the widest ranging. *C. odorata* and *C. nana* have also a wide range, chiefly in the drier parts of the province. *C. juncea* stands next in extent of range, though it does not in this respect surpass the much rarer *C. kirkii*. *C. crassicaulis*, *C. compacta*, and *C. enysii* (?) are the most local and restricted in their distribution.

I think it probable that another new species of *Carmichælia* will be found in Otago, as I have forms of a very distinct character which I cannot refer to any described species. Ampler materials may enable me ere long to throw more light on these anomalous specimens.

ART. XXXII.—*On the Botany of Te Aroha Mountain.* By J. ADAMS, B.A.

[*Read before the Auckland Institute, 29th September,* 1884.]

TE AROHA Mountain stands at the head of the Thames Valley on the right bank of the Waihou River. Its height is 3,176 feet, and thus it is the highest mountain north of the Lower Waikato River.

At a distance it appears to be a continuation of the Coromandel Range; but a nearer examination shows that it is an isolated mountain, and, from a botanical point of view, more closely allied to Karioi and Pirongio on the west side of the Waikato Plains than to the high mountains of the Thames District.

The mountain is somewhat of a pyramidal shape. The side of the base facing the river runs north-west and south-east. On this side, towards its northern end, there are a number of hot springs and mineral springs, with a considerable formation of stalagmite, which is constantly precipitated from the waters of the springs.

The town of Te Aroha is built close to these springs. At the southern end of the same base line at a distance of three miles is situated the township of Wairongomai, so called from the stream that flows from the north-east along another side of this irregular pyramid.

The mountain rises on all sides in a very steep incline; but forms a series of broad plateaux from the base to the summit. At each succeeding plateau in the ascent, a change takes place in the vegetation. The traveller's joy (*Clematis indivisa*), tataka (*Melicope ternata*), titoki (*Alectryon excelsum*), kowhai (*Sophora tetraptera*), tea-tree (*Leptospermum scoparium*), ramarama (*Myrtus bullata*), puketea (*Laurelia novæ-zealandiæ*), mangeao (*Litsæa calicaris*), which are abundant near the base of the mountain, are gradually replaced, at higher elevations, by the different species of maire (*Olea cunninghamii, O. lanceolata, O. montana*), by totara (*Podocarpus totara*), rimu (*Dacrydium cupressinum*), kauri (*Agathis australis*). These again are replaced at higher elevations by neinei (*Dracophyllum latifolium*), pahautea (*Libocedrus bidwillii*), tanekaha (*Phyllocladus alpina*). There are some plants, such as kotukutuku (*Fuchsia excorticata*), kohekohe (*Dysoxylum spectabile*), and taua (*Bulschmudia taua*), that are abundant from the base almost to the summit.

Indeed *Fuchsia excorticata* appears to grow as well on the summit of the mountain as on the banks of the Wairongomai Creek.

A very remarkable change takes place in the vegetation about 700 feet from the top of the mountain.

The rimu, *Ixerba*, *Quintinia*, and tawhero are suddenly exchanged for groves of neinei from fifteen to twenty feet high, and straggling trees of tanekaha (*Phyllocladus alpina*) and of pahautea (*Libocedrus bidwillii*).

The plants peculiar to the broad but irregular summit of the mountain are *Panax sinclarii*, *P. colensoi*, *Coprosma colensoi*, *Dracophyllum latifolium*, *D. urvilleanum*, *Myrsine salicina*, *Fagus menziesii*, *Libocedrus bidwillii*, *Phyllocladus alpina*, *Hymenophyllum pulcherrimum*, *H. malingii*. To these ought to be added *Cordyline indivisa* according to the unanimous testimony of Maoris, but I could not find it.

The humidity of the top of the mountain makes it one of the most favourable localities for ferns; not only for luxuriance of growth, but also for variety of species. This reference to the wonderful natural fernery on the north-west slope, near the trig. station, will appear very tame and common-place to any botanist who has the good fortune to visit the locality on a fine day.

The flowering plants, which are characteristic of the high peaks of the Thames Range, are not found on Te Aroha Mountain. The absence of *Melicytus lanceolatus*, *Phebalium nudum*, *Corokia buddleoides*, *Metrosideros albiflora*, *Panax discolor*, *Gaultheria rupestris*, and *Archeria racemosa* shows a botanical distinction between the Thames Range and that of Te Aroha.

At the altitude of 2,000 feet on the hillside were observed *Olea cunninghamii*, *O. lanceolata*, *O. montana*, *Fagus menziesii*, *F. fusca*, and some beautiful specimens of *Todea superba*. This plant, which grows at 1,200 feet from the summit of Te Aroha, is found within a few yards of the summit of Pirongia.

Rimu (*Dacrydium cupressinum*) grows plentifully at the same level, and it is now being rapidly cut up for timber to be used in connection with the mines. There are a few kauris (*Agathis australis*) scattered over the hill side, which increase in number on descending to an altitude of 500 feet; but on the left side of the Wairongomai there is a large kauri forest.

The most abundant plant on the hill side, spreading over damp rocks and forming a dense network in every mountain rill, is parataniwha (*Elatostemma rugosum*), of which not a specimen exists in the Thames district.

The plain at the foot of the mountain is very favourable to a variety of plants, as it is diversified by long elevated mounds, wide swamps, the stony beds of rapid streams, and the calcareous formation near the hot springs, In the latter locality there are two plants, *Chenopodium glaucum* and *Cotula coronopifolia*, not found elsewhere at Te Aroha. The abundance and variety of native grasses are much less near the springs than four years ago. It may be said of the plain generally that it contains several plants not found in the Thames district, as *Potentilla unserina*, *Myrtus pedunculata*, *M. ralphii*, *M. obcordata*, *Teucridium parvifolium*, *Cladium articulatum*, *Eleocharis sphacelata*, *Ophioglossum lusitanicum*. The sedges mentioned are very abundant.

On a secondary range, lying to the right of the old Maori track from Wairongomai to Katikati, and elevated about 900 feet above the plain, I was pleased to find two lakes, one of which appears to be 10 chains long and 1 chain wide.

The borders of this lake are not swampy, and the middle of it appears to be deep. The Maoris informed me that it was a favourite place for fishing for eels. It is frequented by wild ducks and river gulls. Here I found *Myriophyllum robustum*, *Aristotelia fruticosa*, *Myrtus pedunculata*, *Eugenia maire*, *Dacrydium intermedium*, in addition to the ordinary hill vegetation.

On the dividing range between Wairongomai and Katikati I found no plants different from those found on Te Aroha Mountain except *Celmisia longifolia*.

I was so struck with the difference of the vegetation of Te Aroha Mountain from that of the dividing range between the Thames and Tairua Districts that I made an excursion to the high hills between Waihi and Waitekauri, which are separated from Te Aroha Mountain by the Waihi Plains, in order to discover where the rare plants on the Coromandel Range end. On the sides and summit of Te Paua I found *Panax discolor* and *P. anomalum*, but not *Archeria racemosa* nor the other plants peculiar to the main range. It appears evident that the true Coromandel Range, of which Whakairi, Kaitarakihi, and Pakerarahi are high peaks, does not even extend to Waihi, but probably ends near Whangamata, at the head of the Tairua River.*

The plants that are found at Te Aroha and not found in the Thames district, are *Aristotelia fruticosa*, *Potentilla anserina*, *Myriophyllum robustum*, *Myrtus ralphii*, *M. obcordata*, *M. pedunculata*, *Teucridium parviflorum*, *Phyllocladus alpina*, *Elatostemma rugosum*, *Libocedrus bidwillii*, *Eleocharis sphacelata*, *Cladium articulatum*, *Hymenophyllum pulcherrimum*, *H. malingii*, *Todea superba*, *Ophioglossum lusitanicum*. This list no doubt does not include all those not found in the Thames District, but so far as it goes there is an

* This statement has been verified by a recent visit to the head of the Tairua River. Here the main range rises into Mount Ngapuketurua, 2,275 feet in height, which is clothed with the same vegetation as the other high mountains on the Coromandel Range. There is the same abundance of *Panax discolor*, *Archeria racemosa*, and *Dacrydium intermedium*. In fact, it is essentially a part of Whakairi from a botanical point of view. I found *Melicytus lanceolatus* and *Coprosma fœtidissima* at a somewhat higher elevation than the kauri forest, but not abundant. These two plants appear to spread vigorously some years after the mountain forest has been partly cleared. It is worthy of remark that the five high peaks—Mamaepuke, Whakairi, Kaitarakihi, Pakerarahi, and Ngapuketurua—have all immense kauri forests near the base of the respective mountains, and that these forests extend on a moderately steep incline from the main range to the east coast.

appearance of southern species and a disappearance of some species of *Pittosporum*, of *Panax*, and of heaths. This disappearance of plants closely allied to those of Northern Australia, and the appearance of South Island species, appears to bear upon the theory of the land connection of New Zealand with Australia and with the Antarctic Continent before the glacial period; but in a paper like the present, the plain duty of the writer is to state what he knows and to avoid all theoretical subjects.

In my last paper I mentioned that a *Celmisia* found at Table Mountain differed from the description of *Celmisia longifolia* in the Handbook. There is also a *Celmisia* growing on parts of the dividing range at Te Aroha, which is no doubt a variety of *Celmisia longifolia*, but the following descriptions of both plants will, I think, show that the Whakairi plant is a different species.

Celmisia, sp. Whakairi.

Leaves 4–7 inches long ·7 inch broad lanceolate acuminate flat, distantly toothed. Upper surface dull green almost glabrous. Under surface, cottony, tomentose except the midrib, which is light brown glabrous raised above the leaf, and forms when dry a conspicuous band ·07 inch wide. The leaves are sometimes purple at the base. *Scapes* 7–8 inches long rather weak, bracts leafy. *Involucral scales* silky subulate green. *Rays* few ·75 inches long, ligules broad. *Pappus hairs* yellow brown, weak, ·2 inch long. *Achene* brown glabrous, ·15 inch long.

Celmisia longifolia. Te Aroha.

Leaves, 3½–4 inches long, ·1 inch broad, revolute, covered with a grey tomentum, especially on the under surface, rather coriaceous, uniform in colour to the base. *Scapes* rather stiff, cottony; bracts linear. *Involucral scales* cottony; points brown. *Rays* many, ·5 inch long. *Pappus hairs* numerous, stiff, ·3 inch long. *Achene* glabrous, white, ·25 inch long.

The following list of plants, observed at Te Aroha, cannot be regarded as complete; for although I made two visits to the district, they were both in the month of January. This will partly account for the few orchids observed, as they flower early, and at a later season are easily overlooked. Indeed, the presence of *Myrtus ralphii* and *M. obcordata* mentioned above, but not included in my list, rests on the testimony of my friend Mr. Cheeseman, who observed several plants not seen by me. My exploration of the mountain commenced at an elevation of about 2,000 feet, where I was cataloguing for some days before I visited the base or the summit, and this led me to remark on the locality of the plants in my catalogue, as the absence of some plants and the presence of others on the mountain side were to me alike surprising.

Catalogue of Flowering Plants and Ferns observed at Te Aroha Mountain.

Clematis indivisa, Willd. On the mountain side.
C. hexasepala, DC. Outskirts of the forest.
Ranunculus plebeius, Br. Outskirts of the forest.
R. rivularis, Banks and Sol. Flat and marshy ground.
Drimys axillaris, Forst. Ascending to high elevations.
Nasturtium palustre, DC. Low and damp places.
Cardamine hirsuta, Linn. Outskirts of forest.
C. stylosa, DC. Outskirts of forest.
Viola filicaulis, Hook. f. Marshy ground.
Melicytus ramiflorus, Forst. Ascending to high elevations.
Pittosporum tenuifolium, Banks and Sol. Near banks of streams on the flat.
P. umbellatum, " " " " "
P. crassifolium, " " " " "
P. cornifolium, A. Cunn. High elevations.
Stellaria parviflora, Banks and Sol. Low levels near mountain streams.
Hypericum japonicum, Thunb. Flat and marshy ground.
Aristotelia racemosa, Hook. f. Widespread.
A. fruticosa, Hook. f. Mountain lake.
Elæocarpus dentatus, A. Cunn. Common at high elevations.
Geranium dissectum, Linn. On mounds in the flat.
G. microphyllum, Hook. f. On mounds in the flat.
Pelargonium australe, Willd. Common on low grounds.
Oxalis corniculata, Linn. Common on low grounds.
Melicope ternata, Forst. Outskirts of forest.
M. simplex, A. Cunn. Low ground, banks of streams.
Dysoxylum spectabile, Hook. f. Ascending more than 2,000 feet.
Pomaderris phylicifolia, Forst. On the flat.
Alectryon excelsum, DC. Outskirts of the forest.
Corynocarpus lævigata, Forst. Outskirts of the forest.
Coriaria ruscifolia, Linn. Along Wairongomai Creek.
Carmichælia australis, Br. Banks of Waihou.
Sophora tetraptera, Aiton. Outskirts of the forest.
Rubus australis, Forst. Outskirts of the forest.
Potentilla anserina, Linn. On the flat.
Acæna sanguisorbæ, Vahl. On the flat.
Quintinia serrata, A. Cunn. Mountain top.
Q. elliptica, Hook. f. Mountain top.
Ixerba brexioides, A. Cunn. Mountain top.
Carpodetus serratus, Forst. Ascending to high elevations.
Weinmannia sylvicola, Banks & Sol. Ascending to high elevations.

W. racemosa, Forst. Mountain top.
Drosera binata, Labill. Low and swampy ground.
D. auriculata, Backhouse. On the flat.
Haloragis alata, Jacq. Outskirts of the forest.
H. tetrogyna, Labill. On the flat.
H. depressa, Hook. f. At high elevations.
H. micrantha, Br. On the flat.
Myriophyllum elatinoides, Gaudichaud. Wet places on the flat.
M. variæfolium, Hook. f. Streams near Waihou.
M. robustum, Hook. f. Mountain lake.
Callitriche verna, Linn. Swampy places.
Leptospermum scoparium, Forst. Outskirts of the forest.
L. ericoides, A. Rich. Mountain sides.
Metrosideros florida, Sm. Ascending to high elevations.
M. diffusa, Smith. Ascending to high elevations.
M. hypericifolia, A. Cunn. Ascending to high elevations.
M. scandens, Banks & Sol. Ascending to high elevations.
Myrtus bullata, Banks & Sol. Outskirts of forest.
M. pedunculata, Hook. f. Near mountain lake.
Eugenia maire, A. Cunn. Near mountain lake.
Fuchsia excorticata, Linn. Ascending to summit.
Epilobium nummularifolium, A. Cunn. Near streams in the flat.
E. alsinoides, A. Cunn. Near streams in the flat.
E. rotundifolium, Forst. Near streams in the flat.
E. glabellum, Forst. On the mountain side.
E. tetragonum, Linn. On the mountain side.
E. junceum, Forst. On the mountain side.
E. pubens, A. Rich. In marshy places on the flat.
E. billardierianum, Seringe. In marshy places on the flat.
E. pallidiflorum, Sol. In marshy places on the flat.
Hydrocotyle asiatica, Linn. In marshy places on the flat.
H. dissecta, Hook. f. Near banks of streams.
H. pterocarpa, F. Muell. On dry mounds on the flat.
H. novæ-zealandiæ, DC. On dry mounds on the flat.
H. moschata, Forst. On the mountain side.
Daucus brachiatus, Sieber. On the flat.
Panax simplex, Forst. Summit of the mountain.
P. edgerleyi, Hook. f. Dividing range.
P. crassifolium, Dcne. and Planch. Mountain side.
P. colensoi, Hook. f. Mountain side.
P. arboreum, Forst. Ascending to the summit.

P. sinclairii, Hook. f. Summit of the mountain.
Schefflera digitata, Forst. Mountain side.
Griselinia lucida, Forst. Mountain side.
G. littoralis, Raoul Choix. Mountain side.
Alseuosmia macrophylla, A. Cunn. Mountain side.
Coprosma lucida, Forst. Ascending to high elevations.
C. grandifolia, Hook. f. Ascending to high elevations.
C. robusta, Raoul. Ascending from the flat to 1,500 feet.
C. spathulata, A. Cunn. Mountain side.
C. rotundifolia, A. Cunn. On the flat.
C. fœtidissima, Forst. Ascending to high elevations.
C. colensoi, Hook. f. Summit.
Nertera dichondræfolia, Hook. f. Mountain lake.
N. cunninghamii, Hook f. On the flat.
Galium tenuicaule, A. Cunn. On the flat.
Lagenophora forsteri, DC. On the flat.
L. petiolata, Hook. f. On the dividing range.
Olearia cunninghamii, Hook. f. Outskirts of the forest.
O. albida, Hook. f. On the flat.
Celmisia longifolia, Cass. On the dividing range.
Gnaphalium luteo-album, Linn. Near streams in the flat.
G. involucratum, Forst. Near streams in the flat.
Raoulia australis, Hook f. Mountain streams.
R. tenuicaulis, Hook. f. Gravelly beds of streams.
Cotula coronopifolia, Linn. Near hot springs only.
C. australis, Hook. Waysides.
Erechtites arguta, DC. Upper course of Wairongomai Creek.
E. prenanthoides, DC. Upper course of Wairongomai Creek.
E. quadridentata, DC. Upper course of Wairongomai Creek.
Senecio glastifolius, Hook. f. Summit of the mountain.
Brachyglottis repanda, Forst. Wairongomai Creek.
Taraxacum dens-leonis, Desf. Hot springs.
Sonchus oleraceus, Linn. Mountain sides.
Pratia angulata, Hook f. Mountain streams.
Lobelia anceps, Thunberg. Not common on the flat.
Wahlenbergia gracilis, A. Rich. On the flat.
Gaultheria antipoda, Forst. High elevations.
Cyathodes acerosa, Br. High elevations.
Leucopogon fasciculatus, A. Rich. High elevations.
L. fraseri, A. Cunn. Mounds on the flat.
Epacris pauciflora, A. Rich. Mounds on the flat.

Dracophyllum latifolium, A Cunn. Abundant near the summit.
D. menziesii, Hook. f. Abundant near the summit.
D. urvilleanum, A. Rich. Growing on rocks near the summit.
Myrsine salicina, Heward, M.SS. Mountain side.
M. urvillei, A.DC. Mountain side.
Olea cunninghamii, Hook. f. Numerous at an elevation of 2,000 feet.
O. lanceolata, Hook. f. Numerous at an elevation of 2,000 feet.
O. montana, Hook. f. Numerous at an elevation of 2,000 feet.
Parsonsia albiflora, Raoul. Mountain sides.
P. rosea, Raoul. Mountain sides.
Geniostoma ligustrifolia, A. Cunn. Mountain sides.
Calystegia sepium, Linn. Common on the flat.
Dichondra repens, Forst. Near the banks of Waihou.
Solanum aviculare, Forst. Upper course of Wairongomai Creek.
S. nigrum, Linn. Outskirts of the forest.
Veronica salicifolia, Forst. Common on the flat.
Rhabdothamnus solandri, A. Cunn. Outskirts of forest.
Vitex littoralis, A. Cunn. Mountain side.
Teucridium parviflorum, Hook. f. River banks.
Chenopodium glaucum, Linn. Hot springs.
Polygonum minus, Huds. River bed.
P. aviculare, Linn. In streams near River Waihou.
Muhlenbeckia adpressa, Lab. On the flat.
M. complexa, Meisn. Upper course of Wairongomai Creek.
Piper excelsum, Forst. Outskirts of the forest.
Peperomia urvilleana, A. Rich. Outskirts of the forest.
Hedycarya dentata, Forst. Mountain side.
Laurelia novæ-zealandiæ, Hook. f. Outskirts of forest.
Bulschmudia tarairi, Hook f. Mountain side.
B. taua, Hook f. Ascending to high elevations.
Litsæa calicaris, Hook. f. Outskirts of the forest.
Persoonia toro, A. Cunn. Mountain side.
Knightia excelsa, Br. Mountain side.
Pimelea prostrata, Vahl. Along the beds of streams in the flat.
Loranthus tetrapetalus, Forst. At high elevations.
Fusonus cunninghamii, Hook. f. Mountain sides.
Parahophis mycrophyllis, Raoul Choix. Along River Waihou.
Elatostemma rugosum, A. Cunn. Mountain sides.
Fagus menziesii, Hook. f. Summit of the mountain.
F. fusca, Hook. f. High elevations.
Libocedrus bidwillii, Hook. f. Near the summit.

Phyllocladus glauca. High elevations.
P. trichomanoides, Don. High elevations.
P. alpina, Hook. f. Summit of the mountain.
Dacrydium cupressinum, Soland. High elevations.
D. intermedium. Mountain lake.
Podocarpus ferruginea, Don. Mountain side.
P. totara, A. Cunn. Mountain side.
P. dacrydioides, A. Rich. Along the banks of Waihou.
Agathis australis, Lambert. Mountain side.
Earina mucronata, Lindl. High elevations.
E. autumnalis, Hook. f. High elevations.
Dendrobium cunninghamii, Lindl. High elevations.
Bolbophyllum pygmæum, Lindl. High elevations.
Sarcochilus adversus, Hook f. High elevations.
Corysanthes triloba, Hook. f. Near the summit.
C. oblonga, Hook. f. Near the summit.
C. rotundifolia, Hook. f. Near the summit.
C. rivularis, Hook. f. Mountain side.
Chiloglottis cornuta, Hook. f. Mountain side.
Pterostylis banksii, Brown. Mountain side.
Thelymitra longifolia, Forst. On the flat.
Orthoceras solandri, Lindl. Outskirts of the forest.
Libertia ixioides, Sprengel. Outskirts of the forest.
L. micrantha, A. Cunn. Near the summit.
Freycinetia banksii, A. Cunn. Mountain side.
Typha angustifolia, Linn. Marshy places in the flat.
Sparganium simplex, Huds. Marshy places in the flat.
Potamogeton natans, Linn. In streams and ponds.
P. polygonifolius. In streams and ponds.
Rhipogonum scandens, Forst. Ascending to high elevations.
Callixene parviflora, Forst. Near the summit.
Cordyline australis, Hook. f. On the flat.
C. banksii, Hook. f. Summit of the mountain.
C. indivisa, Kunth. Not seen but doubtless growing on the mountain.
C. pumilio, Hook f. Near the summit.
Dianella intermedia, Endl. Outskirts of the forest.
Astelia cunninghamii, Hook. f. Ascending to high elevations.
A. solandri, A. Cunn. Ascending to high elevations.
A. banksii, A. Cunn. On the summit of mountain.
A. grandis. On the summit of mountain.
A. trinervia. Near the summit.

Arthropodium candidum, Raoul. Near mountain streams.
Phormium tenax, Forst. Low and marshy ground.
P. colensoi, Hook. f. Outskirts of the forest.
Areca sapida, Soland. Mountain side.
Juncus communis, E. Meyer. Low grounds.
J. planifolius, Br. Mountain side.
J. bufonius, Linn. Mountain side.
J. holoschœnus, Br. Mountain side.
Cyperus ustulatus, A. Rich. On the flat.
Eleocharis sphacelata, Br. Swampy ponds.
E. acuta, Br. On the flat.
Scirpus riparius, Br. Wet places on the flat.
S. inundatus, Br. Wet places on the flat.
S. nodosus, Br. Wet places on the flat.
S. lacustris, Linn. Wet places on the flat.
S. maritimus, Linn. Wet places on the flat.
Isolepis prolifer, Br. Wet places on the flat.
Schœnus axillaris, Hook. f. Outskirts of the forest.
S. tendo, Banks and Sol. Dividing range.
S. brownii, Hook. f. Mountain side.
Lepidosperma australe, Labill. Mounds on the flat.
Cladium articulatum, Br. Swamps on the flat.
Cladium glomeratum, Br. Low swampy places.
C. teretifolium, Br. Mountain lake.
C. junceum, Br. On the flat.
Gahnia setifolia, Hook. f. Outskirts of the forest.
G. hectori. High elevations.
G. lacera, Steudel. Mountain sides.
G. arenaria, Hook. f. On the dividing range.
Uncinia australis, Persoon. Mountain side.
U. ferruginea, Boott. Mountain side.
U. rupestris, Raoul. Mountain side.
U. banksii, Boott. Outskirts of the forest.
Carex virgata, Solander. On the flat.
C. gaudichaudiana, Kunth. Low and swampy places.
C. ternaria, Forst. Low and swampy places.
C. forsteri, Wahlenberg. Outskirts of the forest.
C. pseudo-cyperus. Swampy places.
C. dissita, Solander. Swampy places.
C. vacillans, Solander. Mountain side.
Microlæna stipoides, Br. On the flat.

M. avenacea, Hook. f. Mountain side.
M. polynoda, Hook. f. On the flat.
Hierochloe redolens, Br. Swamps.
Paspalum distichum, Burman. Swamps.
Isachne australis, Br. Swamps.
Echinopogon ovatus, Palisot. Pasture land on the flat.
Dichelachne crinita, Hook. f. Pasture land on the flat.
D. sciurea, Hook. f. Pasture land on the flat.
Sporobolus indicus, Br. Pasture land on the flat.
Deyeuxia billardieri, Br. Near hot springs.
D. avenoides, Hook. f. Near hot springs.
D. youngii, Hook. f. High grounds.
D. quadriseta, Br. On the flat.
Arundo conspicua, Forst. Swamps.
Danthonia semi-annularis, Br. Outskirts of the forest.
Deschampsia cæspitosa, Palisot. Low grounds.
Glyceria stricta, Hook. f. Mountain side.
Poa anceps, Forst. Mountain side.
Triticum multiflorum, Banks and Sol. Pasture land on the flat.
Gymnostichum gracile, Hook. f. Mountain side.
Gleichenia dicarpa, Br. In swampy ground.
G. flabellata, Br. Mountain side.
G. cunninghamii, Heward. Mountain side.
Cyathea medullaris, Swartz. Mountain side.
C. dealbata, Swartz. Mountain side.
Hemitelia smithii, Hook. f. Mountain side.
Dicksonia squarrosa, Swartz. Mountain side.
D. lanata, Col. in Tasm. Journ. Mountain side.
Hymenophyllum rarum, Br. Near the summit of the mountain.
H. polyanthos, Swartz. Near the summit of the mountain.
H. javanicum, Wallich. Near the summit of the mountain.
H. demissum, Swartz. Near the summit of the mountain.
H. flabellatum, Labill. Near the summit of the mountain.
H. scabrum, A. Rich. Near the summit of the mountain.
H. dilatatum, Swartz. Near the summit of the mountain.
H. rufescens, Carmichael. Near the summit of the mountain.
H. malingii, Hook. On the summit.
H. tunbridgense, Smith. On the summit.
H. multifidum, Swartz. Common on the mountain.
H. bivalve, Swartz. Common on the mountain.
H. minimum, A. Rich. Summit.

Trichomanes reniforme, Forst. Summit.
T. humile, Forst. Near the summit.
T. strictum, Menzies. Rocky elevated places.
Davallia novæ-zealandiæ, Col. Outskirts of the forest.
Lindsæa trichomanoides, Swartz. Mountain side.
Adiantum affine, Willdenow. Outskirts of the forest.
Adiantum fulvum, Raoul. Outskirts of the forest.
A. hispidulum, Swartz. On the flat.
Hypolepis tenuifolia, Bernhardi. Mountain side.
Pellæa rotundifolia, Forst. On the flat.
P. falcata, Br. Outskirts of the forest.
Pteris tremula, Br. Outskirts of the forest.
Pt. aquilina, Linn. On the flat.
Pt. scaberula, A. Rich. Mountain side.
Pt. macilenta, A. Rich. Outskirts of the forest.
Pt. incisa, Thunberg. Mountain side.
Lomaria patersoni, A. Cunn. Mountain side.
L. discolor, Willdenow. Mountain side.
L. lanceolata, Sprengel. Mountain side.
L. procera, Sprengel. Hot springs.
L. filiformis, A. Cunn. Mountain side.
L. nigra, Colenso. Mountain streams.
L. fluviatilis, Sprengel. Mountain side.
L. membranacea, Colenso. Mountain side.
L. fraseri, A. Cunn. Mountain side.
Doodia media, Br. On the flat.
Asplenium obtusatum, Forst. On the flat.
A. falcatum, Lamarck. Mountain side.
A. hookerianum, Colenso. Swampy places on the flat.
A. bulbiferum, Forst. Mountain side.
A. flaccidum, Forst. Mountain side.
A. lucidum, Forst. Mountain side.
Aspidium richardii, Hook. Outskirt of the forest.
A. oculatum, Hook. Mountain side.
A. capense. Near the summit.
Nephrodium decompositum, Br. Mountain side.
N. hispidum, Hook. Mountain side.
Polypodium punctatum, Forst. Mountain side.
P. pennigerum, Forst. Mountain side.
P. australe, Mettenius. Mountain side.
P. grammitidis, Br. On trees at high elevations.

P. tenellum, Forst. On trees at high elevations.
P. cunninghamii, Hook. On trees at high elevations.
P. billardieri, Br. On trees at high elevations.
P. rugulosum, Labill. Mountain side.
Todea hymenophylloides, Presl. Mountain side.
T. superba, Hook. At an elevation from 2,000 feet to 2,600 feet.
Schizæa bifida, Swartz. High elevations.
Lygodium articulatum, A. Rich. Mountain side.
Ophioglossum lusitanicum, Willdenow. Near swamps.
Botrychium ternatum, Swartz. Banks of streams in the flat.
Lycopodium varium, Br. Near the summit.
L. billardieri, Spreng. Mountain sides.
L. densum, Labill. On the dividing range.
L. laterale, Br. High elevations.
L. clavatum, Linn. High elevations.
L. volubile, Forst. High elevations.
Tmesipteris forsteri, Endlicher. High elevations.

ART. XXXIII.—*Description of a new Species of* Erigeron.

By J. BUCHANAN, F.L.S.

[*Read before the Wellington Philosophical Society, 13th February*, 1884.]

Plate XV.

Erigeron novæ-zealandiæ, Buch. Pl. xv.

A SMALL semi-shrubby plant 7–8 inches high, whole plant viscid. Leaves very narrow imbricating linear-spathulate obscurely and distantly serrate, 1½–2½ inches long, ⅕–¼ inch broad, obtuse or acuminate, green on the upper surface, 3-nerved beneath and covered with closely appressed tomentum. Scapes 2–3, very narrow, proceeding from the axils of the upper leaves. Bracts 5–7 narrow-linear, diminishing in size upwards. Heads 1 inch diameter, involucral scales in few series, linear, very narrow, sometimes recurved. Rays long, narrow, recurved in full flower. Anthers tailless. Pappus ⅕ inch long. Achene with short rigid hairs.

The semi-shrubby habit of the present plant, as also of some others described as belonging to *Celmisia*—namely, *C. discolor*, Hook. fil., and *C. walkeri*, Kirk, indicate—especially when this habit is associated with tailless anthers, as with the plants above named—the necessity of removing them to the genus *Erigeron*, where they will find a more natural alliance, The above three plants are closely related, *Celmisia walkeri*, Kirk, and the present described plant, being probably only varieties of *Celmisia discolor*, Hook. fil.

The figure on plate xv. is drawn of the natural size.

Locality.—Collingwood.

ART. XXXIV.—*Notes on* Loranthus fieldii, *Buchanan.* By H. C. FIELD. Communicated by the President.

[*Read before the Wellington Philosophical Society, 6th August,* 1884.]

I WAS greatly surprised on looking over the last volume of Transactions* to find that a *Loranthus* of which I sent a spray to Mr. Buchanan in February was new to science. It is so abundant in the region where it grows, and that region has been so constantly traversed by Europeans—several tracks from Wanganui to Taupo passing through it—that I never dreamed that the plant could have escaped observation. Those ardent botanists, Dr. Curl and the late Rev. R. Taylor, both visited the locality to my knowledge. The latter indeed did so several times, and, as he spent a Christmas at Taupo, he must apparently have traversed the forest where the plant grows just when it was in blossom.

I first saw it in December, 1870, and have had so many opportunities of observing it since that date that I can describe it fully. It grows on the red birch trees, but only on the upper branches of large trees, where the bark is smooth and firmly attached to the wood. It is never seen on the trunk or large branches, which have their bark more or less rough and detaching in large flakes. I have never even seen it on young trees, though these have smooth firmly-clinging bark. I think it only grows on the red birch, as I have not observed it on the black. The level forests to the south and west of Ruapehu consist almost exclusively of red birch, the black being found growing separately, in detached patches of bush, on the eastern side of the mountain, and thence to the Ruahine.

The *Loranthus* forms large bushes in the tops of the trees, and the blossoms are so abundant as almost to hide the foliage, so that each bush, when in flower, looks like a flame. I believe that the largest bushes are quite 10 feet in diameter, and those of 6 feet are common. I should say that fully ten per cent. of the large trees have one or more plants of *Loranthus* growing on them, and as the blossoms fall the whole ground is sprinkled with the petals. The root of the plant is hard and woody, and of

* "Trans. N.Z. Inst.," xvi., p. 397.

ERIGERON NOVÆ-ZEALANDIÆ.

J. B del.

a dark greyish-brown colour, approaching to black. It is smooth or very slightly roughened, and extends longitudinally, both upwards and downwards, along the branch on which the plant grows. It adheres so firmly to the bark of the birch, that it will drag the latter away from the wood of the tree rather than loose its own hold. At intervals short lateral rootlets branch out and clasp the branch. Plants often grow on branches far smaller than themselves. Thus one with roots from 1–1½ inches thick will grow on a branch no thicker than a man's little finger, which of course bends down with the weight, so that the *Loranthus* swings about with every breath of air. From this it might be inferred that the plant was an epiphyte, drawing little or none of its sustenance from the branch on which it grows. It is, however, unquestionably a parasite, nourished by the sap of the parent tree. When cutting a line 40 feet wide for nearly six miles through the bush, for the Wanganui-Taupo road, in September and October, 1882, my men felled many scores of trees on which the plant was growing. These all blossomed, but died soon afterwards, as the felled trees withered.

In February last I brought down two small plants with me, cutting off the branches on which they grew, without injuring the roots. I bound these branches and roots in moss, so that the plants looked as fresh as ever when I reached home. I planted one (branch and all) in a shady part of my garden, and hung the other (moss and all) under a bench in my greenhouse. Both, however, died without developing their fruit, proving that the birch sap is necessary to them.

The roots of the *Loranthus* are flattened or hollow where they touch the birch branches, and when on a branch smaller than itself, the root surrounds the branch to a greater or less extent. The stems are of the same colour as the roots. The blossoms are yellow at their bases, but shade gradually through orange and scarlet to crimson, and even carmine, at their tips. They are from 1–1½ inches long. They open very peculiarly. A very small proportion (certainly less than a tenth) open from the apex of the petals downwards, in the ordinary manner of flowers. In the remainder the petals become detached at their bases from the fruit beneath them, and roll upwards and outwards like those of the rewarewa blossoms. The upper portions of the petals, however, still adhere to each other, and clasp the stamen firmly. The result is that the stamen bends downwards, and supports the flower in an inverted position. Ultimately the stamen breaks, and its upper end falls to the ground with the petals still attached to it. In the lower forests, on the level of the Karioi plain, the plant blossoms in November and December; but near the upper margin of the bush, on the slope of Ruapehu, it was in full bloom at the end of

January. I have never seen the ripe berry, but it is no doubt viscid, like those of other plants of its class, and eaten by birds. The Maoris call it by the same name, "rorerore," as the smaller roseate fuchsia-shaped *Loranthus*.

I have mentioned that while the forests south and west of Ruapehu are of red birch, the detached bushes on the east of the mountain are of black. It is curious that the vegetation on the east and south of the mountain differs widely, though the soil and everything but the aspect exactly correspond. The slope of the mountain is so gentle that one would think the aspect could make no difference; yet plants which abound on the east are wholly wanting on the south, and *vice versâ*. For instance a plant which seems to be identical with or very closely allied to *Carmichælia enysii* (Trans., vol. xvi., p. 379) abounds, and forms patches many yards in diameter on the east of the mountain, but there is not a trace of it on the south. As it had neither blossoms nor fruit in January, I did not gather any specimens, and could find no small plants. Next day I sought it in vain on the south side of the mountain. From what I have heard, I believe the vegetation on the north and north-west of the mountain is different again.

Art. XXXV.—*Notes on the Occurrence and Habits of some of our New Zealand Plants.* By W. S. Hamilton.

[*Read before the Southland Institute, 13th May, 1884.*]

Glossostigma elatinoides, Benth.

This plant occurs on the flats of the Oreti, in the bottom of ditches that have been opened for some time. Its corolla is pale blue and very pretty, $\frac{1}{4}$–$\frac{1}{3}$ inch. The strap-shaped stigma is irritable, and springs back on being touched, leaving the anthers exposed; and taking a place among the petals, looks exactly like an additional one. Before springing back it forms a hood over the anthers, and looks like an *Orchid* or a *Lobelia*. This plant has not, so far as I know, been reported from the south before. It does not occur on the flats except where a ditch has been opened, thus leading us to suppose that the subsoil is full of its seed, but that the climate is no longer suitable to its growth, and that it can only grow now under exceptional circumstances of shelter and moisture.

Pteris scaberula, A. Rich.

Like the last-mentioned, this plant occurs in Southland under somewhat exceptional conditions. It also springs up where ditches have been opened along the roadsides, in the cemetery, and in sheltered spots on the Bluff Hill, Its spores are no doubt lying in the gravel-beds of the subsoil, and would thus appear to have been of universal occurrence at some past time. Its local and exceptional occurrence at the present day, would also argue the decrease of the temperature, and hence of the moisture held in solution, a change which is also evidenced by the disappearance of the ordinary bush over wide tracts of country in the South Island.

Corysanthes macrantha, Br.

This fine orchid occurs plentifully, but always in one kind of situation, where water is oozing out of a bed of gravel on a slope. It likes a *burn-brae*, and is there only found on the shady side. It is particularly luxuriant and large in Southland; its leaves as large as a florin, bright green and succulent. It folds its large *apron* (*labellum*) so closely around the short style and the pollen masses that it must be a very small insect indeed that is able to find its way to them. It not only seems independent of the services of insects, but takes good care that they do not get at its treasures.

Stylidium subulatum, Hook. f.

This curious little plant occurs plentifully over the Seaward Moss, and seems to be more closely allied to the *Pratia* family than has been generally supposed. The fruit is not one-celled as stated in Hooker's "Handbook," but is strongly two-celled, the cartilaginous septum being particularly strong and permanent. The seeds are agglomerated on a spot in the middle of the septum on each side of it; and from those in the centre having longer placentas than those around the outside of the bunch, they look like a hemispherical mass, somewhat like the spore-bundles of *Polypodium*.

Pelargonium australe, Willd., var. *prostrata*.

This variety, hitherto unreported in New Zealand, occurs in the Seaward Moss, and varies in size from 2 to 8 inches or more, with dark brownish-purple foliage and much-branched prostrate almost creeping stem; rootstock fusiform and very short and stout, flowers small, very slightly irregular and pure white, pink when dry.

Callitriche verna, Linn.

It does not seem to have been observed that the first flowers of spring of this species are all male, with very long filaments. After a few days the male flowers decrease, and a few female flowers begin to appear on the same plants, and sometimes on the same peduncle with the male. Later on the flowers are all female, and one may search in vain for a single male flower, and yet the fertilization goes on, no doubt from the pollen grains adhering to the moist foliage and remaining in a fit state for germination during the summer; this is also observable in the *Gunnera* family, all the New Zealand species of which seem to be more or less polygamous. But it is observable that the first flower-scapes that are sent up in spring bear only male flowers, and after the pollen which is green has been shed, they wither rapidly away. A few days later, and the scapes coming up have often both kinds of flowers mixed, which gives the fruit-spike when ripe a ragged or interrupted appearance very common in some species, from the places of the male flowers remaining vacant. Later still the scapes (which come up in succession all the summer) have nothing but female flowers, and these have the finest fruit. The scapes which bear both kinds of flowers are generally barren, unless the female flowers predominate, in which case a few drupes come to maturity, but are shy, small and half-withered looking.

The male scapes attain their full length before flowering, which they do in a few days; the female lengthen after flowering, and indeed till the fruit is mature. The female flowers are developed as soon as the scape appears in the axil of the leaves, and are in full flower at, or even under, the surface, the long hairy or papillose styles spreading like rootlets among the *débris* of withered leaves, as if in search of the pollen grains which had been shed in spring, and are probably still remaining in a fertile condition among the moist foliage.

Gunnera hamiltonii, Kirk, n. sp.

Mr. Kirk has not yet sent me the description of this handsome and unique species. It is extremely local, occurring in patches on the hills near the New River Heads. It completely excludes every other kind of vegetation, and from its graceful cuneate-deltoid deeply and sharply dentate foliage gives the surface a peculiarly crisp appearance. The extremely coriaceous strongly-ribbed leaves tufted densely together support the foot, and spreading from a hollow centre give the ground a bird-nested appearance. The succulent leaves are extremely rich in lime and silica and give off, when old, the epidermis as a grey paper. The flowers of this species are spiked, the anthers sessile on very stout scapes, not crowded; the drupes on still stouter peduncles, as thick as a goose-quill and two to four inches long, bright red, and with the drupes almost sunk in the fleshy peduncle, not crowded, but occupying an inch or more of the top of the scape.

Tillæa hamiltonii, Kirk, n. sp.

This *Tillæa*, occurring on the flats of the Makarewa, also takes to the river-bed, and, along with other species of aquatic or, rather, semi-amphibious plants, carpets the river-bottom to a very considerable depth. This is a remarkable feature of the Makarewa, and, whatever be its cause, is a very strange peculiarity.

Lindsæa linearis, Swartz.

This fern occurs plentifully in the Seaward Moss, but still in a very local way. It occurs in strips across the plains, as if following the outcrop of some particular gravel bed or some condition of soil or moisture. In some places it is restricted to a strip a few yards wide, but extending lengthwise, following the same level round the little elevations of the plain. It grows in some places very luxuriantly ; fronds 6–8 inches high.

L. trichomanoides occurs in the Longwood Ranges, but is very rare. I have only seen one specimen—brought in by a surveyor, who took it for a maiden-hair fern.

Geranium, sp.

A *Geranium* with pure azure blue flowers occurs on the hill of the New River Heads. I cannot distinguish this species in other respects from *G. molle*, Linn., except that it has much heavier foliage. I have sent specimens to Mr. Kirk, but have not yet received his reply.

Art. XXXVI.—*On the Punui of Stewart Island*, Aralia lyallii, *n. s.*

By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 9th July,* 1884.]

Plate XVII.

The Punui, one of the most striking plants in the New Zealand flora, was discovered by Dr. Lyall in 1848, and referred by Dr. Hooker* to *Aralia polaris*, Homb. and Jacq., discovered by those botanists on the Auckland Islands in 1839. Subsequently Dr. Hooker's suggestion that *Aralia polaris* might form a new genus to be termed *Stilbocarpa* was carried out by Decaisne and Planchon, and in the Handbook of the New Zealand Flora published in 1864, the Auckland and Stewart Island plants are included under the description of *Stilbocarpa polaris*, Decn. & Plan., the author stating that Lyall's plant wants the long bristles which are so characteristic of the Auckland Island plant, and might belong to another species†.

For the sake of conciseness, in the following paragraphs the native name *punui* will be restricted to the Stewart Island plant; the generic name *Stilbocarpa* to that from the Auckland Islands.

Until recently so little has been known of the flora of Stewart Island that, notwithstanding the botanical interest attached to such a remarkable plant as the punui the material for determining its precise relationship to *Stilbocarpa* has not been available: no specimens were to be found in our *Herbaria*, no plants in our botanic gardens. In 1878 a fine living specimen

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* Fl. N.Z. i., p. 95. † Handbook N.Z. Flora, p. 100.

with other Stewart Island plants was kindly placed at my disposal by Mr. C. Traill, who shipped them by the Government steamer "Stella," which also brought several cases of plants from the Auckland Islands for the Colonial Botanic Gardens. As my case was by some mistake removed to the gardens, I allowed the plants to remain there, so that the punui was grown under the same conditions as the *Stilbocarpa*, all the plants at first being planted in the shade-house.

While closely agreeing in the shape of the leaf, toothing, venation, etc., the two plants exhibited marked differences in minor characters—the texture of the leaf, amount of hairiness, and the colour and size of the hairs: the leaves of the punui being more membranous than those of the *Stilbocarpa*, the upper surface usually glabrous, the lower clothed with soft white hairs and the terete petiole. In *Stilbocarpa* both surfaces were clothed with fulvous bristly hairs, longer and stouter than those of the punui, the petiole was slightly compressed, and in some cases faintly grooved on the upper surface. In both plants the petiole was pilose.

Two specimens of *Stilbocarpa* gradually developed new leaves in which the texture was less coriaceous, and the hairs reduced in number, shorter, and less bristly. These were exactly the results which I had observed in a greater degree with plants cultivated for two years in my own garden, so that the theory which attributed the trivial differences between the vegetative organs of the two plants to the different climatal conditions under which they grew, seemed to receive all the confirmation needed to establish their identity. Had good specimens of the flowers and fruit been available for examination, the opinion expressed by me* would have been different. Business, however, took me from Wellington before the punui had fairly developed flowers, and the single imperfect specimen that I was able to secure exhibited no characters calculated to alter my opinion.

In 1880 Mr. J. B. Armstrong gave an imperfect description of the punui under the name of *Stilbocarpa lyallii.*† He states, "unfortunately I have not been able to obtain flowers or fruit, but there is no doubt as to the genus," and describes the leaves as being "from 4 to 8 inches across or more, with a closed—not open—sinus." As will be shown presently, both these statements are erroneous.

Recently I have had the pleasure of examining the punui in its native island, and have received fully ripe fruit from Mr. C. Traill, the result being that not only must my old opinion as to its identity with *Stilbocarpa polaris* be abandoned, but that it must be removed to another genus.

* "Trans. N.Z. Inst.," vol. xiv., p. 387.

† "Trans. N.Z. Inst.," xiii., p. 336.

Stilbocarpa was proposed by Sir Joseph Hooker as the name of a monotypic genus, consisting of the Auckland Island plant already mentioned, and was established by Decaisne and Planchon in 1854, its essential characters being drawn from the 3–4-celled acetabuliform fruit, which in fact affords almost the only characters by which it can be separated from *Aralia*. The fruit of the punui, instead of exhibiting the cup-shaped cavity characteristic of *Stilbocarpa*, has a flattened apex covered with an epigynous disc consisting of the two stylopodia: in all respects agreeing with *Aralia*, to which it must consequently be removed, and in honour of its discoverer may worthily be designated *A. lyallii*. I now append a description.

Aralia lyallii, n. s.

A stout herb. Stems $\frac{3}{4}''$ thick, pilose, forming strong arcuate stolons. Leaves alternate, crowded, petioles $1'$–$5'$ long, fistulose, terete, pilose, with a sheathing laciniated ligule at the base: blade $6''$–$24''$ in diameter, orbicular-reniform, lobed and deeply toothed, upper surface shining, usually glabrous, hairy beneath. Umbels monœcious, on axillary or terminal scapes, equalling or exceeding the leaves, globose $6''$–$12''$ diameter, compound: primary involucral leaves foliaceous, inferior linear. Fl. unisexual, calyx teeth reduced to points, petals linear, more or less imbricate in bud. Male, stamens 5, filaments slender, disk 2-lobed. Female, stylopodia 2, reniform, forming a flat indented disk; styles 2, short, free, straight or divergent, ovary 2-celled. Fruit spherical, black, 2-celled, cells 1-seeded: testa crustaceous, striated.

Hab. South Island:—Coal Island, Preservation Inlet (identified from the deck of a passing steamer); Stewart Island and outliers, chiefly on shady cliffs, etc; Herekopere Island, Ruapuke Island, Green Island, Centre Island (nearly extinct).

Reported also from the Snares, Antipodes Island, and Bounty Island, but I have not seen specimens.

The punui often forms large patches spreading by means of the stout naked stolons which at first are suberect but gradually become inclined or arched until the terminal bud comes in contact with the ground, when roots are given off and a new plant is speedily developed. The stems vary in length from a few inches to $3'$ or $4'$ and are about the thickness of a man's finger. The patch becomes more and more dense as seeding plants are developed amongst the stolons. Specimens grown in the shade exhibit a marked difference from those grown in the open. In the former the leaves are flat or convex, more membranous, and with softer hairs than those grown in exposed places. The latter have leaves of stouter texture and clothed with stronger hairs—the blades often concave forming cups having the cordate or reniform bases folded inwards: it is doubtless this peculiarity which led Mr. J. B. Armstrong to describe the leaf as having a closed sinus, an error which is at once demonstrated by simply flattening the leaf. As a rule large specimens growing in the open have the upper leaves concave and the lower convex, the texture of those most exposed being almost as thick as in some specimens of *Stilbocarpa*. Occasionally hairs are developed on both surfaces, but they are always white and soft.

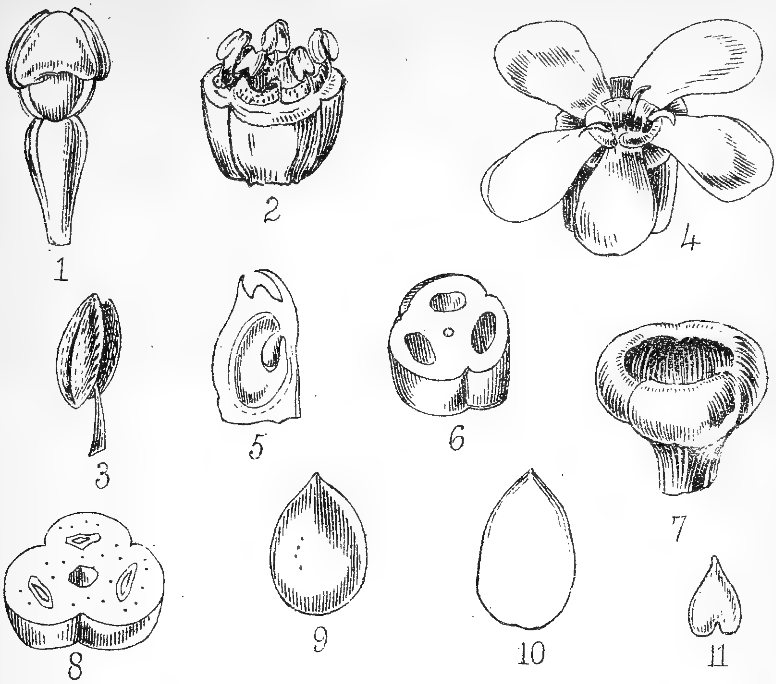
The foliaceous ligule at the base of each leaf is sometimes largely developed, and usually exhibits a pair of acute laciniæ larger than the others, at first sight presenting the appearance of a pair of ordinary stipules: most frequently all the laciniæ are more or less acute and ciliated, but a considerable amount of variation is exhibited in this respect.

Much variation is shown in the density of the inflorescence; the umbels are highly compound, usually forming a dense orbicular mass of reddish-purple flowers, often more than a foot in diameter. Frequently the inflorescence is lax and open. The scapes are fistulose, and equal the petioles; the primary involucral leaves are sometimes 5″ or 6″ in diameter, on stout petioles, and closely resemble ordinary leaves; the secondary series is also petioled but greatly reduced in size and modified in form, being trifid, tripartite, or lobulate with a cuneate base; in the tertiary umbellules they are simply linear.

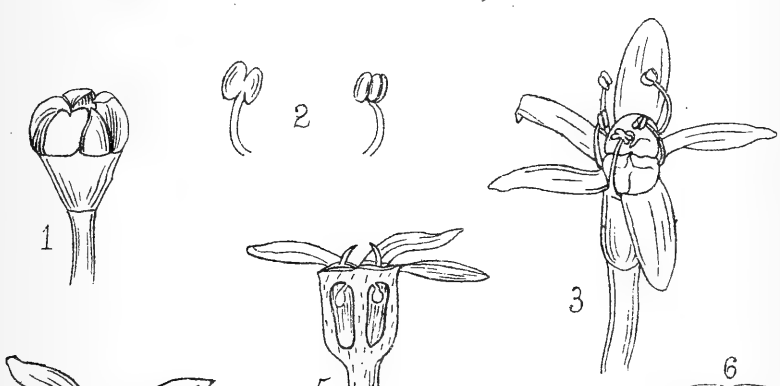
In most specimens each of the secondary rays carries a female umbellule, from beneath which a whorl of from two to five male umbellules is given off; some of these are again branched. Sometimes the apex of a secondary ray terminates in a single abortive flower, when the tertiary rays carry small female umbellules surrounded by male as before. The pedicels of the male flowers are shorter than those of the female.

In the male flowers the calyx teeth are reduced to points, in the female they are obsolete; the petals are usually close set, those of the male being slightly longer than the others, both alike are of a lurid reddish-purple.

Stilbocarpa polaris differs from *Aralia lyallii* in the stouter texture of the leaves, which are clothed on both surfaces with long bristles, and the petiole is slightly compressed, sometimes exhibiting traces of a groove on the upper surface; the ligule is usually more deeply laciniated, the laciniæ being orbtuse and fringed with strong cilia. The petals are broader, obovate-spathulate, and of a pale yellow colour. The stamens are oblong, with rather shorter filaments, and the styles are recurved. The stylopodia form an interrupted annular disk, and as already shown, the fruit is acetabuliform 3–4 celled. It appears to be restricted to the Auckland Islands, Campbell Island, and Macquarrie Island.



STILBOCARPA POLARIS, *After Hooker.*



ARALIA LYALLII, *T. Kirk.*

T. Kirk, del.

EXPLANATION OF PLATE XVII..

I. *Stilbocarpa polaris* (after Hooker).

1. Bud.
2. Staminate flower with petals removed.
3. Stamen.
4. Pistillate flower.
5. Portion of ovary, showing a single ovule.
6. Section of ovary.
7. Ripe fruit.
8. Section of fruit.
9. Seed.
10. Longitudinal section of seed.
11. Embryo.

II. *Aralia lyallii*, T. Kirk.

1. Bud.
2. Stamens.
3. Perfect flower.
4. Pistillate flower.
5. Longitudinal section of pistillate flower.
6. Transverse section of ovary.
7. Ovule.
8. Fruit.
9. Longitudinal section of seed.

ART. XXXVII.—*Description of a new Species of* Fagus. By T. KIRK, F.L.S.

[*Read before the Wellington Philosophical Society*, 1*st October*, 1884.]

Plate XVI.

Fagus blairii, n. s.

A TREE 40–60 feet high, trunk 2–2½ feet in diameter. Young twigs and petioles slightly pubescent. Leaves spreading, petioled, ovate, entire, minutely apiculate, abruptly rounded at the base, coriaceous, ⅔″–¾″ long, ⅓″–½″ broad, clothed beneath with fulvous appressed tomentum. Valves of the involucre with a membranous margin and one or two narrow scales at the outer base. Nuts winged, wings shortly bifid.

Hab. South Island. By the Little Grey River, Nelson. Head of Lake Wakatipu, Valley of the Dart, Otago: *T. Kirk*. Five Rivers Plain: *W. N. Blair*.

This species is closely allied to *F. cliffortioides*, Hook. f., from which it differs in the habit and spray, which resemble those of the European beech, and especially in the ovate apiculate leaves, which are of larger size and are never cordate, while the pubescence is of a fulvous hue, never white. I have not seen Mr. Blair's specimen from the Five Rivers, but, as he at once identified it with mine from the Dart Valley, I entertain no doubt of his correctness, and have great pleasure in connecting his name with the species.

EXPLANATION OF PLATE XVI.

1. *Fagus blairii.* Natural size.
2. Leaf enlarged.
3. Involucre.
4. Nut slightly enlarged.

Art. XXXVIII.—*Notes on the New Zealand Beeches.* By T. Kirk, F.L.S.

[*Read before the Wellington Philosophical Society, 1st October,* 1884.]

Fagus menziesii, Hook. f.

Hook. Ic. Pl., t. 652.

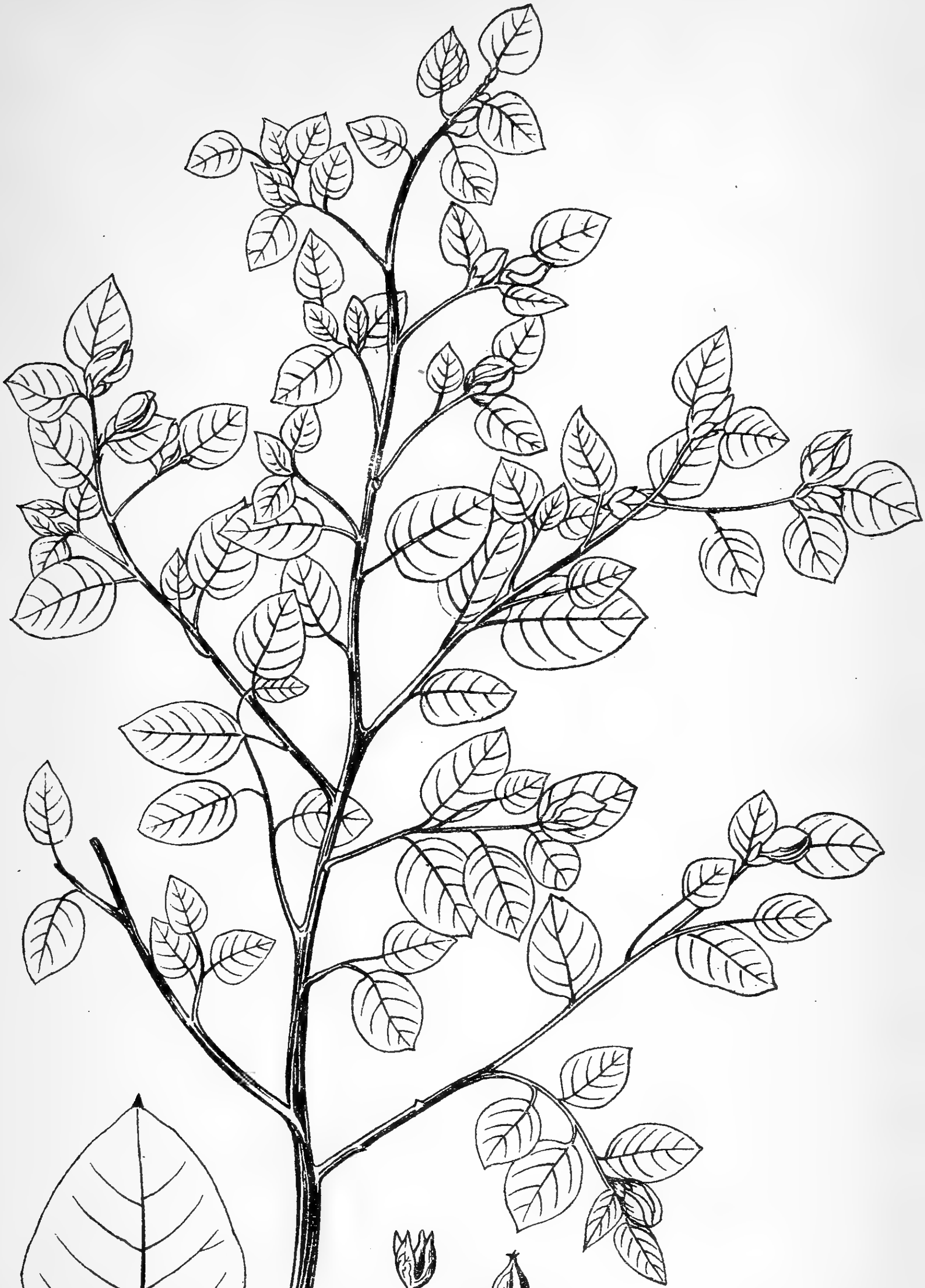
Silver Beech.

Brown Birch, White Birch, Red Birch.
Silver Birch.

Although this species exhibits a considerable amount of variation in the shape, toothing and texture of the leaves, it is the most easily recognized of all the New Zealand beeches, especially when the fruit is fairly developed: the curious glandular scales on the valves of the cupules at once distinguish it from the other species, while they show its close affinity to *F. gunnii*, Hk. f., of Tasmania, *F. moorei*, Muell., of New South Wales, and *F. betuloides*, Mirb., of Cape Horn and South Chili.

This forms a fine tree, 60′–80′ feet high, with a trunk 2′–3′ in diameter, but larger specimens are by no means unfrequent. The twigs are clothed with a fine brown pubescence; leaves glabrous, rigid, orbicular, or broadly ovate, or rhomboid ovate, shortly petioled, with the margins cut into very short blunt teeth, or more frequently crenate, each crenature being irregularly notched. In the young state the leaves are sometimes deeply toothed, stipules linear-oblong. The valves of the cupule are pubescent and clothed with from 5 to 7 horizontal scales, the margins of which carry a fringe of stalked glands. Nuts trigonous, 3-winged, the wings being divided or fringed at the apex.

In common with all the local species, the bark varies considerably at different periods of growth. Before reaching maturity, the tree is characterized by a thin silvery whitish bark much resembling that of *Betula alba*, L. This becomes gradually thickened, and rugose, although patches of



FAGUS BLAIRII, T. Kirk.

smooth bark may often be seen even on the largest trunks. This retention of the smooth bark has led to the adoption of the common name of silver beech for this species.

The timber is of a deep reddish-brown colour, compact in texture, and splits easily. It is well adapted for inside work as rafters, flooring joists, etc., and especially for the manufacture of ordinary furniture, French bedsteads, sideboards, etc.; also for wine casks, tubs, buckets, etc. A considerable demand for these purposes may be anticipated when the progress of road-making has afforded more easy access to the silver beech forests, but at present I am not aware that any timber-merchant considers it worth while to keep the wood in stock. So far as Wellington is concerned, a supply could be obtained from the Rimutaka. When used for fencing purposes it lasts from three to seven years; house blocks in dry ground, and sheltered from the rain, are in a partially decayed state after having been fixed for eleven years. Shingles require renewal at the end of six or seven years.

The silver beech attains its northern limit on the Te Aroha Mountain at the head of the Hauraki Gulf. It is abundant on the mountains of the East Cape, on the Ruahine, Tararua and Rimutaka Ranges, and the Wainuiomata Hills in the North Island. In the South Island it occurs on the Kaikoura Mountains, Mount Arthur Range, Spencer Mountains, and more or less throughout the Southern Alps, especially on their western slopes. In the Makarora Valley it is the only species found between the head of Lake Wanaka and the Haast Pass, the timber in this district being of decidedly better quality than in the lowlands. The most southern specimens known to me occur at Colac Bay and Lake George in the Longwood district.

Sometimes it forms the chief portion of the forest, but is commonly mixed with other species. In the south it often occurs singly, or in small quantity in mixed forest, as in the Makarewa district.

It descends to the sea-level at Colac Bay, Dusky Bay, Preservation Inlet, and other places, but is most frequent at elevations between 1,200 and 2,500 feet. Its highest levels are but little above 3,000 feet.

Specimens from humid situations, at low levels on the west coast of the South Island, generally have leaves of thinner texture, and less closely set than those from higher levels. In both these points as well as in the margination, a wide range of variation is exhibited.

This species is subject to a remarkable foliar transformation: crowded panicles of scaly, fulvous bracts are developed at the tips of the branchlets. Usually four scales form a kind of flask-shaped perianth, which is sessile in the axil of a larger bract-like scale, and covers a number of minute scales. These panicles are often produced in great abundance, and present a close resemblance to the early stages of a true inflorescence.

Fagus fusca, Hook. f.

Hook. Ic. Pl., t. 631.

Tooth-leaved Beech.

Black Birch of Auckland and in part of Otago and Southland.

Black or Bull Birch of Lake Wakatipu.

Red Birch of Wellington, Nelson, and in part of Otago and Southland.

It is not easy to see why any difficulty should have occurred in the identification of this fine timber-tree apart from the misleading tendency of the common names generally applied. The thin yet firm texture of the leaf, the prominent veins, the sharply-toothed margins, are characters that can only be confused with those afforded by other species by a careless observer. Yet merely owing to the use of common names based upon colour, and applied or rather misapplied to the leaves, bark, or wood at the fancy of the bushman, no species has been more misunderstood.

The tooth-leaved beech forms a fine tree 70–100 feet with a trunk from 3 to 8 feet in diameter, the bark varying greatly in colour and rugosity in different localities and at different stages of growth. In the north and in lowland situations in the south it is usually blackish, but in sub-alpine localities the prevailing tint is of a rich deep brown. In the young state it is smooth and whitish.

The wood varies in colour but is usually reddish or reddish-black, stout in the grain. It is one of the strongest and most durable timbers in the colony.

In the young state the twigs are pubescent, leaves oblong-ovate, shortly petioled, with rathar large acute teeth; pubescent or glandular when young. Cupules with membranous scales at the back; nuts winged, the wings being divided at the apex.

Varieties with the teeth more or less abbreviated are occasionally met with, but on the whole these are rare and can scarcely be mistaken for either of the entire-leaved forms by an observer of ordinary intelligence.*

The good qualities of this timber are so generally admitted that it is needless to discuss the question or offer further evidence on the subject. On the Thames Gold Field it has been so generally appreciated by the miners that it has now become extremely rare and is said to be extinct in some localities where it was once plentiful. I may add that I have examined stock-yard fences which have been erected twenty-one years, and which are still in good condition.

This is the most widely distributed of the species; it extends from Ahipara in the extreme north to Southland, in many southern localities forming the greater portion of the forest. In the South Island it is more plentiful on the western side of the main range than on the eastern, and is decidedly rare in the central districts: in Canterbury its chief habitat is in the mountain district between the Waimakariri Gorge and Bealey, where it

* Hook. Ic. Pl., t. 630.

forms the chief portion of a zone ranging from about 2,400 to 3,000 feet, extending up the valley of the Poulter and adjacent ranges. Between the Cass River and Bealey it is so strongly marked in contrast with the mountain beech that it can readily be descried from the terraces on the southern bank of the river. As its occurrence in the interior of Canterbury had been warmly denied, Mr. Blair, the Directing Engineer for the South Island, suggested that I should finally determine the point by an examination of the growing timber. When on a visit to the district in January, 1881, I had the pleasure of carrying out this suggestion in company with my friend Mr. J. D. Enys, and found the tooth-leaved beech occurring freely between the limits already stated, mixed with mountain beech which forms the greater portion of the forest. Most of the mature specimens were from 50 to 70 feet high, with clear unbranched trunks of from 35 to 45 feet, measuring 10 feet in girth at six feet from the ground. The oldest specimens were unsound in the middle, but the shell was firm and hard. Trunks cut down twelve years before the date of my visit and left on the ground were still perfectly sound, the logs retaining the wedges that had been driven to split them. Subsequently I examined a stock-yard fence constructed with timber cut at this spot at the time to which I have referred, and found all the posts of tooth-leaved beech in a perfectly satisfactory state, sound and good; while it had been found necessary to renew all the posts of mountain beech at the end of six years, and the renewed portion was in bad condition, requiring immediate replacement, many of the rails even being worthless.

This species is not found in the Oxford and Alford Forests, although reported to occur there by Mr. Robertson, who was instructed to examine those forests in October, 1876.

It descends to the sea-level in many localities, as Ahipara, Kawau, Omaha, Wairoa East, etc., but rarely in large quantities. It is more abundant and attains larger dimensions at elevations between 1,200 and 3,000 feet, and in a few localities ascends to 3,800 feet, which, so far as I am aware, is the greatest altitude which it attains.

Fagus solandri, Hook. f.

Hook. Ic. Pl., t. 639.

Myrtilloides cinerascens, Banks & Sol., MS.

Cliffortioides oblongata, Dryander.

Entire-leaved Beech.

Black Birch of Wellington, Canterbury, and in part of Otago and Southland.

White Birch of Nelson, and in part of Otago.

Black-heart Birch of Otago.

White, Black, Red, and Brown Birch of Oxford and Alford Forests.

A fine tree, sometimes attaining the height of 100 feet, but usually 60–80 feet, with a trunk from 2 to 4 feet or more in diameter. Branchlets pubescent, leaves narrow oblong, quite entire, with appressed cinereous pubescence beneath in the mature state at least. The leaves vary in width, but are oblique or cuneate at the base. Timber reddish, sometimes streaked with black, stout, and durable under certain conditions, but in all respects inferior to tooth-leaved beech. It has the disadvantage of forming oblique or longitudinal cracks in the sawn state when exposed to the weather.

Great difference of opinion has existed respecting the durability of the timber of this species. In a Report on the Durability of New Zealand Timbers which I had the honour to prepare for the Government in 1874, and again in Captain Campbell Walker's Report on State Forests, I wrote:—" Owing to the confusion arising from the misapplication of the common names of the different beeches, even in the same district, I have been unable to obtain precise and satisfactory evidence on this point." At that date the timber was generally considered to be of inferior value with regard to durability, but recently evidence has been obtained, showing that this opinion requires considerable modification.

The West Oxford Forest consists in its lower parts exclusively of this species, so far at least as could be ascertained during the few hours that I was able to spend there; formerly it was stated officially to contain a large amount of tooth-leaved beech, and it was supposed that any durable timber obtained from the forest was furnished by that species. I failed, however, to find tooth-leaved beech, either at West Oxford or at View Hill, several miles higher up the river, although there can be little doubt that it occurs on the ranges. All the men engaged at the sawmills had heard of "tooth-leaved beech," but only one or two of them had seen it growing, and no one had seen it converted. I am quite satisfied that it must be extremely rare in the locality so that it has not come within reach of the sawmillers.

Now along with numerous instances of lack of durability exhibited by this timber are a comparatively few in which it has shown a much higher degree of durability than it has generally been considered to possess. Several fences are pointed out, the posts of which have been in the ground for periods varying from twelve to twenty years; the longer period, however, has in most cases exhausted their durability; those that have been erected ten or twelve years only will last several years longer. House blocks have proved durable, lower wall plates, and sleepers also. In the cases which I examined there can be no doubt as to the timber being "entire-leaved beech."

In estimating the durability of this timber, however, it must be remembered that these instances of fair durability are comparatively exceptional. It has been largely used in the Oxford district and other places for fences, but in numerous cases these fences have become dilapidated in so short a period as five or six years, even when the timber has been apparently sound and good at the first. How far this may be due to its being cut during the period of active growth, or to its having been used while in a green condition, both practices being the rule rather than the exception, it is impossible for me to say. Another possible cause of its early decay in certain cases may be its having grown upon wet ground. It must be admitted at least that its durability cannot have been fairly tested in the majority of cases. But making all possible allowances on these points I am compelled to place its good properties considerably below those of the tooth-leaved beech.

In the Oxford Forest it is sparingly mixed with white pine, miro, and matai, the last decidedly rare. A few fine trees run up to from 60 to 75 feet in height, but the bulk do not exceed 40 feet in the clear trunk. The manager of one of the largest sawmills informed me that "trunks capable of giving 4–14 feet lengths were extremely rare." I learned that the tree was termed "red birch," "brown birch," "white birch," "black birch," and "yellow birch," at different stages of its growth, but the application of these terms varied greatly: perhaps "black birch" was most generally applied to the mature condition before decay commenced, and "white birch" to the young state; but there were too many exceptions to allow of the names being other than misleading.

Unripe trees of this kind never afford durable timber, however large their dimensions; unless the tree is allowed to stand for a few years after attaining its full growth decay speedily commences. The time required for ripening, at present undetermined, cannot be very long, and when once the process is completed decay sets in very quickly, and progresses with greater or less rapidity. Sometimes it commences at the heart before full growth has been attained; the trunk appears perfectly sound, but on being squared or sawn its defective condition is exhibited at the expense of the woodman. All our beeches are more or less subject to this peculiarity, but I am inclined to believe that the period between the ripening of the wood and the commencement of decay is unusually short in the entire-leaved beech, and as the timber is of but little value at any other period, we have here one cause of its frequent early decay after conversion.

In this species the medullary rays of fully ripened timber are more durable than the wood formed by the fibro-vascular bundles of the annual cylinder. Logs decaying in the forest often present a curious appearance from this cause: after the sapwood has perished the outer surface of the heart-wood appears to be divided into numerous short laminæ running longitudinally. These laminæ project more or less beyond the general mass owing to the early decay of the wood of the cylinder. If the log has been kept from the ground, the appearance is still more remarkable, the medullary plates often projecting from one to two inches beyond the sound portion of the trunk, and exhibiting thin, rounded, weather-worn edges, but perfectly sound, and extremely hard. They vary from $\frac{1}{16}$ to $\frac{1}{8}$ inch in thickness at the base, and may be easily broken off by a sharp blow with a hammer. Unripe trees do not exhibit this peculiarity.

The remarkable difference in the pubescence of the leaf at different stages of growth has not received the attention it deserves. In the young state the leaves are nearly membranous, and perfectly glabrous. In exposed mature specimens the under surface of the leaves is clothed with a layer of closely appressed hairs; but it is quite a common occurrence to find trees thirty feet high or more with leaves destitute of this hairy covering when growing under the shelter of taller trees. These hairs are unquestionably adapted to prevent undue evaporation and injury from sudden variations in temperature. Accordingly we only find them developed on leaves fully exposed to the sun and air, whether on young trees or old. They are never developed on seedling plants, or on branches growing under the shade of taller trees. The series of specimens now exhibited will be found very instructive on this head.

This species appears to attain its northern limit at the East Cape, where it forms a small tree 20 to 30 feet in height. It is plentiful on the lower slopes of the Ruahine, Tararua, and Rimutaka Mountains, in the North Island, and widely distributed in the South Island, but does not appear to extend to Foveaux Straits. It descends to the sea-level at Lowry Bay and other places, but appears to be replaced by the mountain beech, which is often mistaken for it. At altitudes above 2,800 feet, with some few exceptions.

Specimens 100 feet high were observed by Mr. Bidwill at Waiwetu, near Wellington.

Fagus cliffortioides, Hook. f.

Hook. Ic. Pl., t. 673.

Mountain Beech.

Black Birch of portions of Wellington, Canterbury, Otago, and Southland.
White Birch of Nelson, and in part of Otago and Southland.
Rarely distinguished by the woodman from Entire-leaved Beech.

The mountain beech bears a close resemblance to the entire-leaved beech in general appearance, although it never attains the extreme dimensions of that species. The leaves are pointed at the apex and rounded or cordate at the base, so that there is but little difficulty in distinguishing the two kinds.

In the North Island it is confined to the mountain ranges, and appears to attain its northern limit at Lake Waikare on the East Cape. It is most abundant on the mountains of the South Island, often forming the sole constituent of the forest from 2,000 feet to the limits of arboreal vegetation at about 4,000 feet. It descends to the sea-level in Preservation Inlet.

In many districts the abruptness of the higher limit is strongly marked: on the St. Arnaud Range, as on others in the South Island, the upper limit forms a tolerably even line running for miles at a little below 4,000 feet.

On Mount Torlesse a few small detached specimens attain an elevation of 4,600 feet or thereabouts.

Except in special situations it rarely exceeds 40 feet in height, and even at low elevations is frequently much smaller. At the highest levels it is little more than a shrub, often with prostrate stems, and if exposed to the full influence of the wind with the branches so densely set that it is possible to walk for long distances over the tops.

In deep narrow valleys at high elevations this species is sometimes not more than from 6 to 10 feet high, but retains the arboreal habit. At the same time the leaves are excessively reduced in size, densely crowded, and fruit is produced in abundance. At first sight this state presents the appearance of a distinct species, but a careful examination speedily dispels the idea.

On the other hand, isolated specimens growing in the open at below 3,000 feet, are often branched from the base, and form charming symmetrical specimens of great beauty. When dotted over a wide area they give a peculiar park-like character to the scene, and are peculiarly attractive.

This species resembles *Fagus solandri* in the leaves of the young plant being destitute of hairs on the lower surface, while full-grown specimens have the leaves clothed with a thick layer of appressed white hairs. The distichous arrangement of the leaves is a noteworthy character, although in old specimens it is often obscured.

The quality of the timber is much the same as that of entire-leaved beech, and like that species it exhibits a considerable amount of durability in certain cases, while in others it perishes within five or six years, as in sheep-yards at Lake Pearson.

In many districts it is of value as affording the only available timber, but it assumes far greater importance when viewed with regard to its influence on climate. In this respect it is not easy to overrate its importance: its restraining action in the prevention of floods in certain situations is so marked, that the destruction of the mountain beech forests would speedily bring about the devastation of large tracts of country at low levels.

In wet situations the timber of this species often proves durable. Mr. J. D. Enys informed me of an instance in which a large sleeper at the margin of a spring in a situation where it was constantly moist was sound and good after being sixteen years in use. Some of the telegraph poles of the first line erected in the Waimakariri Country were furnished by this species; those fixed in dry soils perished in four or five years, while those driven in swamps remained sound for a much longer period. Similar results have been obtained with fencing posts furnished by mountain beech.

Fagus blairii, n. s.

Blair's Beech.

(*Vide ante*, p. 297. Pl. xvi.)

Hitherto this species has been confused with the mountain beech, although its differential characters are easily recognized. It has been observed in the valley of the Dart and other places about Lake Wakatipu, and by the Little Grey River at elevations between 1,000 and 2,000 feet; also I believe on the Five Rivers Plain.

Usually it attains rather larger dimensions than mountain beech, being from 40 to 60 feet high: it is easily distinguished from that species by the ovate apiculate leaves clothed with appressed fulvous tomentum beneath in the mature state.

The habit and spray of this species more closely approaches *F. sylvatica* of Europe than any other New Zealand species.

At present nothing is known as to the durability of the timber, which in appearance resembles that of mountain beech.

III.—GEOLOGY.

Art. XXXIX.—*On the Age of the Orakei Bay Beds near Auckland.*

By Captain F. W. Hutton, F.G.S.

[*Read before the Philosophical Institute of Canterbury*, 27*th November*, 1884.]

In his lecture on the geology of the Province of Auckland, delivered to the members of the Auckland Mechanics' Institute, on 24th June, 1859, Dr. von Hochstetter, after describing the brown coals of the Province, and the tertiary strata on the west coast from Waikato to Kawhia, said that " the horizontal beds of sandstone and marls which form the cliffs of the Waitemata and extend in a northerly direction towards Kawau, belong to a newer tertiary formation."* This he considered to be of miocene age, but fossils were obtained only at Orakei Bay, and in an ash-bed at Wangaparoa. Subsequently, on his return to Europe, Dr. von Hochstetter followed Dr. Zittel in placing the " Waitemata series " with the west coast or " Aotea series," but he considered both as older miocene.† Dr. Stache, however, considered the Aotea series to be oligocene,‡ and Dr. Zittel considered it to be eocene.§

The first attempt to ascertain the relative age of these two series by stratigraphical evidence was made in a paper read to the Auckland Institute on 8th August, 1870.|| In this paper I showed that the Waitemata series can be traced eastward beyond the Tamaki and Howick to Turanga Creek, where it consists of a set of yellow clays and white or pale yellow sandstones, stained in places by iron oxide. It rests here unconformably on a dark green or bluish sandstone, generally showing a concretionary structure, which can, in its turn, be traced nearly to the Papakura River, and on the other side of the valley it reappears, on the north side of the Hunua hills, where it is associated with the Papakura limestone, and, with other beds, forms the "Papakura series," which rests unconformably on the coal series of Drury. Consequently the Waitemata series is separated from the coal series of Drury by two unconformities. The Papakura series was considered to be the equivalent, or very nearly the equivalent, of the Aotea series, and to be of oligocene age, while the Waitemata series was considered as miocene.

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* Geology of New Zealand, Auckland, 1864, p. 26.

† Reise der Novara, Geology, I., p. 34. ‡ Reise der Novara, Palæontology, p. 298.

§ On the Palæontology of New Zealand, Quar. Jour. Geol. Soc., xix. (1863), Misc., p. 20.

|| Trans. N.Z. Inst., iii., p. 244.

In June 1875, Mr. S. H. Cox, in his report on the Raglan and Waikato districts, * said that the sandstones and clays of Mercer were probably the equivalents of the Waitemata series, and he considered them to form part of Dr. Hector's cretaceo-tertiary formation, now called the "Waipara System;" at the same time saying that "the fossils do not absolutely fix them as such." This is certainly very true, for the only fossil in his list of any chronological value is *Dentalium nanum*, Hutton, which is found in the pliocene beds at Wanganui and Petane. In his further report, however, Mr Cox says that "they are in this locality the higher member of the Leda marls."† In 1879 Mr. Cox was sent to examine the country from Auckland northwards; tracing the Waitemata series towards the Kaipara and Cape Rodney, he found that it gradually changed into greensands mixed with much volcanic ash, and that at Mahurangi and at Komiti Point, in the Kaipara District, it rested unconformably on "chalk-marls and hydraulic limestones," thought to be of cretaceo-tertiary age. This, together with the fossils found at Komiti in the Waitemata series, led him to alter his former opinion, and to consider the Orakei Bay Beds as lower miocene.‡ Dr. Hector in his Progress Report for the same year demurs to this conclusion and suggests that the Waitemata series ought to be divided at the horizon of a volcanic ash bed in the cliffs under Parnell, which he calls the "Parnell Grit;" all below this bed, including the strata at Orakei Bay, being still retained as cretaceo-tertiary: his reason being that *Pecten zittelli*, Hutton, § and many other Orakei Bay fossils are found at Komiti Point only in sandy marls and grits which underlie tufaceous beds containing a number of lower miocene forms.|| Mr. Cox, however, who collected the fossils, says distinctly in his report that "these beds [i.e., the marly grits] curiously enough contain, *associated with a great preponderance of lower miocene forms*, the *Pecten zittelli*, Hutton, and *P. fischeri*, Zittel, of Orakei Bay, on the occurrence of which we have ascribed a cretaceo-tertiary age to these beds,"¶ and he does not mention any fossils in tufaceous beds.

In the following year Mr. Cox was sent to re-examine this point, but he reported that he was more than ever convinced of the correctness of his last year's work, although he thought it possible that the Waitemata series might be of eocene age.** He examined the cliffs from Auckland to Orakei

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* Reports of Geological Explorations, 1874-76, p. 9.

† Reports of Geological Explorations, 1876-77, p. 22.

‡ Reports of Geological Explorations, 1879-80, p. 37.

§ Dr. Hector and Mr. Cox often call this shell *Pecten pleuronectes*; it seems therefore necessary to point out that *P. pleuronectes*, L., is a living species which has never been found in New Zealand.

|| *l.c.*, p. xii. ¶ *l.c.*, p. 17. On page 33 he gives a list of these fossils.

** Probably influenced by his mistake of supposing that nummulites occur at Orakei Bay. (Reports 1879-80, p. 25.)

Bay, and reported that "the sequence between Fort Britomart and Orakei Bay is sufficiently conclusive to make it a matter of certainty that no stratigraphical break occurs above the horizon of the Orakei Bay fossils, which are again seen at Komiti Point."* He also gives a section of Komiti Point, and says, "At Komiti Point, again, a gritty bed occurs at the base of this [older tertiary] series, resting quite unconformably upon the upturned edges of the chalk-marls [cretaceo-tertiary]; and it was from the lowest bed of this series that my collection of fossils was made last year. After passing round the first point and reaching a small bay beyond, a second fossiliferous bed comes in, which is about 100 feet higher in the vertical sequence than the fossiliferous bed first mentioned. This bed corresponds entirely with the fossiliferous deposit at Orakei Bay, Auckland, containing the same fossils, and being of precisely the same character; and these beds pass up again into regularly stratified sandstones and marls, which continue until just before the far point is reached, where beds of consolidated sand come in with lignitiferous deposits and old timber partially carbonized."† It thus appears that Orakei Bay fossils are also found 100 feet above the bed which contains *Pecten zittelli* and *P. fischeri* mixed with miocene fossils; and that there are no tufaceous beds in the locality.

On the 30th June, 1881, Mr. Cox again reported on the position of the Orakei Bay beds. He followed them this time eastward towards Mareitai and found that at Turanga Creek they rested on a green "concretionary tufaceous sandstone" which is underlaid by clay marls and calcareous sandstone.‡ His section shows the Waitemata series conformable to this green sandstone, but in his report he says that it is unconformable, and his map shows a decided unconformity between the two, as the Waitemata series is made to overstep the green sandstone and to lie on the older slates. I may remark that this map agrees closely with an unpublished one which I made in 1866, and which Mr. Cox had not seen.

In October, 1883, Mr. A. McKay was sent to investigate the question. He reported in favour of Dr. Hector's opinion that the Waitemata series consists of two distinct formations of different ages;§ and Dr. Hector in his Progress Report for the same year, in mentioning the coal at the Whau, speaks of "the lower miocene series that overlie unconformably the 'Waitemata beds' of Hochstetter (taking the Orakei Bay beds as his type)."|| Mr. McKay's report however has not convinced me that Dr. Hector is right, and I wish to make a few remarks upon it.

Mr. McKay mentions "bands of soft marly sandstone, parted by beds of soft crumbling sandy marl of darker colour" as forming the beds at Point Britomart, which, he says, pass under the Parnell grit; and he describes

* Reports of Geological Explorations, 1881, p. 27. † *l.c.*, p. 23. ‡ *l.c.*, p. 95.

§ Reports of Geological Explorations, 1883-84, p. 101. || *l.c.*, p. xviii.

the beds above the Parnell grit at Parnell as "yellowish sands and sandy clays easily distinguished from the beds underlying the grit bed," and from this he concludes that "there is a marked distinction in the character of the beds overlying and underlying the Parnell grit."* This statement I may be allowed to question. In 1866 I examined these rocks at the typical locality at Parnell and found that at the east point of St. George's Bay the volcanic ash, called by Dr. Hector the Parnell grit—here about 15 feet thick—is overlaid by a bed of yellow sandstone above which comes a set of false bedded sandstones and shales. It is underlaid by another set of yellow sandstones and shales, also false bedded, below which is a greenish sandstone going down to low water-mark. At Resolution Point the Parnell grit, greatly reduced in thickness, rests on a thin bed of clay, below which is a thick stratum of yellow sandstone; the ash of the Parnell grit is much mixed with the clay, and the two beds are certainly quite conformable. Above the Parnell grit comes a set of thin-bedded sandstones and clays, and on the west side of Hobson's Bay these are seen to be covered by a thick stratum of clay. Thus in a distance of 600 yards the series, both above and below the Parnell grit, has altogether changed its appearance. The rocks at Point Britomart do not contain any beds of marl, as stated by Mr. McKay, and they do not correspond exactly with the rocks either above or below the Parnell grit at Parnell, but are more like the beds above the Parnell grit in Hobson's Bay. This, however, is a matter of little importance, for all the rocks of the Waitemata series are so local that lithological evidence cannot be trusted for correlating beds a few hundred yards apart, and I do not understand how Mr. McKay can, in the absence of fossils, "easily identify" the rocks north of Lake Takapuna with those underlying the Parnell grit at Parnell, which are five miles off.

Again, Mr. McKay gives no stratigraphical evidence in favour of the Orakei Bay beds being older than the Parnell grit. He commences by assuming, without giving any reason, that the beds at Point Britomart are the Orakei Bay beds, and then says that at St. George's Bay they pass under the Parnell grit. Both these statements may, however, be questioned. I will take the second first. On the east side of St. George's Bay

* *l.c.*, p. 106. Mr. McKay also says that "this is made perfectly clear by Mr. Cox in his report already cited." Mr. Cox, however, says that the beds both above and below the Parnell grit are sandstones and sandy marls "which occur throughout the series," but the grit represents the commencement of the volcanic outburst which attained its greatest development near the Manukau Heads, the higher beds being notable for the great abundance of the volcanic material which is mixed with the sand and clay. So that, in the absence of volcanic ash, the upper and lower beds, according to Mr. Cox, cannot be distinguished. On page 27 of the same report Mr. Cox also says that the beds *above* the Parnell grit at St. George's Bay have "a similar but more indurated character" to the strata of Fort Britomart.

the Parnell grit dips southerly and reaches the sea-level some distance from the head of the bay, so that all the rocks at the head of the bay must lie above it. On the west side of the bay the Parnell grit is not seen; and, in my opinion, it either thins out or passes below the Point Britomart beds. As, however, the section has two breaks, one in St. George's Bay and the other in Mechanic's Bay, nothing certain can be made out; but it is worthy of notice that the beds above the Parnell grit on the east side of St. George's Bay contain plant remains, as also do those at Point Britomart. Next, with regard to Mr. McKay's first statement: To the east of Parnell, between Resolution Point and Hobson's Point, there is a break across Hobson's Bay, a mile in length, in which nothing definite can be seen. It is, therefore, quite impossible for any one to say, from stratigraphical evidence, whether the beds at Hobson's Point are above or below the horizon of the Parnell grit, and consequently whether they are or are not the equivalents of the Point Britomart beds. It is indeed probable that, on the whole, the rocks of the Waitemata series get younger to the westward; but, although usually nearly horizontal, they are subject to strong local disturbances—as at Cape Horn, Freeman's Bay, Wangaparoa, and Parnell,—and it is as likely as not that the very oldest beds in the series may have been brought up at Parnell.

Neither can Mr. McKay produce any evidence of an unconformity below the Parnell grit. He says, "Respecting the question of an unconformity between the Orakei Bay beds and the higher miocene rocks, I should submit that, when estuarine muds and soft sandstones are suddenly succeeded by coarse volcanic agglomerate, there is, by whatever degree the unconformity is measured, most surely unconformity to a certain extent; and when it is determined that the beds above and below belong to different groups of formations—*e.g.*, the cretaceo-tertiary and the miocene—although no stratigraphical unconformity were apparent, the conclusion that there is such cannot be escaped."* Accordingly in his section from "Auckland north to Wade" he shows the Parnell grit highly unconformable to the underlying beds. The idea that an outbreak of volcanic energy must necessarily mark an unconformity may be passed over in silence; but if Mr. McKay had proved that the two sets of beds belonged to two different formations of very different ages, then all would allow that an unconformity was probable although it might not be apparent. But this is just what Mr. McKay has not done. He recognizes the few fossils found north of Lake Takapuna, above a bed supposed to be the Parnell grit, as miocene, and says that they differ from those found at Orakei; but he makes no reference to the fact that Mr. Cox had found the Orakei fossils mixed with miocene shells at

* *l.c.*, p. 106.

Komiti Point; and he makes no attempt to prove that the Orakei Bay beds are of cretaceo-tertiary age. He certainly says that the Mercer beds, which are generally thought to be the equivalents of the Waitemata series, "close the sequence of rocks succeeding the cretaceo-tertiary coal formation;" but this is a pure assumption unsupported by any evidence and abandoned by Mr. Cox as disproved.*

Mr. McKay also ignores altogether the opinion of the European palæontologists who have examined the fossils from Orakei Bay. Professor Rupert Jones examined the *Foraminifera*, and thought that they indicated a late tertiary period.† In the Palæontology of the Voyage of the Novara Herr Karrer says that these *Foraminifera* are probably of the same age as the Vienna Basin—*i.e.* miocene,—and Dr. Stoliczka thinks that the *Bryozoa* indicate a miocene or perhaps older pliocene age; while Professor Martin Duncan thinks that the Orakei Bay beds are probably the equivalents of the Mount Gambier series of South Australia, which he calls middle cainozoic,‡ and which are considered by all Australian geologists to be miocene. So that four well-known palæontologists all agree that these beds are not older than miocene.

The reason why the Orakei Bay beds were considered by the Geological Survey to be of cretaceo-tertiary age is stated by Mr. Cox. He says it was because *Pecten zittelli* and *Pecten fischeri* occurred in them; and he further says that "we have always considered *P. zittelli* to be a typical fossil in the cretaceo-tertiary series—indeed, to be almost confined to the *Leda* marls; and now to find it associated with a large number of Pareora fossils is apt to throw discredit on those fossils which we have considered as distinctive of any special horizon."§ But I am not aware that either of these species of *Pecten* has ever been found associated with cretaceous fossils. Both were described from rocks at Papakura, considered by Dr. Stache to be oligocene, and by Dr. Zittel to be eocene. *P. zittelli* also occurs at Cape Kidnappers|| in beds acknowledged both by Dr. Hector¶ and by Mr. McKay** to be miocene, and the finding of both species by Mr. Cox, in 1880, with acknowledged miocene fossils at Komiti Point, proved decisively that neither species can be taken as characteristic of cretaceo-tertiary rocks.

But there is still another point altogether omitted in Mr. McKay's report. If the "marly grits" containing Orakei Bay fossils at Komiti Point belong to

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* Reports of Geological Explorations, 1881, p. 36.

† Quar. Jour. Geol. Soc., xvi., p. 251 (1860).

‡ Quar. Jour. Geol. Soc., xxvi., p. 316 (1870).

§ Reports of Geological Explorations, 1879-80, p. 17.

|| Cat. Tertiary Mollusca of New Zealand, 1873, p. 32.

¶ Reports Geol. Exp., 1877-78, p. 190.

** Rep. Geol. Exp., 1874-76, p. 49, and Rep. Geol. Exp., 1878-79, p. 70.

the Waipara System, what is the age of the "chalk-marls and hydraulic limestone" which underlie them unconformably? These are also considered by Dr. Hector and Mr. McKay to be cretaceo-tertiary, and certainly they are not like any rocks in New Zealand that are older than the Waipara System. Again, if the Orakei beds belong to the Waipara System, what is the age of the green sandstones of Turanga and Papakura, which both Mr. Cox and myself have shown to underlie the Orakei Bay beds unconformably? Dr. Zittel considered the Papakura series to be of eocene age, that is, to belong to the Oamaru System, and if this be correct the Waitemata series must belong to the Pareora System. This conclusion is quite in accordance with the evidence, both stratigraphical and palæontological, at Komiti Point, and at Mahurangi, and is not contradicted by the fact that the Mercer beds are apparently conformable to the underlying marls, for it is quite possible that two systems may be conformable at one place although unconformable at other places.

It appears then (1.) That there is no evidence that the Orakei Bay beds are older than the Parnell grit; they may or may not be so; (2.) That there is no evidence of any unconformity in the Waitemata series between Auckland and the Tamaki; and (3.) That the evidence, both stratigraphical and palæontological, is altogether in favour of the Orakei Bay beds belonging to the Pareora System.

ART. XL.—*Descriptions of new Tertiary Shells.* PART I.

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

[*Read before the Philosophical Institute of Canterbury, 27th November*, 1884.]

Plate XVIII.

DURING the past year I have received several collections of fossils from Mr. S. H. Drew, of Wanganui, and from Mr. A. Hamilton, of Petane, near Napier, and I now offer descriptions of the new species so far as I have made them out. There are, in addition, a few species which, although not known in New Zealand, are living in Australia or Polynesia, e.g. *Drillia alabaster*, Reeve.

Ringicula uniplicata.

Shell minute, ovate, transversely finely striated. Whorls 4, those of the spire small and smooth. Aperture narrow, obliquely notched in front; the outer lip thickened, varicose; columella with a strong anterior plication.

Length, ·08 inch.

Locality. Petane.

Oliva neozelanica. Pl. xviii., fig 1.

Shell oblong, the spire acuminate, of 4–5 whorls, each of which has an anterior callous band covering nearly half the whorl: suture excavated. Aperture narrow, the columella twisted and with four or five spiral grooves anteriorly.

Length, 1·5 inch; breadth, ·63 inch.

Locality. Patea.

Perhaps the same as *O. australis*, Duclos.

Columbella varians. Pl. xviii., fig. 2.

Shell oblong, the spire prominent and acute. Whorls 7, flattened, spirally grooved. Grooves variable, sometimes only one on the anterior half of the whorl, sometimes several are equally distributed all over; generally there is a smooth band without grooves on each whorl; sometimes the spire whorls are quite smooth or with one or two grooves only. Suture deep. Aperture less than half the length of the shell, oval with the right lip flattened; the posterior canal well marked; columella smooth and rounded; the anterior canal very short; right lip toothed within.

Length, ·37 inch; breadth, ·15 inch. Length of aperture, ·14 inch.

Locality. Wanganui and Petane.

A variety occurs at Wanganui in which the whorls are longitudinally plicated.

Columbella pisaniopsis.

Shell fusiform, the spire produced and sharp. Whorls 7; the two first embryonic, smooth, polished; the others rounded, rather gibbous behind, and with rather close spiral ribs. Spire whorls and posterior portion of the body whorl with regular, but not strong, longitudinal plications. There are eighteen or twenty longitudinal plicæ on a whorl. The penultimate whorl has 7 or 8 spiral ribs, the body whorl has from 16 to 20. Suture well marked. Aperture narrow, roundly angled behind; the right lip sharp, toothed inside; the columella smooth.

Length, ·38 inch; breadth, ·17 inch. Length of aperture, ·15 inch.

Locality. Petane.

Columbella cancellaria.

Shell fusiform, the spire produced and sharp. Whorls 6 or 7, the first two embryonic, polished; the others slightly rounded and with strong spiral ribs crossed by longitudinal ribs which are not so strong as the spiral ones, dividing the surface into squares. There are 5 spiral ribs on the penultimate whorl, and about 15 on the body whorl; the grooves are rather broader than the ribs, and are longitudinally striated. The longitudinal ribs die away anteriorly on the body whorl. Suture well marked. Aperture narrow; the outer lip sharp, but thickened and toothed inside; the columella smooth.

Length, ·5 inch ; breadth, ·17 inch. Length of aperture, ·25 inch.

Locality. Petane.

Turricula planata. Pl. xviii., fig. 3.

Shell ovato-fusiform, the spire acute, but not so long as the body whorl. Whorls 7, the first 1½ embryonic, translucent, polished ; the others flattened, distantly longitudinally ribbed and obscurely spirally striated. About 12 or 13 ribs in a whorl. Aperture narrow, the right lip not thickened ; columella with four plaits.

Length, ·56 inch ; breadth, ·24 inch. Aperture, ·29 inch.

Locality. Wanganui.

Related to *T. microzonias*, Lam.

Turricula marginata. Pl. xviii., fig. 4.

Shell ovato-conical; the spire acute, longer than the body whorl. Whorls 6½, the first 1½ embryonic, smooth, polished ; the next 4 or 5 with about 14 longitudinal ribs on each whorl, which are crossed by fine spiral striæ. Suture margined. Body whorl finely spirally striated with obsolete longitudinal ribs. Aperture narrow, contracted in front ; the columella with four plaits.

Length, ·3 inch ; breadth, ·1 inch.

Locality. Wanganui.

Siphonalia (?) *cingulata.*

Shell small, rather thin, fusiform, the spire acute but shorter than the body whorl, not nodose nor ribbed. Whorls 5, the first two embryonic, smooth, usually sharply-shouldered ; the others rounded, finely spirally striated and delicately marked with growth-lines. Suture impressed. Aperture oval, the right lip thin ; anterior canal short, nearly straight.

Length, ·55 inch ; breadth, ·25 inch. Aperture, ·32 inch.

Locality. Wanganui.

A distinct species which should, perhaps, be placed in a new genus.

Cominella elongata. Pl. xviii., fig. 5.

Shell elongated, the spire acute and much longer than the aperture. Whorls 8, the first 2½ embryonic, polished ; the next 3 or 4 with about 10 or 11 longitudinal ribs ; the rest smooth. The spiral sculpture is five spiral lines, and, after the fourth or fifth whorl, some distant shallow grooves, of which there are about 9 on the body whorl. Aperture ovate, the posterior canal small but well marked ; the anterior end deeply notched.

Length, 1·25 ; breadth, ·5 inch.

Locality. Wanganui.

Terebra costata. Pl. xviii., fig. 6.

Shell turreted, smooth, polished, rather thick. Whorls 10–12 ; the first 2½ embryonic ; the others longitudinally ribbed ; about 11–15 ribs on a whorl. Suture well marked. No posterior band on the whorls. Aperture ovate; the columella twisted, produced into a short nearly straight canal. No posterior sinus.

Length, ·53 inch; breadth ·15 inch.

Locality. Wanganui.

Distinguished from *T. tristis* by the stronger and smaller number of the longitudinal ribs.

Clathurella hamiltoni. Pl. xviii., fig. 7.

Shell ovato-fusiform. Whorls 7–8, rather shouldered behind; the first 2½ embryonic, smooth; the others strongly longitudinally ribbed and crossed with fine spiral liræ. There are about 12–15 rounded, longitudinal ribs in a whorl, and the spiral liræ are small and close set. Aperture ovate, rather angled behind; posterior sinus obsolete; the anterior end deeply notched; inner lip reflected over the columella.

Length, ·65 inch; breadth, ·33 inch. Length of aperture, ·25 inch.

Locality. Petane. A small variety is also found at Wanganui.

Clathurella dictyota. Pl. xviii., fig. 8.

Shell minute, elongato-fusiform. Whorls 6, the first two embryonic; the others slightly angled and cancellated. Longitudinal ribs narrow and distant, about eleven in a whorl. Spire whorls with three strong distant spiral ribs, the interstices finely spirally striated; body whorl with about 9 spiral ribs, the posterior three larger, and alternating with a small rib between each, as well as the spiral striæ. Aperture oval, nearly half the length of the shell; posterior sinus broad and shallow; anterior canal moderate.

Length, ·23 inch; breadth, ·1 inch. Aperture, ·11 inch.

Locality. Wanganui and Petane.

This species approaches *C. oxyclathrus*, Martens, but the spiral ribs are fewer and further apart.

Clathurella abnormis.

Shell minute, mitriform, the spire produced and acute. Whorls 6½, the first 1½ embryonic, polished; the others angled, strongly longitudinally costate and delicately spirally lined. There are eleven longitudinal ribs on a whorl, which are crossed by three or four spiral threads in front of the angle, none behind it. On the body whorl, the spiral threads in front of the angle are about 12, some of which are stronger than others. Aperture linear; the right lip rather thick but not grooved; a posterior shallow sinus above the angle; columella smooth.

Length, ·2 inch; breadth, ·08 inch. Aperture, ·09 inch.

Locality. Petane.

Clathurella (?) *nexilis.* Pl. xviii., fig. 9.

Shell minute, fusiform, cancellated. Whorls 6, the two first embryonic, polished; the others angled. Those of the spire with a prominent spiral keel crossed by rather oblique and rather distant spiral threads, forming an obtuse angle on the keel. Suture margined. Body whorl with 8 or 9 spiral ribs, the first and third larger than the others; all after the sixth very close together on the canal; these are crossed by rather distant longitudinal lines which form a very obtuse angle on the first spiral rib or keel; aperture less than half the length of the shell, rather constricted and angled behind; columella straight, produced into a short canal.

Length, ·17 inch.

Locality. Wanganui and Petane.

Apparently near to *C. tricarinata*, Val., perhaps it should be considered as a species of *Drillia*.

Daphnella protensa.

Shell elongato-fusiform, with the spire longer than the body whorl, rather thin. Whorls 7, the first 2½ embryonic; the others ornamented with delicate spiral threads crossed by growth-lines; those of the spire rounded more or less longitudinally plicated; about 15 plications in a whorl. Suture well marked. Aperture oval, the anterior canal broad and short; posterior sinus small but well marked and giving rise to a series of curved growth-lines on the posterior portion of each whorl.

Length, ·33 inch; breadth, ·1 inch. Aperture, ·15 inch.

Locality. Petane.

Daphnella lacunosa.

Shell minute, sub-fusiform. Whorls 5, the first two embryonic, polished; the others slightly rounded, with strong spiral ribs at equal distances. Spire whorls with 3, body whorl with 10 or 12 of these ribs; the grooves are rather broader than the ribs and are smooth or very slightly longitudinally striated. Suture well marked. Aperture ovate, about half the length of the shell; the posterior sinus obsolete: anterior canal short; outer lip thin.

Length, ·18 inch.

Locality. Wanganui.

Natica (Ampullina) lævis. Pl. xviii., fig. 10.

Shell sub-globose, transverse, smooth, without any spiral markings. Whorls 4, the two first polished. Aperture broadly ovate, rounded in front; columella curved, the callus covering the umbilicus.

Length, ·78 inch; breadth, ·9 inch. Aperture, length, ·67 inch; breadth, ·5 inch.

Locality. Wanganui and Petane.

Sigaretus undulatus. Pl. xviii., fig. 11.

Shell sub-globose, smooth, ornamented with delicate, close, undulating spiral lines. Whorls 4½, the first 2½ polished. Aperture ovate, produced anteriorly; columella curved, the callus completely covering up the umbilicus.

Length, ·82 inch; breadth, ·82 inch. Aperture, length, ·65 inch; breadth, ·47 inch.

Locality. Wanganui and Petane.

Sigaretus (Naticina) cinctus. Pl. xviii., fig. 12.

Shell globoso-ovate, smooth, closely spirally grooved, the grooves shallow. Whorls 4½, the first three without spiral markings. Suture excavated. Aperture oblong; columella nearly straight; umbilicus widely open.

Length, ·6 inch; breadth, ·55 inch. Aperture, length, ·5 inch; breadth, ·28 inch.

Locality. Wanganui.

Eulima micans.

Shell minute, subulate, highly polished, slightly curved to the right. Whorls 6, flattened, suture almost obliterated, enamelled. Aperture oval, rounded in front and pointed behind, the columella curved.

Length, ·14 inch.

Locality. Wanganui.

Eulima media. Pl. xviii., fig. 13.

Shell minute, slightly polished, straight. Whorls 6 or 7, slightly convex, smooth, without any markings; suture impressed. Aperture ovate rounded in front but not pointed behind; columella curved to the right. Not umbilicated.

Length, ·14 inch.

Locality. Wanganui.

Doubtfully located; should perhaps be placed in *Eulimella.*

Eulimella deplexa.

Shell minute, slightly polished, straight. Whorls 6–7, flattened, smooth, without any markings; suture impressed. Aperture sub-quadrate; columella straight, callously reflected over the umbilical region.

Length, ·14 inch.

Locality. Wanganui.

Eulimella obliqua.

Shell minute, smooth, almost polished, slightly curved to the right. Whorls 7 or 8, the last slightly keeled in the middle; suture rather obscure. Aperture sub-quadrate, pointed behind; columella straight and parallel with the outer lip.

Length ·13 inch.

Locality. Petane.

Aclis costellata. Pl. xviii., fig. 14.

Shell minute, subulate. Whorls 6, rounded; the first two smooth and polished, the rest spirally grooved. Spire whorls with the two posterior spiral grooves deeper and broader than the others, and the rib between them raised higher; crossed by delicate longitudinal plications. Body whorl like those of the spire; the whole of the base very finely spirally grooved. Suture well marked. Aperture ovate, less than half the length of the shell; columella arched; umbilicus covered.

Length, ·13 inch.

Locality. Wanganui.

Odostomia sulcata. Pl. xviii., fig 15.

Shell large, ovato-elongate, spirally grooved, the spire slightly gradated. Whorls 8, flattened; those of the spire with 5 to 7 narrow grooves crossed by longitudinal growth-lines; body whorl with 18 to 20 grooves, the anterior of which are sometimes closer than the posterior. Suture impressed. Aperture ovate, pointed behind; columella with a single, posterior, oblique fold, almost or quite covering the umbilicus.

Length, ·62 to 1·0 inch; breadth, ·34 to ·43 inch.

Locality. Wanganui.

The form of this shell is very variable; the length is from 2 to 2½ times the breadth.

Odostomia georgiana. Pl. xviii., fig 16.

Shell rather elongated, shining. Whorls 10, flattened, polished, irregularly longitudinally marked, but without any spiral sculpture; body whorl very obtusely keeled. Suture impressed. Aperture oval, pointed behind; columella with a single deep, posterior, oblique fold, nearly or quite covering the umbilicus.

Length, ·58 inch; breadth, ·22 inch.

Locality. Wanganui.

Named after Mr S. H. Drew's son, an indefatigable collector.

Odostomia (Parthenia) plicata. Pl. xviii., fig 17.

Shell minute, ovato-elongated, longitudinally plicated. Whorls 6, flattened, irregularly longitudinally, rather strongly, plicated on the posterior half only; the anterior half of the body whorl smooth; the whole shell faintly spirally striated. Suture impressed. Aperture ovate; columella with a single, rather strong, fold; the umbilicus covered.

Length, ·12 inch.

Locality. Wanganui and Petane.

Odostomia (Pyramis) fasciata.

Shell minute, ovato-elongated, faintly spirally striated. Whorls 5, the first rounded and polished, the rest flattened; those of the spire with three shallow spiral grooves at the posterior end, a broad smooth band in the centre and a single spiral groove at the anterior end. Body whorl with numerous spiral grooves in front of the smooth band. Suture impressed. Aperture ovate; columella with a single nearly obsolete fold; umbilicus open.

Length, ·14 inch.

Locality. Wanganui.

Cancellaria lacunosa.

Shell ovato-fusiform, not umbilicated, the spire produced. Whorls 6, the first two embryonic; the others rounded, spirally ribbed and longitudinally plicated. Spiral ribs three on the spire whorls, and seven or eight on the body whorl, with fine spiral threads between them. Longitudinal plications numerous and rather oblique, about 15 in a whorl. Aperture broadly ovate; columella with three strong folds; no anterior notch; outer lip acute.

Length, ·43 inch; breadth, ·36 inch.

Locality. Petane.

Admete (?) *ambigua.* Pl. xviii., fig. 18.

Shell minute, ovate, perforated, spirally striated. Whorls 4, the first two smooth, the others rather convex, spirally grooved, about 18 or 20 grooves on the body whorl. Suture well marked. Aperture ovate, more than half the length of the shell; columella smooth, rather produced in front, not covering the umbilicus.

Length, ·08 inch.

Locality. Wanganui.

Turritella (Eglisia) planostoma. Pl. xviii., fig. 19.

Shell minute, turreted. Whorls 8 or 9, flattened, the anterior portion concave, smooth. Spire whorls with four strong, equal, spiral ribs. Body whorl with five or six spiral ribs and a smooth base. Suture well marked. Aperture ovate, flattened anteriorly, and the outer lip rather straight.

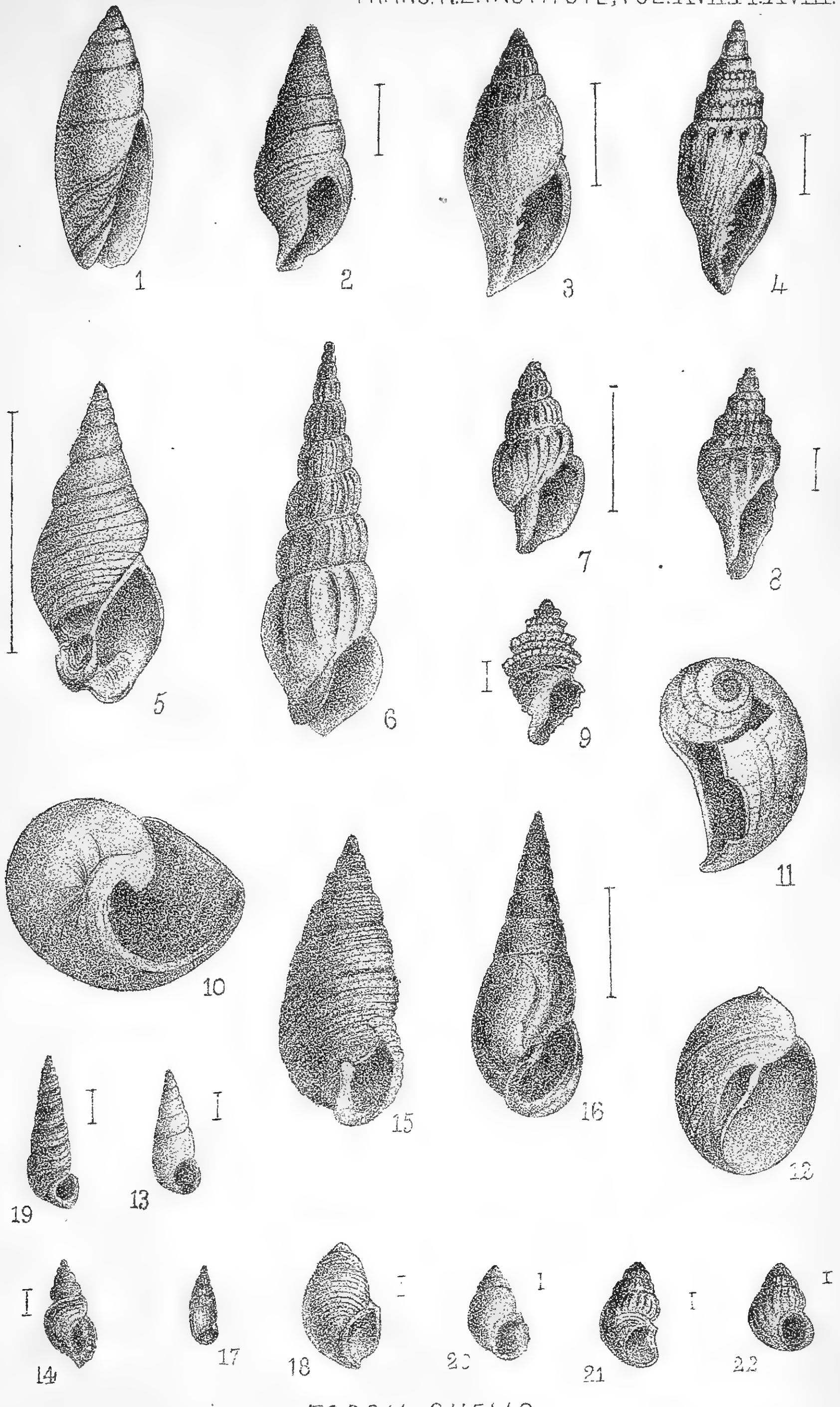
Length, ·2 inch.

Locality. Wanganui and Petane.

Rissoa emarginata. Pl. xviii., fig. 20.

Shell minute, ovato-conical, smooth, polished, very delicately spirally striated. Whorls 6, flattened, the two first very small and smooth. Suture obscure. Aperture ovate, the peristome continuous; slightly notched anteriorly.

Length, ·08 inch.



FOSSIL SHELLS.

F.W. Hutton del.

Locality. Wanganui and Petane.

Rissoa semisulcata.

Shell minute, pupiform, thick. Whorls 5, flattened; the first three or four smooth; the last, or the two last, smooth anteriorly, but with four shallow but well marked spiral grooves on the posterior half. Suture distinct. Aperture roundly ovate, not notched anteriorly; peristome continuous.

Length, ·1 inch.

Locality. Wanganui.

Rissoa rugosa.

Shell robust, pupiform, roughish. Whorls 6 or 7; the first 1½ polished, the others of the spire longitudinally plicated with one spiral rib and a sulcus behind and two in front of the plications; plications more or less nodulose. Body whorl sometimes not longitudinally plicated, the posterior half with about 8 spiral ribs, the anterior half smooth. Aperture broadly ovate, the peritreme continuous and rather patulous.

Length, ·17 inch.

Locality. Petane.

Rissoa impressa.

Shell small, pupiform. Whorls 5, the two first smooth; the others longitudinally plicated; base of the body whorl smooth; a single spiral groove just below the suture, which is margined. Aperture broadly ovate; peritreme continuous and rather patulous.

Length, ·08 inch.

Locality. Petane.

Rissoa gradata. Pl. xviii., fig. 21.

Shell small, ovate, cancellated. Whorls 5, gradated; the two first smooth and polished; the others longitudinally and spirally ribbed. Longitudinal ribs about 15 in a whorl. Spirals—a posterior one near the angle, and two anterior ones with a smooth band between. On the body whorl there are about 7 spirals in front of the smooth band and the longitudinals become obsolete. Suture impressed. Aperture roundly ovate, not notched in front; peritreme continuous.

Length, ·1 inch.

Locality. Wanganui and Petane.

Scalaria nympha.

Shell small, turreted. Whorls slightly rounded, very finely spirally striated and longitudinally ribbed. About 18 or 20 ribs and one or two varices in each whorl. Suture impressed. Body whorl keeled anteriorly, all the longitudinal ribs ending abruptly at the keel; the base slightly concave and smooth below the keel. Aperture sub-rotund.

Length, ·3 inch (?, specimen broken); breadth, ·12 inch.

Locality. Petane.

Scalaria corulum. Pl. xviii., fig. 22.

Shell minute, ovate, slightly perforated. Whorls 5, very convex, the two first smooth, the others longitudinally ribbed; about 22 to 24 ribs in a whorl; the interstices finely spirally lined; suture deep; body whorl rounded. Aperture roundly ovate, the peritreme continuous.

Length, ·06 inch.

Locality. Wanganui.

Zizyphinus ponderosus.

Shell large, solid. Whorls 5 or 6, flattened, the periphery roundly angled; with distant smooth spiral ribs, which are closer together on the posterior part of the whorls; suture distinct; base with about 12 fine spiral ribs. Aperture rhomboidal, the umbilical callus large.

Length, 1·4 inch; breadth, 1·7 inch.

Locality. Wanganui.

Differs from *Z. decarinatus* by the periphery being more rounded, the base not so flattened, and the umbilical callus larger, as well as in the whole shell being much thicker.

Hemimactra crassa.

Shell trigonal, sometimes nearly as high as long, massive, inequilateral, rather rudely concentrically striated. Anterior dorsal margin straight, or slightly concave; posterior dorsal margin slightly convex, larger than the anterior margin, the posterior slope barely keeled; ventral margin curved. Left valve with a single strong elongated lateral tooth on each side. Right valve (?). Pallial sinus very shallow and rounded.

Length, 1·6 inch; height, 1·4 inch.

Locality. Wanganui.

Tellina angulata.

Shell ovato-trigonal, transverse, compressed, inequilateral, anterior end longer, regularly concentrically grooved. Posterior end truncated, and with a well marked fold on the left valve. Anterior dorsal margin convex, the posterior dorsal margin slightly concave, ventral margin rounded in front and flattened behind. Right valve with two cardinals, the anterior bifid. Left valve with two cardinals, the posterior bifid. Posterior laterals obsolete.

Length, 1·3 inch; height, ·85 inch; thickness, ·35 inch.

Locality. Wanganui.

Tellina retiaria.

Shell ovato-trigonal, compressed, sub-equilateral, the anterior end shorter, finely and rather distantly concentrically lamellated, and decussated with radiating lines. Posterior fold obsolete. Anterior dorsal margin slightly convex, the posterior also slightly convex, ventral margin rounded. Left valve with two cardinal teeth, the anterior bifid; posterior lateral tooth small, the anterior one obsolete. Right valve (?).

Length, ·58 inch; height, ·46 inch.

Locality. Wanganui.

Kellia robusta.

Shell orbiculo-triangular, nearly as high as long, compressed, nearly equilateral, very delicately regularly concentrically striated. Anterior and posterior dorsal margins nearly straight, sub-equal, the anterior rather the steeper; ventral margin and both ends rounded. Right valve with a lateral tooth on each side, both of which are nearly parallel with the margin. Anterior tooth the stronger of the two.

Length, ·12 inch; height, ·11 inch.

Locality. Petane.

Kellia effossa.

Shell oblongo-triangular, nearly equilateral, rather swollen, rather coarsely irregularly concentrically striated. Anterior dorsal margin rather concave, the posterior one rather convex, ventral margin flattened, the two ends rounded. Right valve with a lateral tooth on each side and a flattened concave portion in the centre; posterior lateral sharp and nearly parallel to the margin; the anterior thickened and curved inward forming a deepish pit between it and the dorsal margin. Left valve with a lateral tooth on each side and a cardinal tooth in the centre, sloping backward.

Length, ·13 inch; breadth, ·1 inch.

Locality. Petane.

Loripes concinna.

Shell small, sub-orbicular, the umbos turned forward, truncated behind, compressed, regularly very finely concentrically grooved. Anterior dorsal margin hollowed under the umbo, then convex; posterior dorsal margin slightly convex, descending suddenly near the posterior end; anterior end sometimes slightly undulated; ventral margin rounded. Lunule lanceolate. Anterior adductor impression elongated. Teeth: right valve one cardinal, the posterior lateral obsolete; left valve with two diverging cardinals, the laterals obsolete.

Length, ·3 inch; height, ·27 inch.

Locality. Wanganui and Petane.

Mysia ampla.

Shell sub-orbicular, rather thick, concentrically striated; posterior dorsal margin slightly concave, the anterior dorsal margin slightly arched. Interior rough, slightly radially striated, the adductor impressions and pallial line well marked. Hinge moderate; left valve with two diverging cardinal teeth, the anterior of which is grooved; lateral teeth obsolete.

Length, 1·55 inch; height, 1·47 inch.

Locality. Wanganui.

Mytilicardia trigonopsis.

Shell small, higher than long, strongly radiately ribbed. Ribs ten, nodular, the interstices strongly concentrically striated. Anterior margin straight, long; posterior dorsal margin straight, short, then suddenly bent down; ventral margin regularly curved.

Length, ·13 inch; height, ·15 inch.

Locality. Wanganui and Petane.

Anomia undata.

Placunomia, sp. ind., Cat. Tert. Moll. of N.Z. (1873), p. 34.

Shell broadly oval, transverse. Upper, or left, valve thin, rather inflated, the surface gently rather regularly waved; the undulations take different directions on different shells, but are more or less parallel on the same individual. Muscular impressions three, confluent, forming a long oval mark sloping from before the umbo to the centre of the shell; the upper one the largest, the other two sub-equal.

Length, ·83 inch; breadth, ·7 inch.

Locality. Petane.

EXPLANATION OF PLATE XVIII.

1. Oliva neozelanica.
2. Columbella varians.
3. Turricula planata.
4. Turricula marginata.
5. Cominella elongata.
6. Terebra costata.
7. Clathurella hamiltoni.
8. Clathurella dictyota.
9. Clathurella nexilis.
10. Natica lævis.
11. Sigaretus undulatus.
12. Sigaretus cinctus.
13. Eulima media.
14. Aclis costellata.
15. Odostomia sulcata.
16. Odostomia georgiana.
17. Odostomia plicata.
18. Admete ambigua.
19. Turritella planostoma.
20. Rissoa emarginata.
21. Rissoa gradata.
22. Scalaria corulum.

PART II.

[*Read before the Wellington Philosophical Society, 13th February*, 1885.]

THE following new species are chiefly from the collection in the Canterbury Museum, which Dr. von Haast very kindly allowed me to examine. But I have also added a few which I obtained in the Hawke's Bay District last January.

Tornatellina ovalis.

Shell ovate rather thin, spirally grooved; whorls 5, rounded; the two first smooth, the others with smooth spiral ribs much broader than the grooves, which are longitudinally striated; ribs about 16 on the body whorl, and 6 or 7 on the penultimate whorl. Aperture ovate, pointed behind; columella with a single strong, sharp, fold about half-way up.

Length, ·17 inch; breadth, ·08 inch.

Locality. White Rock River.

Ancillaria lata.

Shell broad, tapering anteriorly; the spire short and obtuse, covered with a large callus extending over the posterior portion of the body whorl. The rest as in *A. australis.*

Length, 1·65 inch; breadth, ·9 inch.

Locality. Petane and Wanganui.

Distinguished from *australis* by its greater breadth and obtuse spire, but there are intermediate varieties. *A. hebera*, with which it has been confounded, differs in having the sides nearly parallel and the spire longer.

Voluta aculeata.

Shell small, fusiform, the spire produced, acute; whorls 6 (?), longitudinally ribbed, the posterior end of each rib rising into a sharp tubercle pointing outwards; ribs low, rounded, 8 in a whorl; suture covered up. Aperture rather narrow, the outer lip not reflexed; columella with four plaits.

Length, ·8 inch; breadth, ·33 inch.

Locality. White Rock River.

Voluta kirkii, v. *kirki*, Hutton, Cat. Tert. Moll., p. 7, 1873.

Shell ovato-fusiform; spiral short, acute, the whorls smooth; body whorl longitudinally subplicate, rounded at the shoulder and narrowing anteriorly; the plications rising into a row of tubercles below the shoulder; there are 8 or 9 in a whorl. Aperture moderate, with a posterior callus. Columella plaits not seen.

Length, 3·5 inch; breadth, 2·0 inch. Length of aperture, 2·6 inch.

Locality. Porter River.

Mitra inconspicua.

Shell fusiform, tapering nearly equally towards both ends from about the middle; quite smooth. Whorls 6–7, rather flattened, but the suture is well marked. Aperture narrow, produced anteriorly into a short canal, which is very faintly spirally striated; columella plaits four, subequal and equidistant.

Length, ·65 inch; breadth, ·28 inch.

Locality. Mount Harris and Waihao greensands.

Much like *M. grœnlandica*, Gray, but narrower anteriorly.

Turricula lincta.

Shell minute, fusiform, broadest in the middle, smooth and shining. Whorls 6, the two first embryonic, the others angled; those of the spire with numerous small longitudinal nodules, which get smaller and disappear altogether on the body whorl. Suture covered. Posterior portion of the whorls slightly concave. Body whorl spirally striated at the anterior end. Aperture narrow; columella with four plaits, the anterior one being very small.

Length, ·2 inch.

Locality. Petane.

Siphonalia orbita.

Shell fusiform, spire produced, acute. Whorls 8, the first 2½ embryonic, the others with distant strong spiral ribs. Spire whorls shouldered and slightly longitudinally plicated, marked with growth-lines and with 3 or 4 spiral ribs; the space above the shoulder without any spiral ribs, slightly concave, overlapping the suture. Body whorl rounded, with about 14 spiral ribs, which are flattened and narrower than the grooves. Aperture oval; anterior canal moderate, slightly recurved.

Length, 1·45 inch; breadth, ·75 inch.

Locality. Greta, Canterbury.

Like *mandarina* in shape, but distinguished by the regular distant spiral ribs.

Pisania media.

Shell fusiform, spire acute, without longitudinal ribs. Whorls 7, the first two embryonic, polished; the others finely spirally ribbed; about 14 of these ribs on the penultimate whorl just above the mouth; suture well marked. Aperture ovate; canal short.

Length, 1·0 inch; breadth, ·45 inch.

Locality. Waikari; Pareora; and White Rock River.

Of the same shape as *P. lineata.* It is more strongly spirally marked than *P. striata* and less so than *P. drewii*; the latter having only about 6 or 7 spiral ribs on the penultimate whorl above the mouth.

Nassa (Tritiaria) cingulata.

Shell elongato-ovate, the spire produced, acute. Whorls 7½, the first two embryonic, the others rounded, spirally and longitudinally ribbed; about 6 spiral ribs on the spire whorls and 12–14 on the body whorl; about 18 longitudinal ribs on a whorl: some of the spiral ribs are double. Aperture ovate; a small posterior sinus; anterior canal very short and recurved; columella and right lip smooth; callus on inner lip small but defined.

Length, 1·05 inch; breadth, ·47 inch. Aperture, ·42 inch.

Locality. Greta, Canterbury.

Perhaps a *Cominella.*

Cominella monilifera.

Shell small, ovate, the spire rather short. Whorls 5–6, the first two embryonic, the others longitudinally and spirally ribbed; about 14 longitudinal low ribs on the body whorl, the intervals as broad as the ribs; 11–12 spiral ribs on the body whorl, close, making the longitudinal ribs nodulose; posterior portion of the whorls concave, covering the suture. Aperture ovate, the posterior canal strongly marked; anterior canal quite short; outer lip thickened, toothed inside.

Length, ·68 inch; breadth, ·44 inch.

Locality. Shepherd's Hut, Waipara.

Terebra biplex.

Shell turreted; whorls 9 or 10, flattened, longitudinally ribbed; ribs 13 in a whorl, sharp, straight or slightly curved, usually higher at each end than in the middle, especially on the anterior whorls of the shell; on the body whorl they end suddenly at the shoulder. Aperture oval; a posterior sinus apparent; anterior canal short, not much twisted.

Length, ·7 inch; breadth, ·2 inch.

Locality. Pareora.

Differs from other New Zealand species in the shouldered whorls and peculiar ribs.

Clathurella cincta.

Shell fusiform, the spire produced and acute. Whorls 7–8, rounded, the first two smooth, the others longitudinally plicated and spirally ribbed; plications low, about 10 in a whorl; spiral ribs strong, distant, narrow, 5 on the penultimate whorl, of which the two posterior are smaller. On the body whorl there are 16–18, some of which are alternately larger and smaller; suture well marked. Aperture ovate, produced into a short anterior canal.

Length, ·35 inch; breadth, ·15 inch.

Locality. White Rock River.

Clathurella rudis.

Shell fusiform. Whorls 7, convex, with large, rounded, longitudinal ribs, which are broader than the interstices; there are 9 on a whorl, rising abruptly at the posterior end and dying away anteriorly; those of the body whorl scarcely reaching half its length. Spiral ribs weak, about as broad as the interstices, 9 on the spire whorls and 20–25 on the body whorl. Aperture ovate, produced into a short anterior canal.

Length, ·43 inch; breadth, ·22 inch. Aperture, ·22 inch.

Locality. Waihao, in green-sand.

Clathurella leptosoma.

Shell small, elongato-fusiform, the spire produced and acute. Whorls 6–7, the first two smooth, the third spirally striated, the others longitudinally ribbed and spirally striated; all the whorls after the third slightly angled. On the body whorl the longitudinal ribs are obsolete; spire whorls with two strong spiral striæ and other smaller ones; body whorl with the two strong spiral striæ followed by about 20 small ones, regular and equidistant. Aperture narrow, angled behind, produced anteriorly into a short canal.

Length, ·25 inch; breadth, ·08 inch.

Locality. White Rock River.

Clathurella incisa.

Shell fusiform. Whorls 6–7, rounded, the first two embryonic, the others longitudinally plicated and strongly spirally ribbed. Longitudinal plications 16 in a whorl; spiral ribs 9 on the penultimate, and 13 on the body whorl; posterior spiral ribs about their own breadth apart, but the four anterior ones on the body whorl further apart. Aperture ovate, produced into a short anterior canal.

Length, ·8 inch; breadth, ·42 inch.

Locality. Te Aute, Hawke's Bay. Collected by Mr. A. Hamilton.

Spiral ribs much stronger than in *C. hamiltoni.*

Cassis senex.

Struthiolaria senex, Hutton, Cat. Tert. Moll. of N.Z., p. 11.
Purpura excursa, Hutton, *l.c.*, p. 6 (1873).

An excellent specimen from Pareora shows that this species is a *Cassis.* The inner lip has a large callus and is slightly rugose in front. The whole shell is finely spirally striated, and there is sometimes a third row of nodules on the body whorl. There are 12–17 nodules in a row on each whorl.

Cerithium bicorona.

Shell subulate. Whorls flattened, spirally striated, the posterior half with two rows of longitudinally elongated nodules, of which there are about

19 or 20 in a whorl, the whole crossed by growth-lines. Aperture, apparently, ovate, produced anteriorly into a well-marked and much-twisted canal.

Length, (?); breadth, ·27 inch.

Locality. Tutaekuri River, Hawke's Bay. Collected by Mr. Winkleman.

A fragment only, but so well marked as to deserve description.

Struthiolaria obesa.

Shell globoso-ovate, smooth or finely spirally striated. Whorls 5–6, convex, the suture covered. Body whorl inflated, very slightly flattened in the middle. Aperture broadly ovate; columella much bent, and with a large callus extending to the posterior end of the aperture; outer lip thick, reflexed, slightly produced in the middle.

Length, 1·75 inch; breadth, 1·4 inch.

Locality. Shepherd's Hut, Waipara.

Struthiolaria frazeri.

Shell large, elongated, spirally grooved. Whorls 6–7, keeled and flattened laterally so that the spire is distinctly gradated. Usually a row of small tubercles on the keel, about 10 on a whorl. On both sides of the keel the whorls are deeply spirally grooved; three or four grooves behind the keel, and four or five in front of it, on the spire whorls. Body whorl with about ten spiral grooves in front of the keel; the anterior part of the shell is spirally striated only. Aperture ovate; inner lip with a large continuous callus, the columella slightly bent; outer lip reflexed, produced in the middle.

Length, 3·0 inch; breadth, 1·8 inch.

Locality. Kikowheru Creek, Hawke's Bay.

This species has been thus named by Dr. Hector.

Trochita alta.

Shell sub-circular, conical, high. Apex sub-central.

Height, ·65 inch; diameter, 1·0 inch.

Locality. Kikowheru Creek, Hawke's Bay.

Distinguished from *T. scutum* by its great height; but intermediate forms occur.

Eglisia striolata.

Shell minute turreted. Whorls 8, rounded, the suture deeply impressed, delicately spirally striated; two of the striations usually more prominent than the rest; sometimes almost smooth. Aperture broadly ovate or subrotund, the columella bent.

Length, ·15 inch.

Locality. White Rock River.

Scalaria marginata.

Shell large, elongated, imperforate. Whorls (?), flattened, distantly longitudinally ribbed, 8 in a whorl, sub-equal, the interstices smooth or very delicately spirally lined; the whorls sharply keeled at the base, the keel shows in the spire whorls just above the suture; the longitudinal ribs end at the spiral keel; base of the body whorl concave, smooth. Aperture (?).

Length, (?); breadth, ·7 inch.

Locality. Curiosity Shop.

A fragment only of this very well-marked species is in the Canterbury Museum.

Trochus nodosus.

Shell small, conical, imperforate, the spire acute. Whorls 6–7, flattened, keeled, below the keel bent parallel to the axis; keel placed a little above the suture and with a single row of tubercles, about 9 on a whorl. Body whorl bent vertically below the keel for a short distance and then flattened, giving a double keel to the body whorl, the lower of which is smooth; base spirally striated; apparently no umbilical callus. Aperture rhomboidal. The whole surface of the shells appears to be finely cancellated with spiral and longitudinal lines.

Length, ·54 inch; breadth, ·45 inch.

Locality. White Rock River.

Corbula humerosa.

Shell small ovato-trigonal, much inflated, smooth, with irregular growth lines; sub-equilateral, slightly produced and rounded posteriorly, not carinated.

Length, ·25 inch; height, ·18 inch.

Locality. White Rock River.

Corbula pumila.

Shell small, ovate, concentrically sulcated; sub-equilateral, slightly produced and truncated posteriorly; slightly angled.

Length, ·3 inch; height, ·22 inch.

Locality. White Rock River.

Differs from *C. erythrodon* in being shorter and less angled behind. From *C. sulcata* it differs in being larger, more compressed, and in the sulci being smaller and more numerous.

Pholadomya neozelanica.

Shell oblong, very inequilateral, moderately ventricose, the posterior end compressed. Concentrically ridged, about 12 to an inch; the ridges rounded, broader than the grooves. Central portion radiately ribbed, ribs moniliform, not so strong as the concentric ornamentation, about 20 in number, the two anterior further apart. Anterior dorsal margin very short; the posterior dorsal margin slightly concave. Anterior end flatly rounded. Ventral margin flatly rounded. Posterior end rounded.

Length, 2·75 inch; height, 2·0 inch.

Locality. Oamaru and Broken River.

The type is in the Otago University Museum, from Oamaru. It was presented by Mr. J. Ashcroft, but the exact locality is not known.

Mactra lavata.

Shell oval, thin, inequilateral, smooth, rather compressed. Dorsal slopes nearly straight, the posterior much longer. Ventral margin rounded. Posterior end tapering, but not truncated nor angled. The whole shell with very fine concentric lines which are seen, under a lens, to be crossed by excessively minute radiating lines, giving a delicate granulated appearance. Right valve with two strong anterior and two equally strong posterior lateral teeth; short and high, the inner on both sides being higher than the outer. Left valve with one lateral on each side; longer than those of the right valve.

Length, ·9 inch; height, ·75 inch; thickness, ·42 inch.

Locality. Petane. Collected by Mr. A. Hamilton.

Loripes laminata.

Shell small, orbicular, the umbo turned forwards, compressed, finely distantly laminated and radiately striated between the lamellæ. Dorsal anterior margin hollowed; the posterior dorsal margin slightly convex; the ventral margin rounded. Anterior muscular impression elongated.

Length, ·28 inch; height, ·27 inch.

Locality. White Rock River.

Differs from *L. concinna* in the greater distance of the lamellæ and in the radiate striation.

Macrodon (Cucullaria) australis.

Right valve. Shell transversely sub-oval, inequilateral, moderately inflated, radiately finely ribbed, the ribs apparently scaly. There are about 60 of these ribs near the margin, but many die out towards the umbo. Margin of shell crenated; the posterior margin perpendicular to the hinge line. Umbos rather anterior, incurved, slightly separated. Hinge area narrow, crossed obliquely by one anterior and one posterior line radiating from the umbo. Hinge line very slightly curved; two or three small teeth below the umbo, in front of which are four and behind it five teeth, all of which are nearly parallel to the hinge line; making about 12 teeth in all.

Length, ·5 inch; height ·4 inch.

Locality. White Rock River and Mount Horrible.

Scaphula (?) *lanceolata*.

Right valve. Shell small, thin, compressed, smooth, much elongated, not carinated behind, very inequilateral. Anterior portion short, rounded. Posterior portion elongated, gradually tapering, truncated at the end. Posterior dorsal margin straight. Hinge line straight posteriorly, curved anteriorly, edentulous in the centre. Eight anterior and eleven posterior teeth all nearly parallel to the hinge line. The three or four most anterior teeth are short, all the rest are elongated. From the umbo a narrow concave cartilage pit slopes very obliquely backwards, and divides the two sets of teeth.

Length, ·7 inch; height, ·25 inch.

Locality. Petane. Collected by Mr. A. Hamilton.

Probably a new genus, as the shape is very different from the Indian shells and the posterior teeth are not branched.

Mytilus striatus.

Shell elongated, inflated anteriorly, compressed posteriorly; finely radiately ridged and crossed by concentric rugose growth-marks. Umbo acute, terminal, compressed, strongly curved ventrally. Ventral margin slightly undulating; dorsal margin rapidly rising from the umbo to about a third of the length, then parallel to the ventral margin; posterior end truncated.

Length, 1·15 inch; height, ·52 inch.

Locality. Broken River.

Art. XLI.—*On the Geological Structure of the Southern Alps of New Zealand, in the Provincial Districts of Canterbury and Westland.* By Professor Julius von Haast, C.M.G., Ph.D., F.R.S.

[*Read before the Philosophical Institute of Canterbury, 27th November*, 1884.]

The publication of a new geological map of New Zealand accompanied by sections, issued by the Geological Survey Department, induces me to offer the following remarks on the geological structure of the Southern Alps, which I consider in some of its most essential features to have been altogether misunderstood by the officers of that survey.

In my former publications I stated that the Southern Alps are only the eastern wing of a huge anticlinal arrangement, of which the western portion has been either destroyed or submerged below the Pacific Ocean. It thus exhibits the same one-sided features so conspicuous in almost every alpine chain of which the geological structure is known.

The lowest beds on the western slope are gneiss-granites, overlaid by mica, chlorite and other metamorphic schists of similar origin. These rocks are followed by clay-slates, semi-crystalline sandstones and felstones, which in some instances form not only the summits of the central chain, but even reach several miles across to its eastern slopes. They generally contain quartz veins. Upon them reposes the great sandstone, conglomerate, clay-slate and shale formation, of which the greatest portion of the Provincial District of Canterbury is composed, and which in many instances can be followed for nearly seventy miles to the east. I have named this extensive series of rocks the Mount Torlesse formation. On the eastern side of the great anticlinal it forms a succession of huge folds, dipping throughout at high angles, but these folds have been so much destroyed during numberless ages, that at present their synclinals generally form the summits of the mountains, while the deep broad valleys often run along their anticlinals. Besides this folding a great deal of crumpling has taken place, so that, although the general character of the arrangement has been preserved, over a short space of ground the strata often strike and dip in all directions of the compass. During my first journey to the head-waters of the river Rangitata, in 1861, I discovered in the Clent Hills a series of beds containing numerous impressions of plants, and some twelve miles distant in the Rangitata Valley at Mount Potts other beds containing fossil shells and saurian bones. Professor F. McCoy, in Melbourne, to whom I sent the collections made, for identification and description, informed me that the plants were of Jurassic and the molluscs mostly brachiopods of Upper Devonian or Lower Carboniferous age, both being identical with exuviæ found in the coal fields of New South Wales. However, judging from the position and sequence of the strata in both localities, agreeing with each other in a remarkable manner, though the Mount Potts beds are of much greater thickness, I could not accept this conclusion, being convinced that they were of the same age. Since that time it has been proved by a number of experienced geologists, that the beds in New South Wales, to which Professor McCoy alluded, are interstratified, and that consequently they must be of the same age.

Both palæontologists and geologists have agreed that if there exist in any geological horizon beds containing a marine fauna of an older together with a terrestrial flora of a younger aspect, the former will more correctly indicate the age of the beds. Thus, if the fossil shells of any given formation have a palæozoic and the plants a mesozoic character, the beds in which both occur have to be classified as palæozoic.

It would be foreign to the object of this paper were I to enter more fully into this important question, but I may observe that both in India and

South Africa a similar mixing of an apparently older marine fauna with a younger terrestrial flora has been observed, and that universally it has been admitted that the same explanation as that given for the coal fields in New South Wales has also to be applied to both those countries.

Considering the same character and sequence of the rocks overlying both the shell and plant beds, I have always held that the facts observed in New South Wales should guide us in New Zealand, and consequently that the beds under review ought to be classified as young palæozoic. In the geological maps, issued by the director of the New Zealand Geological Survey in 1869 and 1873, this view was accepted, and consequently the whole of the eastern portion of the Southern Alps was so coloured. However, since then the director himself, as well as the officers of the Geological Survey, have visited and revisited that portion of the colony with the result that the experience gained in New South Wales has been put aside or ignored, and that beds not only having the same lithological character, but situated in the same horizon, have now been divided solely according to their fossil contents, thus creating such an utter confusion that it will take years of hard work to put matters right again.

Thus instead of the eastern sides of the Southern Alps forming one wing of the great anticlinal, a synclinal arrangement has been given to the series of beds, a broad zone of mesozoic rocks forming the central portion lying between Mount Torlesse and Mount Hutt on the one side and the higher portion of the central chain on the other side which have been put down as palæozoic, thus reversing the facts, which examination in the field and experience elsewhere have taught us to be correct.

It would be quite impossible to pass in review the whole of the publications of the Geological Survey upon which these conclusions have been based; but a few observations in further explanation of the points at issue may not be amiss. Since the Clent Hills plant beds were discovered by me, further localities have been found at Mount Harper, in the Malvern Hills on both sides of the Selwyn, in the Taylor Stream, in the Mount Hutt Range, in the high Mount Somers Range, near the foot of the high ranges east of Lake Coleridge, near the Coleridge Pass, and some few other localities. In fact they generally appear where great denudation has taken place, and thus the lowest strata of the formation under review have become exposed; but now for a number of years this unmistakable position has invariably been explained by the officers of the Geological Survey, by their assertion that these plant beds were lying either above or against the strata containing the marine shell beds, or they simply denied the facts, against all evidence brought forward.*

* See amongst other instances Geological Survey Reports, 1879-80, p. 106.

Returning to the Mount Torlesse formation, which Dr. Hector in his annual Geological Survey Report classifies as Carboniferous (or Maitai series), the only fossil upon which reliance is placed, is a peculiar annelid; this annelid, however, of which well-authenticated specimens are in the Canterbury Museum, has been found in numerous other localities now marked mesozoic on Dr. Hector's map.

Any one knowing the character of the rocks in our eastern chains, close to the Canterbury Plains, will be rather astonished to see that a few miles north of the Waimakariri, in the northern continuation of Mount Torlesse, the Puketeraki Range, the Mount Torlesse formation comes abruptly to a close, and only mesozoic (Permian, however, included) continue towards the north. I know this range well, having crossed it in various directions repeatedly, and I can simply affirm that no change of formation takes place, but that the character of the rocks up to the Hurunui is exactly the same. Of course I have to repeat what I stated in my Report on the Geology of Canterbury and Westland, on page 279, that it is even more than probable that this huge assemblage of beds may belong to several distinct periods, ranging from the palæozoic to the lower mesozoic; but hitherto it has been impossible to divide this (Mount Torlesse) formation, for the present at least, into smaller groups, owing to the want of fossils. Since this was written, beds with triassic fossils have been found in the Okuku Range, lying east of the Puketeraki Range, so that there is evidence of younger rocks existing near or amongst the older Mount Torlesse formation. It would have been far more suitable to have marked clearly those localities in the map, than to have coloured all their surroundings of the same age, without being able to bring forth the necessary proofs.

Dr. Hector now classifies the Mount Potts beds as Permian. It is not my object to defend the opinions of such an excellent palæontologist as Professor McCoy, who classifies them as Lower Carboniferous or Upper Devonian, but it is greatly to be regretted that we have still, I fear, to wait for an indefinite period for a reliable description of the older New Zealand fossils, which ought to have been published years ago, and without which we are still groping in the dark.

In the volume of Geological Reports, containing the geological map of New Zealand, I observe that Mr. Cox does not attempt to subdivide the Permian to Jurassic series in this Provincial District, but places them together for the present. He, however, separates them from the Lower Carboniferous or Maitai beds.

Mr. Cox states that to the latter belong the Mount Hutt, Mount Somers and Palmer Ranges, but he fails to explain how in deep gullies near the very centre of the two former ranges the plant beds could occur.

Another curious statement is that of the Director,* that probably the same rocks (Maitai or Mount Torlesse) continue to the west coast watershed, judging from the shingle in the Rakaia River. Thus the information conveyed to us in the geological map in the very same volume, which shows a broad belt of mesozoic rocks on both sides of that river, is now put aside simply on the casual observation of river shingle by one of the geological surveyors. Thus there is no doubt that the director of the Geological Survey himself is now inclined to abandon, at least as far as the country near the Rakaia is concerned, his present mapping of a large belt of mesozoic rocks between palæozoic beds to the east and west of it. All I wish to contend is that the attempted separation of our younger palæozoic rocks into two divisions according to their fossil contents is incorrect and not according to the evidence in the field, as far at least as I was able to understand it. Moreover, it would be a most remarkable and unique fact in palæontology, that we possess in New Zealand the same fossil fauna and flora that occur interstratified with each other in the neighbouring continent of Australia, to which either a Permian or Carboniferous age has been assigned, but which with us, owing to the circumstances that hitherto they have not been found together, are said by the Geological Survey of New Zealand to belong to two distinct periods, the molluscs and saurian beds to the Permian and the plant beds to the Upper Oolite period.†

This, in the face of it, is evidently a hypothesis which can never be sustained, the more so as the geological evidence in the field is against it, notwithstanding all that has been written in its support by the director and officers of the New Zealand Geological Survey. I might also show how fallacious it is to support any sub-division of our young palæozoic or old mesozoic rocks, by asserting that there exist two series of reddish and purple slates of different age, or by the presence or absence of cherts, which are found from the east coast to the western watershed, but the object of this paper is not to refute in all their bearings the statements contained in the Reports of the New Zealand Geological Survey, for which I have not the time at my command and of which many seem apparently to have been written only to find fault, year after year, with the work of other geologists, who are no longer connected with that Survey. It is simply a protest against the deductions arrived at by the New Zealand Geological Survey on some of the most important points of our stratigraphical geology. If I were to continue silent, it might be construed into my agreeing with the conclusions published by that department.

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* Progress Report, p. xx., in that volume.

† Report of Geological Explorations during 1879-80, p. xxii.

Fortunately the evidence before us will remain there for all time to come (not geologically speaking), and our successors will be best able to judge what is really the truth, which we all ought earnestly to strive to discover.

ART. XLII.—*Note on Geological Structure of the Canterbury Mountains.*

By DR. HECTOR, Director of the Geological Survey of New Zealand.

[*Read before the Wellington Philosophical Society, 13th February,* 1885.]

THE following note is an abstract of a paper that will appear in the Geological Reports in reply to a recent paper by Professor von Haast*, which impugns the correctness of a small sketch map of the geology of New Zealand, which I issued in 1883.

The chief, or rather almost the only geological contention in the paper referred to is that there is no evidence known to Dr. von Haast that warrants the subdivision of his Mount Torlesse formation, of which he says "the greatest portion of the Provincial District of Canterbury is composed." This formation he maintains to be of Lower Carboniferous or Upper Devonian age: Firstly, because certain fossils which he discovered in 1861 at Mount Potts, comprising fossil shells and *saurian bones* were by Professor McCoy, of Melbourne University, pronounced to belong to that horizon: Secondly, fossil plants which he obtained at the same time from the Clent Hills, twelve miles from Mount Potts, are stated to have been referred by the same distinguished palæontologist to a Jurassic formation: and Thirdly, both animal and plant fossils from these localities are stated on Professor McCoy's authority to be "identical with exuviæ found in the coal-fields of New South Wales."

Unfortunately, I am unable to refer to the wording of Professor McCoy's deliverance on this matter, as it has never been published, so far as I am aware. If, however, it is true that fossils among which were saurian bones were really sent to Professor McCoy in 1861, and he felt compelled to refer them to a Devonian or Lower Carboniferous formation, I cannot but think that such a renowned master in palæontology would have long since emphatically enforced such an important discovery, for, as geologists are aware, even to this day the earliest trace of a saurian is only found in Permian formations.

However, in a paper published in 1879,† which has perhaps escaped Dr. von Haast's notice, I pointed out, after personal inspection, that the

* Art. xli., *ante*.

† Trans. Roy. Soc. N.S.W., 1879, and abstracts in Prog. Rept. N.Z. Geol. Surv., 1879.

correlation of the Mount Potts fossils with the marine strata underlying the coal measures of New South Wales is incorrect, and that the proper equivalent of the latter in New Zealand is to be found at the base of the Maitai series. For instance, in addition to the presence of saurian bones, there is a total absence of true Spirifers; the broad-winged Spirifer that has been so often mentioned in connection with the Mount Potts beds being really a *Spiriferina* of the sub-genus *Trigonotreta*, King, distinguished by having a strong central septum in the rostral valve and a punctate shell structure, characters wholly wanting in true Spirifers. This particular fossil is indeed identical with a species very characteristic of the Permian, and it has been collected in many other parts of New Zealand where the stratigraphy leaves no doubt of its true position in that formation. No true Spirifer has yet been found on the eastern side of the New Zealand Alps, and no *Spiriferina* of the type of *Trigonotreta* is found in the true Spirifer beds at Reefton and in New South Wales, which I refer to Lower Carboniferous or Devonian. The ample collections from both the Australian and New Zealand localities in support of this are in the Colonial Museum, and here therefore arises a conflict of evidence that can only be cleared up by knowing what fossils were really submitted to Professor McCoy, and what was the wording of his report on them.

Dr. von Haast, however, could not accept on Professor McCoy's alleged authority that the Clent Hills plant beds were Jurassic, because he was "convinced that they were of the same age" as the Mount Potts beds. He considers this divergence from his authority has been since justified, because he thinks Professor McCoy has been worsted in a controversy about the age of the plant beds associated with coals and marine fossils in New South Wales. But in this particular case of the Clent Hills the experience in New Zealand has proved that Professor McCoy was quite correct in his alleged determination, and this without a whit affecting the question of the age of the New South Wales plant beds, as there is not a single fossil plant found in the proper coal formation of New South Wales which also occurs among the fossil plants of the Clent Hills beds; on the other hand the latter agree perfectly with fossil plants found in the Clarence River (New South Wales), in Queensland, and in Tasmania, which are always accepted as Jurassic. We thus find that the Mount Potts and the Clent Hills beds form almost the lowest and the highest numbers of a great Permio-jurassic system, the sequence of which has been very clearly worked out in other parts of New Zealand, where there had been less of the "folding and crumpling" to which Dr. von Haast alludes. The Permian base of this system has never been found resting with any approach to conformity on the Maitai series, which is Lower Carboniferous, the Upper Carboniferous formation or the Lower Coal

Measures of New South Wales being still undiscovered in New Zealand. Dr. von Haast's Mount Torlesse formation must therefore, if it is palæozoic, be restricted as equivalent to the Maitai series.

The circumstance which he notices that the fossiliferous beds of his Mount Torlesse formation (*i.e.* the Clent Hills beds) generally appear when great denudation has taken place, and the many localities he cites for these fossils, which we have every proof are really of mesozoic age, even without the direct observations which have been made, would quite justify the belief that over a very large area of the Canterbury district lower mesozoic, and not only palæozoic, rocks prevail at the surface. Indeed the areas of the latter are becoming more and more restricted as the structure of the country is worked out in detail. Except in the typical section, near Nelson, of the Maitai series, where true Carboniferous Brachiopoda and corals have been found, it is unfortunately almost devoid of fossils, a calcareous tubular body which has been long known as the Mount Torlesse Annelid and obscure plant remains being the only fossils that have yet been found out of the Nelson District. These are, however, pretty common wherever the upper part of the Maitai Series is exposed. From near Wellington in the North Island there is no locality recorded until we reach the Ashley Gorge and Glentui, but there is reason to believe that a large portion of the Seaward Kaikoura Range is composed of this formation. Following south we find the characteristic tubular fossil in the south-eastern end of Mount Torlesse, Big Ben Range of the Malvern Hills, Mount Hutt, source of the Rangitata, Mount Cook, and at Lake Ohou. On the western slopes we find it at Nelson, Taipo Range, south of the Teremakau, and in the glacier *débris* brought down from the Alps between Hokitika and Okarita. The Maitai series thus crops out along both sides of the Canterbury Alps, but both outcrops are to the eastward of the only area of Lower Palæozoic rocks which we know in New Zealand.

Without any attempt to pourtray the minor irregularities, the only possible generalization of the geology of the country on such a small scale map was to express it by a synclinal, and this view is supported to a remarkable degree by the observations scattered through the geological reports. No doubt changes in the map will be required in future, as the examination of the country is proceeded with, just as they have been required in the past. To cavil at such changes being made on the ground that they seem to over-sensitive persons to have been "written only to find fault," is to bar the progress of science. But it is not even a change that is complained of in Dr. von Haast's paper, but only an expansion of our knowledge that had been quite anticipated by that author.

The particular case to which exception is taken, may be stated as follows:—Dr. von Haast submits "that it is even more than probable that this large assemblage of beds," which to evade difficulties of survey he had lumped as his Mount Torlesse formation, "may belong to several *distinct periods* ranging from the palæozoic to the lower mesozoic, but hitherto it has been impossible to divide this formation, for the present at least, into smaller groups owing to the want of fossils." Well, in the progress of the Geological Survey, the requisite fossils have been found and the subdivision made. Why should Dr. von Haast object?

Art. XLIII.—*Analysis of Slate in contact with Granite from Preservation Inlet, New Zealand.* By A. Liversidge, F.R.S., Professor of Chemistry and Mineralogy, University of Sydney. Communicated by Professor F. W. Hutton.

[*Read before the Philosophical Institute of Canterbury, 27th November*, 1884.]

Analysis of a specimen of slate and granite in contact was read before the Otago Institute in November, 1877 (Trans. N.Z. Inst., 1877, p. 505). Since then a further analysis of another portion of the slate has been made with the following results:—

Analysis.

Hygroscopic moisture	·480
Silica	53·350
Alumina	19·889
Iron sesquioxide	2·294
,, protoxide	5·241
Manganese protoxide	1·522
Lime	3·025
Magnesia	5·060
Potash	3·904
Soda	3·652
Undetermined, combined water, etc.	1·583
	100·000

Specific gravity .. 2·72

The above results, in common with the first analysis, show that on the whole there is no very great similarity in composition between the granite and slate, such as might be expected were the granite merely a metamorphosed or crystalline form of the slate; it would rather appear that the granite is distinctively intrusive, and not derived from the slate by metamorphic action.

NOTE BY PROFESSOR F. W. HUTTON.

This specimen was collected by me in Isthmus Sound, Preservation Inlet, during March, 1874, when I was examining the west coast Sounds as geologist to the Provincial Government of Otago. My observations seemed to show that the granite was intrusive and much younger than the gneiss with which it is associated in Preservation and Chalky Inlets, and in my report to the Provincial Government of Otago* I considered that it had pierced rocks belonging to the Maitai (=Kaikoura) System, and consequently that it was much younger than the gneiss which was considered as of Archæan age. Fragments of the slate are found in the granite, and consequently the slate is the younger of the two. The analysis by Professor Liversidge shows that the granite cannot be metamorphosed slate, so consequently it must be intrusive. The age of the slate is however doubtful, as Dr. Hector in his last geological map of New Zealand has coloured it as belonging to his "foliated schists" of uncertain age. The actual rock in question, however, is not a foliated schist, but an argillite, that is an uncleaved slate, and the alteration produced by the granite does not penetrate very far into it.

ART. XLIV.—*On Water-worn Pebbles in the Soil.*

By JAMES COUTTS CRAWFORD.

[*Read before the Wellington Philosophical Society, 9th July*, 1884.]

IN the soil and subsoil of the Hataitai Peninsula, and I am inclined to believe of all the district surrounding Port Nicholson, water-worn pebbles may be found, in general sparsely distributed, possibly a foot or a yard or more from each other, reminding one of the old story of the school plum-pudding where the drummer-boy had to be called in to beat his instrument to call the plums together.

The occurrence of these pebbles may seem of small import, but in reality they form a very puzzling geological problem, possibly involving great movements of the earth's surface. How they got into their present position I shall try to explain; but I am quite open to conviction if any one can produce a more plausible theory.

An explanation by a subsidence of the land to the extent of 1,000 feet or more is not admissible. There is no appearance of marine strata or action above a height of about 15 feet from present high-water mark.

It may be suggested that these pebbles are the remains of a conglomerate, or of a coarse sandstone rock, which has undergone decomposition, but no traces are found of any such rock.

Some years ago I endeavoured to point out that Port Nicholson had formerly been a fresh-water lake. Does not the occurrence of these pebbles support that theory, supply direct evidence of lacustrine deposit which I previously admitted we had not found, and show that the boundaries of the lake were far outside those of the present harbour?

I have reason to suppose that there are deposits of gravel high up on the hills surrounding Port Nicholson. These may show the margin of the ancient lake, while the sparsely deposited pebbles may show where these were gradually distributed by waves or currents over the lake bottom.

The theory involves great movements in the land, and a great sinking in the direction of the Straits, but I do not see any other way out of the difficulty.

To obtain further proof of lacustrine deposit may be difficult, and will at all events take much time. Should these deposits occur in the harbour they must be overlaid by those of marine origin, and could only be found by boring, but there are strata at Karori and Johnsonville, etc., lying on the old rocks, which it might be well to study to see whether they are lacustrine or marine. The talus on which that part of Wellington called Thorndon is built might also yield some information, as also the lower parts of Te Aro.

Art. XLV.—*On Changes in the Hataitai Valley.*

By James Coutts Crawford.

[*Read before the Wellington Philosophical Society, 9th July*, 1884.]

As I am rapidly bringing the Hataitai Valley into cultivation, and thereby destroying geological landmarks, it may be as well to put on record what will soon be lost to the eye. At present I refer particularly to the old forest which at one time filled the valley, and whose stumps and logs are apt to smash my ploughs. Doubtless the hills also were at one time covered by forest, but all traces of this seem to have long ago disappeared.

There are a series of sea-formed lakes, detached rocks, etc., showing a depression of the land to the extent of about fifteen feet. This is the point at which I propose to commence, as it would be desirable to fix some approximate date for this occurrence.

The highest level of the land in the Hataitai Valley being now about 14 feet, it is evident that a depression of 15 feet would entirely submerge it. We therefore find the valley to be filled with strata of sand and gravel, the latter generally underneath, but also occurring in bars at various points;

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* Geology of Otago, by Hutton and Ulrich. Dunedin, 1875, p. 40.

the sand is much mixed with recent marine shells. A rise of the land must now have taken place, for it next appears to have been covered by dense forest of the usual trees of the district, viz., totara, rata, kahikatea, manuka, etc.

The forest has then been destroyed, possibly by the advent of man, and has been replaced by swamps and by a shallow lake (Burnham Water) in the centre. The swamps supported a vegetation of raupo, flax, etc., and before being drained a stick could be easily thrust down for about seven feet, until it struck the hard sand bottom. Burnham Water was evidently formed after the destruction of the forest, because roots of large trees are found in its bed clearly *in sitû.*

How long ago was it that the land was depressed to the extent of 15 feet? To fill the Hataitai Valley with sand, gravel and shells must have taken a considerable time; but this time it must be impossible to arrive at, for the sea might have gone on for ages at the work, grinding away, and shifting, and replacing. For the age of the forest we should probably have to allow some centuries. The swamp era must also have occupied a very long time. The seven feet of soft vegetable matter consolidated into about 5 or 6 inches of peat. How many centuries must we allow for this accumulation of vegetable matter?

I have in a previous paper on wind-formed lakes shown how Burnham Water was formed. Probably the advent of the Maoris occurred during the forest period. Hataitai having been a great settlement from which eventually the South Island was colonized, the ground would naturally be cleared by the natives, and thus the forest would be destroyed. Then the wind would have got its opportunity of scooping out the bed of Burnham Water.

At what period did the moa live on Hataitai? Many remains have been found near the Maori ovens, and I myself found a head in the bed of Burnham Water.

Altogether, I think we might be safe in making a rough guess of ten centuries as the date of depression of the land. It may have been less, it may have been indefinitely more.

As the imbedded timber from the old forest is excellent firewood, and as in clearing the ground for ploughing it must be removed, all traces of its previous existence will disappear during the next few years.

ART. XLVI.—*On the Drift Beds of Wakapuaka and Port Hills, with Remarks on the Boulder Bank and its Formation.* By W. WELLS.

[*Read before the Nelson Philosophical Society, 3rd March,* 1884.]

ABSTRACT.

I HAVE chosen this locality for my paper from its proximity to the township, so that members who take an interest in geological science may have no difficulty in visiting the district, which may tend to invite discussion on a future occasion, and assist in verifying, or otherwise, the conclusions I may have come to on the subject.

Drift in geological language means portions of the earth's crust removed by forces from one place and deposited in another, some from comparatively short distances and others very wide apart. These forces are of various kinds, the most important of which are, Fire, Water, Ice, and Wind—Fire exhibited in volcanic action, which is powerfully exemplified on the west coast of the North Island, from Mount Egmont to Wanganui. This belt of country is chiefly composed of pounded pumice stone, in some places many feet in depth, which has been erupted from volcanoes in that district and drifted by wind currents all along the belt, now producing the luxuriant grasses which exist there for the feeding of cattle and sheep. Water, the next force I have noted for effecting changes on the earth's surface, is by far the most important, being constant and continuous. The smallest rippling stream to the largest river are daily engaged in transporting matter from a higher to a lower level, as instanced on a large scale—the Canterbury Plains, the soil of which is the degraded high lands brought down by the force of water to nearly sea-level. Ice glaciers you are all aware are forces which carry in their course large quantities of rock and *débris* and deposit them at a low level in what are called "moraines." The last noted is wind force, which drifts lighter materials, such as fine scoria and pumice dust in volcanic countries, in some cases for hundreds of miles from the mountains from which they have been erupted.

With these preliminary remarks on drift beds and the forces which occasion them, I now come to boulder drift on a small scale, seen on the Wakapuaka Road and Port Hills.

This drift shows itself on what we may call a raised beach, commencing at the town boundary, and exposed on bare faces for several miles towards Wakapuaka. This beach is raised at a high angle, in some places not less than 45 degrees. In the clay drift on these faces we find stone boulders stuck through it, somewhat like plums in a pudding. These boulders are generally round in form and smooth in surface, showing they have been carried from a distance, getting their round shape and smooth surface from

rolling about on their journey to where we find them. If these surmises are correct, then some force must have been at work to bring them to their present position. This force the observing geologist concludes has been water, bringing down fragments from the parent rock, also detritus of a lighter material in the form of clay, and depositing it at sea-level. However, we find this deposit, as I have before remarked, far above the level of the sea, consequently some other force must have been at work to raise it to the elevation at which it now stands.

If we travel up the Maitai, a short distance before reaching the slate formation we find a range of greenstone dykes running in a north and south direction, and to them I presume may be attributed the upheaval of this raised beach. Where these dykes obtruded themselves, the elevation of this boulder drift was the sequence. I may mention here that the boulders in this drift are of a different mineralogical character from those brought down by the River Maitai, being mostly hard indurated sandstone and conglomerates, while the Maitai drift partakes more of rocks of a crystalline character, such as serpentine, hypersthene, dunite, and various hornblendic rocks, with a mixture of slate, so we must look for another outlet for this Wakapuaka drift than the Maitai. If we examine the back country north of the Maitai, and onwards towards the Happy Valley outlet, we will find the same sandstones and conglomerates *in sitû* and they are at the present time being brought down by the Ludd Stream, which flows through that district, so that we may fairly conclude that this drift has been carried from the degraded rocks of the higher country behind, and subsequently raised by the ejecting of the greenstone.

The Port Hills are all drift matter, overlying the sandstone which is exposed at the cliffs, part of which has been carried from the eastern ranges and part from the west, and is very easily defined. The western drift is well shown on the ridge at the back of Major Richmond's property, containing granite boulders in the clay, and as no granite is found on this side, *in sitû*, we may conclude that this drift material came from the west, granite there being the prevailing rock; and on examining the Port Hill faces on the Nelson or township side, they partake more of the material which might be expected to come from the Wakapuaka Ranges; so that water-force must have been at work both on the east and west side of these drift beds.

In mostly all sedimentary strata of any considerable antiquity we find faults occurring, that is to say, we seldom find them in the same horizontal position in which they were deposited, but either at a less or more abrupt angle, having been subjected to internal forces from underneath. These greenstone dykes I have been speaking of are one of a large family generally known as the trap series, largely distributed over the earth's surface, and as they contribute in a larger degree than any other class of rocks to the economy of vegetable and animal life, I may be excused in alluding here to their properties in this respect. In their composition they contain in considerable quantity potash and other salts necessary to the growth of plant life, and when decomposed by the sun's heat and rain, which destroy their cohesion, the pulverized particles are washed down into the valleys and form our best soils for growing grass and cereals. It is possibly one of the best tests in looking after new country for settlement, to examine the character of the rocks surrounding the country you are traversing, and you may rest assured that if this trap series is the prevailing rock the valleys will be rich and fertile. We have a very good example of this in that part of our township called The Wood, where we have that rich sedimentary deposit, where we grow hops and vegetables. That district has at some former period been a lagoon of comparatively still water, the force of the Maitai current being broken by the bluff at Mr. Huddleston's property, and the sediment from the degraded trap dykes I have before mentioned, finding its way in solution into this lagoon, gradually deposited itself into a rich alluvium, which proves so fertile for cereal crops. I conclude, therefore, that this alluvium is chiefly a decayed trap deposit, because no other rock in the Maitai series from its composition could give out soil of this description. The dyke from which this deposit has chiefly come runs from Mr. Huddleston's Bluff, past the back of Mr. Sharp's house, and again shows itself on Mr. Curtis's property, on the Wakapuaka Road, the worn-down face of this ridge being the deposit I have now mentioned.

Probably our greatest misfortune in the Province of Nelson is, that we have so little of this class of rock, but are surrounded on all sides right on to the west coast by slates, schists, and rocks of a quartzose character, and on the east by the Dun Mountain Range, by slates and a variety of rocks of a magnesian class, extending from D'Urville Island in the north, to the Tophouse at the head of the Wairau Valley—all these rocks I have mentioned being from their composition unfavourable to plant life, and the alluvium from them being considered country of a third or fourth class. We are not, however, left without some comfort in having at different points in our surroundings rocks of a more fertile class, such as a volcanic trap, granites, and limestones of various kinds, and some others containing felspar in considerable quantity, which has given the district some rich alluvial soil. We are very apt, in travelling through a country, to pass along giving very little heed to the character of the rocks surrounding us on every side, but there is little doubt that the fertility or non-fertility of a country depends very much on the character of the rocks by which it is intersected.

I do not think I have anything further to say about the boulder drift on the line of the Wakapuaka Road. It would be a very pleasant excursion for any of the members of this Society to take a hammer in hand, traverse the district, and find the parent rocks from which these boulders have come, and endeavour to trace the course the force of water took in bringing them to the position in which we now find them.

I may, however, mention here, that as you get higher up on the line of this raised beach, you meet with beds of shells from a few inches to a foot under the surface, at a considerable elevation above sea-level. When these beds were first exposed on the slopes, the impression of the settlers who exposed them with the spade or plough was, that the Maoris must have brought them; but when we find them assuming the same striæ and curved shapes which the tidal current gives them at the present time in our lagoon, or what we call our mud flat, there is no difficulty in coming to the conclusion that they were deposited at sea-level, and subsequently raised by forces from underneath.

I shall now offer a few remarks on a natural object conspicuous among our surroundings here, viz., the "Boulder Bank." How was it formed, and what were the forces employed in building it? The first consideration is, where did the material come from of which it is built? If we travel to the extreme north end of the bank, by Mr. Mackay's property, we will find a bold rocky bluff, nearly vertical, with the sea lashing on its base at flood tide. This rock is local, and does not extend far beyond this point, and is of the class of mineral called syenite, composed chiefly of quartz, hornblende, and felspar, very hard and crystalline in its character. Now if we leave this bluff and walk down towards Nelson on the seaside and examine the boulders which form the bank, we will find them mostly all of the same character as the perpendicular bluff before mentioned. This bluff has been acted upon by the sun's rays on its face on the one hand, and by the sea and spray and rain on the other, whereby its cohesion is loosened, when it gradually falls down into the sea in smaller or larger pieces. These fragments of rock get disturbed by the swell of the sea and by a powerful current which sets down from that point, are then gradually rounded at their sharp edges by rubbing against one another, when they are easily carried forward by the swell and current, and rolled up on the bank where we now find them. It is observable also that the further they get on their journey the less they get in bulk from the grinding process they have to undergo in transit.

Another feature in this bank is the straight line—north and south—on which it is built. How has this straight line been preserved throughout? We find there are two forces in operation, an outer and inner current, the swell of the sea and a strong tidal current on one side, which heaves up the larger boulders, and a lesser current flowing up on the inner side, thereby disturbing and heaving up the smaller shingle. It will be observed also that the inner side is characterized by small gravel and the outer by larger boulders; so that the bank itself may be said to be the centre of two actions, an outer and inner current.

These two currents are performing the same work that a couple of navvies would do in building a breakwater of the same materials, the one heaving up the boulders on the one side and the other shovelling up the smaller material on the other, the only difference being a question of time as to the completion of the work. It has been suggested by some observers that there may have been at some early period a ridge of rock extending the whole distance, and that the present Arrow Rock at the entrance to our harbour is the termination of this supposed ridge, the other portion having been degraded and worn down, and the present bank resting on its base.

This is a probable theory and may be correct, and certainly would go far in facilitating the building-up of the bank, it having got a solid foundation to rest upon, but I have never heard of its being verified by sinking or otherwise. I am however of opinion that the forces at present in operation, however inadequately I may have described them, are quite sufficient to form the bank without the help of this rocky base to rest upon. This is a subject it would be interesting to get proofs of, and probably some enquirer of this society who may have time and inclination to institute a research in this direction may communicate his views on some future occasion.

I have said in the course of my remarks that this bank is chiefly composed of fragments from this syenitic bluff, and would hazard the opinion that, if this very hard crystalline rock had not been in the position we now find it, there would have been no Boulder Bank, or, had the bluff been sandstone or any other rock of a softer and more friable material, the forces acting upon it would speedily have reduced it to sand or mud, which would not have had the resistance to form a breakwater—in fact, no other rock in the district would have been fitted for the work; and when the supply of fresh material from this source is exhausted, or ceases to be rolled down to supply the degraded waste going on in the bank below, the decay of the bank itself will take place—there are some appearances of this going on at the present time. A large bank of shingle has been and is being formed at the base of this syenitic dyke, the degraded fragments of which no longer drop into the sea to be rounded and carried down, but are left where they fall among this shingle, consequently the bank below is not receiving the same amount of fresh material necessary to its support in supplying the waste going on in consequence of the action of the sea, thereby a breach in the bank itself may sooner or later be the consequence and the sea find its way into the inner lagoon from the upper end of the bank. Should this happen, it would of course speedily change the character of the district, and might have important effects on the lower part of the township itself. I do not state this as an alarmist, as artificial means might be employed to support the weak points in the bank as they occur; but there is no doubt that inroad at the present time is being made by the heavy swell which strikes the bank in its upper portion, and symptoms of degrading influences are already showing themselves.

Another geological feature in this district, and connected with drift material, is the basin or mud flat between the main land and boulder bank, which is being silted up, and will at no very distant period be dry land and covered with natural pasture—"provided no intervening circumstances occur"—without any artificial aid more than the forces employed at the present time. Since I first lived in the district, nearly forty years ago, I perceive a considerable change in this direction; from 1 foot to 3 feet in some places of mineral deposit has been laid down in the upper part of the lagoon during that period. I also perceive a very considerable change in the character of the material now deposited from what it was at a former period, which was then more of an argillaceous decomposed vegetable ooze, in which you sunk to the boot-tops in crossing over to the Boulder Bank at ebb tide. Now we have over that a firm layer of clay deposit on which you may walk over on the upper part of the flat in a pair of slippers without soiling them. This is accounted for by the settlers disturbing the surrounding country in their farming operations, which the rains and intersecting rivulets bring down to the sea-level, the silt being more of a consistent clay material than the deposit of a former period. This is a very good example of how sedimentary strata are determined by surrounding circumstances. In sinking a vertical shaft in the earth's crust, we find one layer overlying another, having different mineral characteristics. These lie over one another like leaves in a book, and it is the business of the geologist to turn over these leaves, where he finds a true and accurate history of what the surrounding country presented from time to time—the animals and plants then alive upon its surface, and external events faithfully photographed for æons of years in our earth's history.

I may before closing this paper mention a few of the historical drift beds now in course of formation, although I have no doubt you are all acquainted with them in the course of your reading. The lower basin of the Mississippi shows a drift bed at the present time to the extent of 700 miles in length, formed from the sediment brought down this river and its tributaries, from the lands and degraded mountain ranges in the upper districts of the country. This bed is being daily added to, and no doubt at some time in the future will have filled up the entire Gulf of Mexico. The Nile Valley basin, 500 miles in length, is the mineral and vegetable ooze brought down by that river from the Abyssinian Mountains and interior of Africa, which is the great fertilizer of Egypt, a country which would be comparatively worthless without its agency. It is calculated that not less than sixty millions of tons of solid matter is yearly brought down this river, rendering the waters of the Mediterranean turbid for a distance of 30 miles from its mouth. These are two prominent examples of water-drift, and all other rivers on the earth's surface are similarly employed in effecting the same ends and purposes.

I have not remarked previously on moraines or ice-drift beds. A remarkable bed of this description is seen on the Norfolk coast in England in what is called the boulder clay, extending many miles. It puzzled geologists for a long time to account for its formation, the boulders in the clay being entirely of a different character from any rocks existing on the English coast, till the glacial theory was suggested and established, when it was afterwards proved and verified that these boulders and clay had their parent rocks on the mountains in Scandinavia, and had been brought over by glacial ice and deposited where they now lie. As to volcanic drift, we have as examples the buried cities of Pompeii and Herculaneum, and we are informed from the accounts of the very recent volcanic eruptions in the island of Java and Straits of Sunda, that scoria and ashes in immense quantities were ejected from the volcanic island of Krakatoa, some of which was drifted by wind-force as far as Cheriton, 250 miles distant. From the remarks made, we may infer that rock masses form a very important part in life's economy.

Art. XLVII.—*The Ascent of Mount Franklin.*

By James Park, Survey Department.

[*Read before the Nelson Philosophical Society, 5th May,* 1884.]

Abstract.

Although occupying a most prominent and central position in the Province of Nelson, this important mountain region is almost unknown, and up to the present time has always been considered inaccessible, or at least impossible to ordinary private enterprise. Even the hardy miner, who in his search after gold has penetrated the dark bush-clad and rugged ranges of the west coast of this Island, and other equally broken country elsewhere,

has avoided this wilderness, doubtless thinking that the chances of finding payable gold were insufficient inducements to meet the difficulties likely to be encountered in the search after the precious metal.

Mount Franklin may be called the culminating point of the Spenser and St. Arnaud Ranges, for while the former, which is merely the northern continuation of the Southern Alps, rises to the northward by a succession of peaks gradually increasing in height, the latter, which trends somewhat more to the eastward, falls away to the northward by a like series of gradually decreasing heights, eventually losing itself in the densely wooded spurs at the sources of the Buller River. It was with the desire of making geological and botanical collections in this mountainous country that this trip was organized.

Our party, comprising five persons, left Nelson on the 10th March. Proceeding by railway to Belgrove, we walked to the Rainbow, *via* Top-house, our camp gear being carried by two pack-horses. At the mouth of the Rainbow River there is evidence of a glacier that once came down its valley, flowing over the spur dividing that river from the Wairau. The moraine of this glacier can still be traced, but the greater part has been washed away by the river.

After passing the mouth of the Rainbow Valley the mountains on either side of the Wairau suddenly converge, apparently blocking further progress in this direction. However, on getting close to this barrier, we found a narrow flat running parallel with the river. Where the flat was washed away, or a precipice rose abruptly from the river, the track was cut out of the solid rock, in many places being half tunnelled to obtain a few feet on the solid.

The Wairau Gorge is, we believe, one of the most wonderful and imposing sights in New Zealand. On both sides the mountains frequently rise by a succession of steep, rugged precipices to a height of 3,500 feet above the river, and in this might be said to rival the deep canõns of the Rockies.

About half way through the gorge we crossed Coldwater Creek, and Judge's Creek half-a-mile beyond. These creeks rise towards the sources of the Awatere, breaking through the Raglan Ranges, locally known as the "Bounds of Hades."

On the 12th we reached Tarndale old station. Next day the range behind the old station was ascended to a height of 5,500 feet. As seen from this elevation much surprise was expressed that the Wairau preferred to cut its present course through a high mountain range to finding an easy outlet by the Alma, which drains the tarns giving the name to Tarndale, and rises within a stone's throw of that river. However, an examination of the structure of the mountains forming the gorge shows that the river has cut down an old anticline, a task not so stupendous as might at first be supposed. That the erosion of this gigantic anticline has been attended by very momentous consequences is not difficult to conceive, when we remember that at one time it was the sole support of the inner sides of the synclines now forming the ranges on both sides of the river.

On the 14th we proceeded up the Wairau to Island Saddle, 4,100 feet high, and thence down the Serpentine to the Clarence River. It was from this point, looking through Maling's Pass, that we first obtained a view of the snow-clad Spensers. Having crossed the river, we followed down the right bank to Duncan's Creek, where we were hospitably entertained by Mr. F. A. Thompson, Government Surveyor, engaged in this district on topographical and trigonometrical work.

The next day, the 15th, under the guidance of one of Mr. Thompson's men, we retraced our steps to the junction of the Serpentine, and thence followed up the Clarence to Lake Tennyson. At the south end of the lake there is a great accumulation of glacier *dêbris*, covered with a soft peaty deposit, in which the pack-horses frequently bogged, thereby greatly impeding our progress.

Leaving Lake Tennyson on our right, we proceeded over Maling's Pass, 4,150 feet, into the valley of the Waiau. The aspect of the country had now changed. Instead of the bare inhospitable mountains of the Clarence, the slopes of the ranges on both sides of the valley were wooded to a height of 4,500 feet. Content with our day's walk, we camped on the large *fan* of Pass Creek.

Next morning, the 16th, we raised camp and proceeded along the right bank of the river, keeping a sharp look-out ahead for Mount Franklin, to which we were now rapidly approaching. For some seven miles we travelled over a succession of fine grass flats. In this distance several creeks were crossed, those from Mounts Enid and Humboldt being the largest. On both sides of the valley we noticed many fine waterfalls descending to the river below by a series of low falls or cascades.

The valley now narrowed to a chain or two in width, and, the bush closing on the river, we were constrained to turn the horses adrift. From this we had to carry our swags on our backs, and now made but slow progress. At times we were scrambling through the thick bush or over steep shingle slips; at other times we had to take to the river bed, crossing and recrossing on the large boulders piled in the channel, and between which the water rushed with a deafening noise. Some two hours of this laborious travelling brought us to the last clump of bush, in which, well sheltered from all winds, we pitched our camp, at an altitude of 4,050 feet above the sea. Shortly after dark our party was further augmented by the arrival of Mr. Thompson and another guide.

The next day was occupied in making botanical collections and looking out the best route to ascend the mountain. About 20 chains above our camp, that is at the foot of Mount Franklin, the Waiau divides, and proceeding up the left-hand branch for about two miles, we left the main stream and scrambled up the steep face of an old terminal moraine, composed of huge angular rocks and *débris* piled to a height of 700 feet.

On the opposite side of the valley we counted six or seven very distinct parallel terraces, furrowed out by glacier action. These terraces occupy a lower level than the foot of the terminal moraine just mentioned, and must therefore be due to the action of the glacier that once filled the Upper Waiau Valley. Still pursuing an upward course, we encountered a small area of glacier ice, probably all that now remains of the great Waiau Glacier. At this place, 6,050 feet high, may be seen small patches of that peculiar 1-celled plant, *Protococcus* or red snow. The presence of this vegetable growth is said to be an indication of the very permanent character of the snow on which it occurs.

At 5,600 feet Mount Franklin presents an almost perpendicular wall from 500 to 1,000 feet high, and seeing little prospect of a practicable route in this direction it was determined to attempt the ascent from the other branch of the Waiau.

Next day, the 18th, we proceeded up the right-hand branch some two miles above the junction, and turning to the right began the ascent of the mountain. A succession of rounded bluffs and steep shingle slips soon brought us to an elevation of 5,500 feet. From this height we observed a lake at the head of the right-hand branch, some two miles to the westward. This lake, which was estimated at two miles long and a quarter of a mile wide, was named Lake Thompson in compliment to Mr. Thompson, to whose assistance the success of the trip was mainly due.

The hollows now began to be filled with snow, and the grasses, so luxuriant below, now gave place to *Celmisias* and *Haastias* and occasional patches of *Raoulias* and *Donatias*.

At 6,500 feet we encountered permanent snowfields, and at 7,500 feet we reached the top of the range, which is a mere razor-back, being only a few feet wide, and composed of loose angular and slab-like rocks.

On looking over to the north side we observed a clear mountain lake, very similar in size and appearance to Lake Thompson. This lake was named Lake Constance. From the direction of its outlet it appears to be the source of the east branch of the D'Urville river, which drains into Lake Rotoroa.

Continuing along the ridge in a westerly direction we attained the summit of the highest peak we could see at 2 p.m. The height by our aneroids was 7,850 feet above the sea. Mr. Thompson has since taken observations to Mount Franklin, and calculates the height at 7,900 feet, that is about 2,000 feet lower than shown on the maps.

The prospect, which from the central postion of this mountain must be very extensive, was entirely hidden from view by a heavy mist, and fearing lest we should be caught in a snowstorm, we hastily erected a cairn over a tin box containing the names of the party and the date of ascent. We then began the descent, and reached the camp before dark.

Next day we commenced the homeward journey. As we continued down the river we observed, in many places, on the slopes of the Spensers, about 1,000 feet above the river flats, the remains of glacier terraces. Instead of returning by Maling's Pass, we proceeded down the Waiau to Lake Guyon. Here the Waiau Glacier appears to have divided, the Stanley River branch having its terminal moraine at Mr. Fowler's homestead. The evidences of glacier erosion around the lake are very distinct and interesting.

Passing Lake Guyon we came to the Stanley River, and thence by way of Fowler's Pass, 4,350 feet, arrived at Duncan's Creek, on the Clarence. On the 21st we reached Tophouse, and the following day the accommodation house on the Motupiko. In our journey to the latter place we made a detour to Lake Rotoiti. The waters of this lake, like those of Lake Tennyson, are held back by an immense moraine, through which it has cut its outlet. This old moraine covers an area many square miles in extent.

Near the lake occur heavy deposits of gravel, sand, and clay, occupying positions 200 or 300 feet higher than the moraine. They have been deeply furrowed by the great Rotoiti Glacier, thus showing that they were deposited prior to the New Zealand glacial period. These gravel beds extend down the valleys of the Motupiko, Motueka and Waimea, forming the Moutere and Waiiti Hills. They also cap the Port Hills, Nelson, where they overlie beds of lower miocene age. Except at the latter place, where they are highly inclined, they everywhere occur as perfectly horizontal strata. These gravels and sands are river drifts that have been deposited in still water. The high altitude they occupy at Lake Rotoiti gradually decreasing to the north-east till sea-level is reached, is due to a period of slow upheaval, subsequent to miocene times, and before the great glacial period of New Zealand.

On the 24th March we arrived in Nelson, the trip having occupied just fourteen days.

During the trip the scarcity of birds was a subject of frequent comment. A few paradise ducks, usually in pairs, grey ducks and teal, and black swans, were seen on the tarns at Tarndale, and Lakes Guyon and Tennyson. The blue mountain duck, the whio of the Maoris, was more plentiful in the mountain streams. Even wekas were rare, and of the kiwi, kakapo and kea, nothing was seen or heard.

Geological Observations.

In the ascent of Mount Franklin it was found that two formations enter into the structure of the Spenser Range,—a metamorphic series, consisting of chlorite schists and quartzites; and a younger series, probably of carboniferous age, consisting of hard grey and green sandstones, with numerous quartz veins, clay slates, purple jasperoid slates and slate breccia.

The chlorite schists and quartzites occur as a low rounded ridge in the bottom of the higher basin of the Waiau. The strike of these rocks is north-west, with a southerly dip at high angles. They run in the direction of Lake Thompson, but their exact position in that direction was not ascertained. This outcrop occurs in the core of an old anticline, its exposure being due to denudation. Gold is reported to have been found in the Upper Waiau, no doubt derived from these rocks, and in prospecting this country they are worthy of a careful examination, not only for gold but also for other valuable metals.

The sandstones, slates, etc., lie unconformably upon the upturned edges of the metamorphic series, and compose the mass of the Spenser Mountains. Their general strike is north-east. The sandstones on account of their hardness form all the peaks and rocky projections, while the slates, being softer and more easily removed, have been selected by the creeks in which to cut their channels. A band of black slates, interbedded with the sandstones, is highly charged with peacock copper ore, a variegated variety of copper pyrites.

Botanical Notes.

From 4,000 feet to the snow-line Mount Franklin is such a waste of bare rock as to be almost destitute of the numerous fine alpine forms for which the St. Arnaud Range, a short distance to the north-east, is celebrated. Appended is a list of the plants collected during the trip. This is by no means an exhaustive collection, but is merely characteristic of the flora of Mount Franklin from 4,000 to 6,500 feet. For the identification of the species I am indebted to the kindness of Mr. J. Buchanan, F.L.S., Botanist to the Geological Department.

PHÆNOGAMS.

Ranunculus lyallii.
,, *pinguis.*
Celmisia lateralis, Buch.
,, *glandulosa*, Hook. fil.
,, *sessiliflora.*
,, *obcordata*, Buch.
,, *longifolia*, Hook. fil.
Veronica cupressoides.
,, *canterburyensis*, Armstrong.
,, *odora*, Hook. fil.
,, *linifolia*, Hook. fil.
,, *elliptica.*
,, *bidwillii.*
,, *pinguifolia.*
Gnaphalium bellidioides.
,, *colensoi.*
Haastia sinclairii.
,, *pulvinaris.*
Aciphylla monroi.
,, *lyallii.*
Ozothamnus microphyllus.
,, *depressus.*
Cotula pectinata.
Brachycome sinclairii.
Ourisia colensoi.
,, *macrocarpa.*
Traversia baccharoides.
Acæna sanguisorbæ.
,, *glabra*, Buch.
,, *inermis.*
Notothlaspi australis.
,, *rosulatum.*
Dodonæa viscosa.
Mitrasacme cheesmanii.
Hydrocotyle pterocarpa.
Leucopogon frazeri.
Pentachondra pumila.
Cyathodes colensoi.
Dracophyllum urvilleanum.
Raoulia grandiflora.
Pimelea lyallii.
,, *prostrata*, var. γ.
Gentiana con inna.
,, *saxosa.*
Thelymitra pulchella.
Claytonia australasica.
Clematis colensoi.
Senecio bellidioides, var. γ.
Drosera stenopetala.
Drapetes dieffenbachii.
Wahlenbergia cartilaginea.
Carpha alpina.
Juncus australis.
Luzula oldfieldii.
Carex colensoi, Petrie.
,, *wakatipu.*
Uncinia australis.
,, *campestris.*
Hierochloe alpina.
Trisetum antarcticum.
Danthonia flavescens.
,, *australis.*
Agrostis pilosa.
,, *canina.*
,, *æmula.*
Poa foliosa, var. α.
,, ,, var. β.
,, *anceps*, var. *debilis.*
,, *colensoi.*
,, *australis.*
Festuca duriuscula.

CRYPTOGAMIA.

Polypodium grammitides.
,, *australe.*
Hymenophyllum flabellatum.
Cystopteris fragilis.
Aspidium cystostegia.
Lycopodium clavatum.
,, *varium.*

IV.—MISCELLANEOUS.

Art. XLVIII.—*On the recent Sun-glows and the Theories that have been advanced to account for them.* By John Meeson, B.A.

[*Read before the Nelson Philosophical Society*, 1st *September*, 1884.]

Seldom in modern times has a natural manifestation in the physical world attracted such universal attention or excited so much admiration and wonder as the recent so-called sun-glows. The uneducated have everywhere gazed at them in mute astonishment; the learned, on all sides, have cudgelled their brains to assign for them a plausible and sufficient cause. The interest has not been merely local, for the phenomena have appeared, as far as we know, everywhere, and to appear was to excite curiosity. Scientific magazines and the ordinary public journals, during a period of more than six months, have devoted long articles to the subject; and even now, when the display is almost or quite over, public interest therein still finds frequent expression, and *savants* and scientific societies in various parts of the world are still engaged in researches which have for their object the elucidation of that which has excited the astonishment of mankind. The selection of such a subject for our consideration this evening can scarcely be thought inappropriate, the wonder rather should be that it has not been made before.

It will be well to state at the commencement what I propose to do to-night and what I do not propose to do; and, to begin with the latter, I do not presume to offer any original theory of my own. There are many branches of science connected with the subject of which my own knowledge is scanty and superficial. Others have made of these branches a life-long study. *Credendum est cuique in suâ arte.* Yet I hope to do something this evening which I would fain think will prove to some of us at least interesting and instructive. I have carefully examined such scientific magazines and public journals as are within my reach and have appeared during the past twelve months, with the view of gathering together the various facts and theories bearing on my subject. I have arranged these methodically under their different heads, and have pointed out, where I could, what appeared to me weak and fallacious arguments, what needed fuller testimony or consideration, and what seemed to satisfy the requirements of common sense and probability. The outcome is a *résumé* of the most salient facts, together with a *précis* of very much that has been written on the subject in such journals as "Nature," "Knowledge," Hardwick's Science Gossip," "The American Journal of Science," "The Scientific American," Dr. Taylor's Notes in the *Australasian*, and one or two other less important periodicals. In a word, I have summed up in a somewhat judicial—perhaps presumptuous—way, the whole evidence that is before us, and have not hesitated to give expression to my own opinion from time to time, nor to add arguments or objections of my own, nor to make original comments and criticisms in a way that, if not equally judicial, may be thought at least equally presumptuous.

Perhaps the present time may be considered specially suitable for a discussion on the subject, inasmuch as the phenomena have, if not totally disappeared, become comparatively insignificant; and the most distinguished men in the scientific world have, with the salient facts before them, given expression to their opinions as to the circumstances which have acted as operative causes.

The Phenomena.

It will not be necessary to describe much in detail the most widespread of the phenomena to which I am about to address myself, *i.e.*, the sunglows, for they must be well within the remembrance of every one of us. Indeed it would require the pen of a poet or the brush of a Turner or a Canaletto to do anything like justice to the display. Our almost uniformly clear skies have enabled us in this Nelson province to witness the splendour, perhaps, at its best; but even in the murky climate of England it has excited admiration. London Bridge, nightly during the months of December and January, witnessed a concourse of people larger than usual; for the clear and open view of the western sky, which the broad bosom of the Thames permitted, revealed a picture in which imagination revelled and admiration delighted. When crowds of people are drawn nightly from "the little village" to the open country on every side to see the glows of the setting sun, we may be sure the display was not much inferior to our own, especially in Italy where the climatic conditions would assimilate the spectacle to that which we saw here. The character of the picture is shown by the fact that many persons at first said the colouring was due to an aurora. These people soon reflected, of course, that that explanation would not do, as auroras do not appear in the west, and are not necessarily connected with the setting sun, moreover the glow did not scintillate, and there were no contemporaneous magnetic disturbances. In one case, indeed, in the colony of Victoria (month of December), the display did merge into a veritable aurora—silver streamers appearing before all the red ones were gone—but that was an exceptional circumstance, and no one has asserted that there was any connection whatever between the two (Ellery, "Nature"). We have descriptions of similar appearances in various parts of

Asia (*e.g.*, India, Ceylon, China, Japan); Africa (Cape of Good Hope, Gold Coast); America (the United States, Barbadoes); the Sandwich Isles and Australia; so that we may conclude pretty safely that skies similar to those with which we have been familiar have been seen in all parts of the world. At the observatories on Mounts Washington and Pike, in the United States, it is stated that nothing remarkable was observed except a sun-glow on the first-mentioned peak on the 2nd December; the *absence* of the appearance there is in itself phenomenal when they have been seen so persistently elsewhere.

Most of the accounts agree as to the gorgeousness of the display made by masses of yellow-orange clouds, silhouetted in a clear sky of magnificent colour varying in tint from pink to primrose. The sun on many nights set somewhat hazy, but of a brilliant golden or light yellow colour. Even before he disappeared there were signs of the coming glory. But a few minutes after he sank behind the summit of Mount Arthur, we in Nelson here saw the western sky suffused, as it were, with a blush. When, as frequently happened, a few light streaked or parallel clouds attended the orb on his departure, these would first catch the colour. But it quickly passed towards the zenith, and every second became more intensely red. When there were any clouds about the face of the western sky, cumulus, cirrus, or cirro-cumulus, these at once were bathed in glorious hues. For ten minutes or more after sunset one half of the heavenly canopy was a blaze of orange, red, and green colours of every shade and tint. Then this brightness gradually waned. But meanwhile a glow as from infinite fires mounted from the western horizon, and behind the golden masses of clouds far and away transcended them in brilliance. The sky had the appearance of burnished metal under the influence of this second, and more remote, and more lasting glow. Every colour of the rainbow could be seen therein (primrose, orange, violet, rose, and pale green could be distinguished—all blending into one another), from the horizon to the zenith was a perfect blaze, forming where it touched the horizon a vein of brilliant silver white, and the opposite half of the sky, even though cloudless, appeared by contrast to be in Cimmerian darkness. To compare great things with small ones, the contrast in light and brightness between the two sides of the sky was suggestive of the effect of a splendid theatrical transformation scene. It was difficult at times to believe that the western glow was not produced by terrestrial fires of colossal proportions. Gradually, but imperceptibly, the colour would disappear. In some places it lasted even so long as a couple of hours, and frequently here it lingered, as if loath to leave the scene of its glory, till the observer grew tired of watching, and dreaming, and wondering what it might mean, and reluctantly passed indoors.

Elsewhere the colour of the sun when setting has been almost white (F.A.R.R., "Nature," 12th June), and occasionally the whole display has been, to use the language of one observer (Ellery, "Nature," April), almost frightful. This observation was made by Mr. Ellery in January last in the morning from the summit of a peak 3,000 feet high, and subsequent to the date of that gentleman's remark that there was nothing astonishing about the sunsets except that above the yellow there came a purple colour. The whole landscape on that occasion was crimson blood red. Sometimes we have had the second glow only, the *striæ* and cirrus clouds having been either absent or invisible. I find to my surprise that the sunrises have been as glorious as the sunsets. No doubt every one here but myself is well aware of the fact from personal observation. It is astonishing, nevertheless, that so little has been said about the morning glows, when so much has been said about those in the evening. Is it the retiring modesty of early risers that accounts for this? The phenomena in the morning have, of course, been reversed as to the order of their appearance. But Dr. Taylor says they have been even *more* brilliant than those in the evening (*Australasian*, 22nd March). Sometimes there has been the pre-glow alone; at other times, when the *striæ* have been visible and confused by clouds, there has been a display corresponding to the earlier one at night. The occurrence of two glows—one, the earlier, on the under surface of clouds; the other well behind them, somewhat later and apparently very high, in fact altogether above the region of clouds—may have escaped general observation; but close observers are unanimous about it (Hazen, "Am. J. Science;" Matthieu Williams; F.A.R.R., "Nature"), and I have myself distinctly and repeatedly seen it. Some correspondents of "Nature" affirm, indeed, that a second after-glow has occasionally been observed.

Now, in addition to the general phenomena just described, there have been locally seen others of even more astonishing character. I refer to unusual colours of the sun and moon. It does not, of course, follow, because these happen at about the same time as the brilliant glows in the sky, that they therefore owe their origin to the same general cause; but those best competent to form an opinion on the subject think they do. Blue and green suns were seen in India and Ceylon for five weeks after 27th August (A. C. Ranyard, "Knowledge"), particularly about 9th and 24th September (Langley, "Sci. Am."), also in the West Indies at Paramamibo, and on the Gold Coast, and on 24th September at London (F.A.R.R., "Nature"). A blue moon was seen in England early in December (Taylor), and during the same month it was at times of metallic-green colour. At Soporo (Japan) both sun and moon for some days in the middle of October were blood red in colour. A green sun was also seen at

Fanning's Island in the North Pacific, and at Honolulu on 5th September (S. E. Bishop, "Nature"); and the *Riverina Star*, 8th March, says that "recently the sun has been surrounded by a halo, the outer rim being black, the inner like a cloud of smoke." In Europe, in December, the moon and stars at various times were observed to be green, and the sun white towards setting. From 9th to 12th September the sun was green at Trincomalee, in Ceylon, till it ascended to the height of 10 degrees above the horizon; later it was blue; at noon, a bright blue; and during its declining similar changes took place, only reversed in order. The moon on or about the same dates was similarly tinged (Langley, "Journal Am. Sci."). It will be well to bear this observation in mind when we examine into the cause or causes of the various phenomena.

There are one or two other points that have been noticed in connection with the displays. In the neighbourhood of Timaru and elsewhere a great luminosity, almost like a continuation or a revival of the evening glow, has been observed in the depth of the night all across the face of the sky round about the place of the sun's setting. This was observed here frequently in the months of November, December, and January, at one, two, and even so late as three o'clock in the morning. The glow sometimes in these midnight displays extended from horizon to zenith over not the western but the *southern* heavens, and was so brilliant that an observer (Mr. Marsden, of Stoke) says he could by means of it easily have read ordinary clear type. During the day the sun, even when the sky was cloudless, has been frequently observed to be surrounded with a whitish glare (Conte California, "Nature," 28th February), coronæ, or coloured halos. Often it has been very hazy. This was noticed by Mr. Hazen, who read a paper on the whole subject recently before the Philosophical Society in Washington. Occasionally also, as at Freiburg on the 11th January, and here in Nelson on the 24th of last month, even with a clear sky there has been no glow at all, though on the previous day there was a very distinct one; again, through the glow the stars have been distinctly seen, and on the 4th and 5th of January there was a ring of 30 degrees in diameter round the moon, and that satellite seemed to be gleaming through watery vapour. Again, on the 1st December it was observed that the glow did not become bright till a full hour after sunset (Hard. Sci. Gos.). Some observers, too, have noticed a large and striking coloured arc, pink or crimson, opposite the sun at the time of the glow. Furthermore, it is recorded that the cirrus-like wisps of cloud on which the sunset phenomena appeared in November and December disappeared altogether or became very faint and large towards the commencement of the current year.

Dates of Phenomena.

And now for a word or two as to the dates of the first appearance of the phenomena in the different places where observations have been made and recorded. This enquiry is decidedly important, whether we associate the phenomena with the eruption of Krakatoa or otherwise account for them by a cause or causes terrestrial rather than cosmic. The following table gives the dates of recorded observations in chronological order:—

27th August. Sun obscured during day and set gorgeously at Seychelles, and Rodriguez, and Diego Garcia.

28th August. Sun-glows at Mauritius, 3,000 miles from Krakatoa.

29th August. Sun dull and like the moon at Seychelles.

30th August. Sun very hazy at Tokio in Japan, and in Brazil.

1st, 2nd September. Sun blue at Cape Coast Castle (7,000 miles away), then rose colour, then white.

1st, 2nd September. Sun green at Barinas in Venezuela (12,000 miles away), previously like burnished silver.

1st, 2nd September. Sun-glows at New Ireland.

4th September. Sun green at Fanning's Isle.

5th September. Sun-glows at Honolulu.

8th September. Sun-glows in Ceylon.

9th September. Sun green and blue in India, Ceylon (Trincomalee).

15th September. Sun-glows in South Australia, and Nelson, New Zealand.

18th September. Sun-glows in Wellington, New Zealand.

20th September. Sun-glows at Cape of Good Hope.

2nd October. Sun-glows in Victoria.

5th October. Sun-glows at Honolulu and Valparaiso.

8th October. Sun-glows in Florida.

19th October. Sun-glows at Yuma (California).

30th October. Sun-glows in United States.

8th November. Sun-glows in England and California.

20th November. Sun-glows in Turkey.

23rd November. Sun-glows in Iceland.

27th September. Sun-glows nearly everywhere, and on this evening the grandest display of all in the Old World.

— December. Sun-glows in North China.

I regret exceedingly that I cannot supplement this list by giving the precise dates of the first appearance of the sun-glows in Nelson. I made certain notes in my diary, but they are not sufficiently conclusive. Perhaps some one present can and will kindly help me in this respect. I neither made exact memoranda myself of the earliest displays nor can I find anyone who did. In these, as well as in other matters, one does not recognize the importance of recording observations till the opportunity of doing so has slipped by. Then we see what useful work in any locality an observatory can do, and how desirable it was for us to get our local meteorological instruments into actual work. We may now congratulate ourselves that in the future the dates of the more remarkable and patent meteorological facts will be found at Bishopdale without difficulty.

On turning over the file of our local evening paper I find the first sunset that was thought worthy of a paragraph to itself—or, indeed, of any notice at all—was on the 29th December. The issue of the 31st—the last day of the year—mentions the glow of the 29th as "the most gorgeous of the many that have excited admiration of late." This display was at its best at 9 o'clock, and half an hour afterwards had almost entirely disappeared. But certainly for three months before this date we had become familiar with the spectacle. I have a distinct impression that we had witnessed it several times before the middle of October. Our vice-president, Mr. Atkinson, whose astronomical studies would make him likely to record or remember with accuracy the dates of the earliest appearances, states his conviction that it was as early as the 1st October or the last days of September. But our secretary, Dr. Hudson, assures me that he can fix the date of one very early display as Monday, 17th September, and he thinks this was not the first. I find what notes I did make confirm this record, and so am able approximately to give the date as Saturday, 15th September.

Dr. Hector, on the 14th November, before the Wellington Philosophical Society, states "that the extraordinary coloured glow in the sky had been visible every clear night and morning since the first* week in September, proving the existence at an enormous altitude of some vapourous matter capable of refracting the sun's light into its prismatic components. He had observed, to his surprise, on several evenings that through rifts in the vapour masses crimsoned in the ordinary way by the sun after it had set, a back-ground of intense greenish blue was visible. After all the ordinary sun-tints had faded, this blue changed to orange-pink, and graduated off through the various prismatic tints to a magnificent crimson spanning over what appeared to be cloudless sky considerably to the eastward of the meridian. This spectacle gradually faded with the advance of nightfall, but lasted 1 hour and 20 minutes after the ordinary twilight tints had faded." I have quoted this at length, to embody in my paper an accurate and graphic description of phenomena, which we all well remember, but more especially because of the date given for their first appearance. In the table

* Misprint for "third." The exact date was the 18th September.—[ED.]

that I have given it will be seen that at Adelaide (South Australia), which is in 35°, the first marked appearance of the sun-glow was on the 15th September. In Victoria, which is only situated a few degrees nearer the tropics than Nelson, the glows did not appear, it seems, till the 2nd October.

To supplement the information given by the above table, I must proceed to say that the displays have continued since their first appearance intermittently up to the present time. The last ones in the old world of which I find any record in "Nature," were, one observed by Professor Reilley, I presume in Dublin, on the 11th June, another on the 22nd June in Dalston, and a third on the 7th July noted by B. J. Hopkins. The displays continued in Nelson without any intermission during the first few months of the present year. I have made memoranda of very striking ones on the 13th March, 14th April, and 5th May. Since the last-mentioned date, I cannot positively say that there have been no sun-glows here in Nelson, for I noticed something very like one even so recently as the 22nd of last month, and again on the 23rd when a faint after-glow was clearly visible for an hour after sunset; but I have not seen anything at all extraordinary in the sunsets since the 5th May. Concerning the latest appearances in distant parts of the world, there has scarcely yet been time to collect particulars and records of observations. To judge from a letter in "Nature," there appears to have been in England in June and July a return of the phenomenon. Be it observed, in no place do the glows seem to have been continuous. Everywhere there were days, even weeks, when none were observed at all. Cloudy weather and other meteorological conditions would account for this in part, but not entirely. In the month of November, there seems to have been a curious intermission, lasting three weeks, even in places so distant from one another as England, Honolulu, and the United States. Two or three days prior to the Sunda eruptions, Moncure Conway reports that he saw the sun steel-blue during the daytime, and green towards setting. This observation, reported by Mr. Ellery to the Royal Society of Melbourne on the 13th December, seems to be somewhat singular.

In leaving this part of my subject, I would point out:—

1. That the earliest places to get the sun-glows and the coloured sun and moon were within the tropics, and as a rule, near to the Straits of Sunda.

2. That the appearances commenced on the very day following the Krakatoa catastrophe, with the exception of the one reported by Moncure Conway, about the date of which there may be some slight mistake.

3. That all the places which witnessed the phenomena before the 8th September, are situated within 15 degrees of the equator.

4. That the glows have differed from ordinary brilliant sunrises and sunsets in respect of intensity, duration, area, and time of appearance. Moreover, the colours of the after-glows have been in themselves very exceptional, and they have succeeded one another with more regularity than ordinarily occurs.

5. That the period of their greatest intensity seems to have been from the middle of November to the middle of January—the display on the 27th November having been the most gorgeous of all.

6. That the phenomena are very gradually disappearing, and becoming less and less remarkable as the weeks roll on. At the present time they are very intermittent, and, when visible at all, are exceedingly faint.

Having described the phenomena, it remains for us now to consider

The various Theories

that have been advanced to account for the same, and we shall find that they are numerous and in some cases sufficiently ridiculous. As Tyndall says, "Man longs for causes, and the weaker minds, unable to restrain their longing, often barter for the most theoretic pottage the truth which patient enquiry would make their own." In the first place there is the "*Supernatural Theory*." The world is in its death-throes. It has always been foretold that portents in the sky and convulsions of nature should precede the coming dissolution. Scientific men cannot account satisfactorily for the heavenly splendours. It is only in their pride of intellect that they attempt to do so. The sun-glows must be classed with the fearful earthquakes, the terrific volcanic eruptions, the weird colours of the sun and moon;—the spread of the destructive blights, the invention and employment of dynamite for dastardly purposes, the growth of human wickedness, etc., etc., are signs that the end of all things is near! We all know the form this argument takes and how many good people there are who honestly advance it. But it need not detain us here to-night.

Then, there are those who thought that *Biela's Comet*, which was rushing towards us in January last, might have exercized sufficient influence in some mysterious way to produce the sun-glows; and some New South Welshman who probably had been sun-struck during the fervid days of December last in his colony, attributed the world-wide appearances to the *sandy deserts* in the interior of Australia. Another theory, scarcely more respectable perhaps, is that the light is such as has been travelling to us *from distant suns* for thousands of years, and has only just succeeded in penetrating to our dark continents. In connection with which, what explanation is given of the disappearance of the abnormal light does not appear. Then, although the glows were repeatedly seen when there was not the slightest magnetic disturbance, we have, of course, the *electrical* theory.

This is a convenient one in many difficulties. Here is something we cannot understand. It must, therefore, be caused in some way by that mysterious force, electricity—which in the near future is to produce for us, even artificially, light, heat, motion, and every form of energy. As is the supernatural to one class of people, so is electricity to another, wiser in its own eyes—a key to unlock every dark and mysterious chamber in the universe. And when we consider what electricity has enabled us to do in recent times, we cannot wonder that it should be credited with effects for which it is not at all responsible.

I.—The Cosmic Dust Theory.

But now we must pass to theories which are more plausible; and the first of these is that the earth has been recently passing, particularly in its intertropical parts, through some *meteoric region* or a cloud of *cosmic dust.* But those who advance this, forget to tell us how it is that there has been even less than the usual number of shooting stars during the period of the glows. The dust in the upper air was once thought to come from outside space and to be the residuum of burnt-out meteors. Some of these erratic bodies rushing aimlessly through space are, from to time, caught by the gravitation of the earth, and then in their rapid passage towards its centre, striking the air, acquire such intense heat that they burst after a very brief moment of incandescence into vapour and are burnt out 60 miles above the level of the sea (Ranyard, "Knowledge"). Now, if we had been passing lately through such a meteoric belt as is supposed, during the numerous clear nights that we have had, meteors or shooting stars such as I have described must have been seen in considerable numbers. As a matter of fact none, or next to none, have been visible. Lockyer, Ranyard, and Williams, nevertheless, were at first inclined to this theory—the latter gentleman more especially—in consequence of the results obtained through examination and analysis of the dust gathered from melted snow; and Mr. Ellery stated, in an address to the Royal Society of Melbourne on 15th November, that there were only two admissible theories to account for the sun-glows, and one was that the earth was passing through a meteoric region resulting in refraction of the sun's rays. Mr. Ranyard says ("Knowledge," 14th March) that at first he could not resist the impression that the glows were caused by meteoric dust, though he knew well enough that in 1861 the earth passed directly through a comet's tail without any such glows appearing. But all these gentlemen abandoned this theory subsequently. A Mr. Biggs, of Launceston (Tasmania), says that if we *had* been running through a meteoric belt such as is supposed, the meteoric bodies would have been falling upon us at the rate of 200,000 miles a day—that celestial fireworks would have been astonishing, and that everything sublunary would have been burnt up—unless, indeed, the meteoric dust was in our own orbit and moving with our velocity, in which case the phenomena would have been an old acquaintance. Other objections to the cosmic dust theory are the almost instantaneous appearance and the intermittent character of the phenomena. Every re-appearance would imply another cosmic cloud moreover; and the amount of meteoric dust requisite to produce the effect, would have to be enormous and very exceptional. The number of meteorites that enter our air daily is computed to be about 10,000,000, weighing not less than 100, nor more than 1,000 tons altogether (Langley, "Scientific American"). This amount of matter falling into the air, it is considered, would be far too small to produce the result for which we are seeking the cause. A further argument lies in the fact that particles of dust brought down by rain and snow-water recently, when subjected to microscopic and chemical analysis, are found to resemble volcanic matter rather than meteoric (Professor Rees, New York Academy of Sciences). So that, on the whole, it may be concluded that, if it is dust in the upper air that causes the sun-glows, that dust is not meteoric but terrestrial.

II.—THE AQUEOUS VAPOUR THEORY.

The precise cause of the brilliant colouring which so frequently beautifies the heavens and accompanies the setting and rising of the sun is not positively known. It is, however, generally supposed to be owing to an extraordinary amount of aqueous vapour (Lockyer, *Times*, 18th December, 1883), or dust (Hazen, "American Journal of Science") in the higher atmosphere absorbing the blue rays which go to the composition of white light, and diffusing the red. The connection between red skies and rainy weather is recognized in the oldest folk lore.

"Red sky at night is the shepherd's delight,
Red sky in morning is the sailor's warning."

"When it is evening ye say it will be fine weather, for the sky is red. And in the morning, it will be foul weather to-day, for the sky is red and lowering."—Matt., xvi., 2, 3. I presume red in the sky in the evening does not imply wet weather, but rather the reverse, because it shows us that the aqueous vapour in the air is following and passing away with the setting sun. Just as the colouring of the deep sea is owing to the refraction and decomposition of light passing from one medium into another of different density—shallow water appearing, as a rule, colourless—so aqueous vapour in the atmosphere causes the absorption of certain component rays of white light, and the others being dispersed in the air, impart their colour. The ordinary phenomena of *twilight* and *dawn* are partly owing to the same cause; and it is said that when the sun is seen through the funnel of a steam engine it appears green. It was natural, therefore, that the aqueous vapour theory should be advanced to account for the sun-glows; as it was brought forward under somewhat similar circumstances, hereinafter referred to, in the year 1783, by the philosopher Lalande, so it first occurred to many eminent astronomers and meteorologists (Mr. Ellery amongst the number) of the present day; and although in most cases the theory was subsequently abandoned, yet at first it was maintained vehemently, and most other theories treated with contempt. With Mr. Ellery of Melbourne the *aqueous* was one of his two admissible theories, and that which he strongly advocated. He said—there is unusual moisture in the upper air—our exceptionally wet season proves it. The average rainfall for January is 1·60 inches. This year it has been 4·75 inches. Such exceptional moisture in the air will account for the sun-glows (Royal Society, Melbourne, 15th November). But, unfortunately for this theory, as it happened, the season in New South Wales, the neighbouring colony, was exceptionally *dry*, as the squatters there know to their cost. The drought was so severe indeed that it brought about a loss to the colony in one way or another of £10,000,000, and again in North China (from the testimony of a Mr. Sowerby in "Nature") the winter was remarkably fine. Yet in both New South Wales and China the sun-glows were brilliant—those in China, in the month of December, being described as gorgeous with magnificent rose-pink after-glows. Mr. Ellery, furthermore, says that an assistant of his at Port Darwin, in March, 1883, saw several such sunsets as we have had with similar after-glows, and that they always came before or after rain. Herein the Government Astronomer of Victoria strangely loses sight of the fact that *before* or *after* rain, as it appears to me, makes all the difference in the world, for if the sun-glows continue to appear after a rainy season, and during a succeeding dry one, as they have done in Victoria, it is clear that they must be produced independently of aqueous vapour in the air. As far as our experience here in Nelson is concerned, I do not think there can be any doubt whatever that our finest sun-glows occurred during a spell of dry, keen, and exceptionally cold weather. Moreover, the air of England is wet enough in all conscience, yet fine sunsets are comparatively rare there, and green suns almost an unheard-of phenomenon. Dr. Hector,* again, as I have already quoted, spoke on the 14th November, 1883, of the extraordinary coloured glow in the sky, as *proving* the existence at an enormous altitude of vapourous matter capable of refracting the sun's light into its prismatic components. Except that the expression employed here is "vapourous matter"—in the place of "aqueous vapour"—the language is not at all doubtful. The context, however, states that the *vapour* must have an unusual altitude, that

* Trans. N.Z. Inst., vol. xvi., p. 556.

it was gradually drawing towards the pole, and that it was connected with the Sunda eruption. But that the exceptional matter in the upper air *is vapourous at all* seems to me very doubtful. I would remark here parenthetically that it is very easy for us to be wise when a great many facts and opinions have been given and collected; but very difficult when the phenomena are quite new and few accurate observations have been made, and we have had no opportunity of comparing notes with other observers. To say this much is due to those who, from their position, are expected at all times and at a moment's notice to give a correct opinion as to the cause of whatever baffles ordinary comprehension in natural phenomena. That they should occasionally make a mistake is to be expected, but that they *have* done so as far as this aqueous theory is concerned, I conceive, as yet, is certainly "not proven." That they have, in some cases, changed their opinion, shows the difficulty and uncertainty with which the whole subject is surrounded.

However, there is another test of the "aqueous vapour" theory—the *spectroscope.* When the glow is examined by means of this tell-tale instrument, if there were aqueous vapour in any quantity in the upper air, you would have the solar spectrum with its Fraunhofer lines and certain black bands—wet weather or rain bands as they are called—intervening, even as when a ray of light is seen through straum (M. Jansen). Now, as a matter of fact, during the period of the sun-glows, whenever the spectroscope was employed, it was found that the rain bands instead of being at a maximum were at a minimum. On the other hand, the dry-air band was well defined—in fact, to use the words of Lockyer, it was at a tremendous maximum. Notwithstanding some evidence to the contrary furnished by Mr. Michie Smith, of Madras, and Dr. Assman, of Maddebûrg, this seems at first sight pretty conclusive. But it is not so, for there arises this question, *Would the spectroscopic effect be altered according to the condition of aqueous vapour in the upper air?* If the vapour were turned by the intense cold of the upper currents into icy particles, *Would the rain band then appear?* I do not think it would, and we shall see subsequently direct testimony that it would not. So that, after all, the aqueous vapour theory does not completely break down—it only becomes modified. We have *ice crystals* instead of watery vapour. I read that green and blue suns are frequently seen in polar regions; and icy particles in the air refracting the sun's light into its prismatic components are very favourable for the display of sunset colours ("Hard. Sci. Goss.") The question is, what other independent proof have we that the upper air has been full of ice crystals? The general view of the world's weather recently does not seem to provide any evidence in this direction. Some places have been certainly unseasonably cold. I think New Zealand has for example. The summer of Christmas last was both late and cold. A frost was experienced at Ashburton on 5th December, and for the past few months we have had more than the usual amount of biting weather. But, *per contra*, last winter in England, when the sunsets were most brilliant, was very exceptionally mild. So I believe it will be found to have been elsewhere. Nevertheless, the *ice crystal* theory still finds advocates, notably Dr. Verbeek, who connects the appearances notwithstanding with Krakatoa. He says that the vapoury discharge on 26th and 27th August at Straits of Sunda was immense; that it was condensed to water as it ascended into the colder air, and eventually in the coldest, was frozen. The refraction through the innumerable ice crystals, he thinks, was quite a sufficient cause for the abnormal sun glows.

Now this carries us through all the theories which attempt to account for the sun-glows independently of Krakatoa and its memorable eruption, and it is evident that although there is very much to be said in favour of the aqueous vapour theory—or rather its modification, the ice crystal theory,—yet not one of these attempts to account for the displays is perfectly satisfactory. Moreover, when we are regarding exceptional events, we must look for their origin in events which are in themselves both exceptional and adequate.

III.—The Volcanic Theory

therefore next claims our attention. It is impossible, I think, to consider the dates of the earliest occurrence of sun-glows, coming as they do immediately after the Krakotoa eruption, which, you must remember, culminated on the 27th August at 10 in the morning,—without arriving at the conclusion that the two things are in some way associated—the fallacy in "*post hoc, propter hoc*" notwithstanding, but historical records help us also in this direction. It has been pointed out on the authority of that accurate and painstaking naturalist Gilbert White, that strangely enough exactly 100 years ago, *i.e.*, in the summer of 1783, similar phenomena were observed (" Nat. Hist. of Selborne," Letter LXV.).

"The summer of the year 1783 was an amazing and portentous one, and full of terrible phenomena; for, besides the alarming meteors and tremendous thunder storms that affrighted and distressed the different counties of this kingdom, the peculiar haze, or smoky fog, that prevailed for many weeks in this island and every part of Europe, and even beyond its limits, was a most extraordinary appearance, unlike anything known within the memory of man. By my journal I find that I had noticed this strange occurrence from 23rd June to 20th July inclusive, during which period the wind varied to every quarter without making any alteration to the air. The sun, at noon, looked as blank as a clouded moon, and shed a rust-coloured ferruginous light on the ground, and floors of rooms; but was particularly lurid and blood-coloured at rising and setting. All the time the heat was so intense that butchers' meat could hardly be eaten on the day after it was killed; and the flies swarmed so in the lanes and hedges that they rendered the horses half frantic, and riding irksome. The country people began to look with a superstitious awe at the red lowering aspect of the sun; and indeed there was reason for the most enlightened person to be apprehensive, for, all the while, Calabria and part of the Isle of Sicily were torn and convulsed with earthquakes, and about that juncture a volcano sprang out of the sea on the coast of Norway."

And Cowper in the "Task" describes the same appearances (Task, Book ii.).

> "Sure there is need of social intercourse,
> Benevolence, and peace, and mutual aid,
> Between the nations in a world, that seems
> To toll the death-bell of its own decease,
> And by the voice of all its elements
> To preach the gen'ral doom. When were the winds
> Let slip with such a warrant to destroy?
> When did the waves so haughtily o'erleap
> Their ancient barriers, deluging the dry?
> Fires from beneath, and meteors from above,
> Portentous, unexampled, unexplain'd,
> Have kindled beacons in the skies, and th' old
> And crazy Earth has had her shaking fits
> More frequent, and forgone her usual rest."

From another source ("Nature," 17th July) I hear that extraordinary sunrises and sunsets in that year lasted for eleven months, and have been attributed by Arago to volcanic dust, for besides the volcanic activity to which the Vicar of Selborne refers in the letter mentioned, there were, it appears, in 1783 tremendous eruptions of Asama Yama, in Japan, and Skaptar Jokul, in Iceland. Mrs. Somerville, Sir C. Lyell, and Sir J. Herschell all refer to the latter event, and the last named says that on that occasion 21 cubic miles of lava were ejected from the crater. Again, similar phenomena were observed in Europe and America in 1831, and at first when this fact was disinterred from historical archives or recalled by human memory, it was stated that that year was memorable for no particular eruption. But a quotation from Nile's Register, 31st October, 1831, given in "Nature" of May last, puts a different aspect on the case. It says that on 7th August preceding, there occurred a violent eruption off the coast of Sicily, during which Graham's Isle was formed: two days later the sunsets began to be very lurid and remarkable, the glow extending to the zenith, and lasting beyond twilight. After the 11th August a blue sun was seen at the Bermudas, and on the 15th at Mobile. In October at Washington, and at Alexandria in Virginia, there was a red sun-glow, and at mid-day the sun was silver white. Again, Dr. Taylor (in his *Australasian* notes) quotes Col. Stuart-Wortley to the effect that he has seen similar skies in the Pacific, caused by the volcanic eruptions of South America: and Ed. Whymper, on the slope of Chimborazo, 3rd July, 1880, saw an eruption of Cotopaxi, 65 miles away, which produced not only a blood-red sky, changing to verdigris green and the colours of brick dust, copper, and shining brass, but also a veritable green sun.

The fact which I wish to bring out by all this evidence is that somehow or other by the discharge of smoke, dust vapour, or gas—*i.e.*, matter in one of its three leading forms—from volcanic rents, the colours in the sky and of the heavenly bodies have been and can be for a period of time, short or long, very considerably changed. Here, therefore, we have an additional reason besides that of sequence in point of time, for associating the late manifestations with the outbreak at Krakatoa, and the very exceptional violence and extent of the operation of that eruption enables us to see why the sun-glows recently have been so remarkable and brilliant, and of such long continuance.

But that is not all. The year 1883 was as a whole wonderful in its volcanic activity. The old fiery life is still throbbing in the earth's veins, and as the *Times* recently remarked in a leading article, the lava catastrophe clearly shows that our little world is not near its latter end yet. I find that from March of last year almost up to the present time there has been a series of earthquakes and eruptions such as mankind has probably never before experienced in historic times, within a similarly brief period. By the microseismometer, earth-tremors of the faintest character are duly recorded; and this delicate instrument reveals the fact that for some time, particularly in certain parts of the world, earth-tremors have been more than usually continuous. I would ask you to carefully note the following list of the eruptions and earthquakes during the period indicated. I have compiled it up to Christmas last from a journalistic summary of the events of the year:—

22nd March. Earthquakes in Sicily, eruption of Etna.
26th March. Eruption of Hecla.
12th April. Earthquakes in Tasmania begin, and last through year.
20th May. First eruption of Krakatoa.
22nd July. Earthquake in Ischia (6,000 killed; felt even so far as Wiesbaden).
25th August. Great eruption of Krakatoa.

28th August. Earthquakes in West Australia and Tasmania.

29th August. Earthquakes in New South Wales and Tasmania.

30th August. Earthquakes in New South Wales and Queensland.

20th September. Earthquakes in New South Wales.

8th October. Eruptions in Iceland.

10th October. Last eruption of Krakatoa.

11th October. Earthquakes in California. Eruptions in Alaska.

15th October. Earthquakes in the Levant and Asia Minor, 200 perished.

22nd October. Earthquake in Lisbon.

It is indeed, though very incomplete doubtless, a formidable list, and since Christmas almost up to date, the volcanic activity has been continued. Ischia and Alaska have again suffered, and even steady Old England has felt the effect of internal fire, or shrinking, or whatever may cause earthquakes—having experienced a severe shock in the neighbourhood of Colchester.

But of all these outbreaks that at Krakatoa was by far the most formidable and gigantic. Professor Verbeek, who was at the head of the Committee of Enquiry appointed by the Dutch Government at Batavia to investigate on the spot the causes, features, and effects of the eruption, has already sent in a long report, a translation of which appeared in "Nature" of 1st May; it is a most complete and interesting account. Even a synopsis of it, however, would be too long for me to give to-night. I must content myself with mentioning a few of the particulars and estimates given, mainly with the view of showing the magnitude of the operations.

It appears that there is a rent in the earth across the Straits of Sunda, and that a slight pressure on the molten matter beneath the crust, or the entrance of salt water causing the generation of steam, produced the explosion. The Professor naturally thinks that the simultaneous occurrence of earthquakes in Australia indicates a very large area of operations. The activity of Krakatoa really began in May, 1883, but culminated on Monday, 27th August, at 5 minutes past 10 a.m., in an explosion so terrific that the noise of it was heard in Ceylon, at Perth in Western Australia (1,800 miles away), and even at Diego Garcia, near Mauritius, 3,000 miles away; in fact over nearly one-fourth of the earth's circumference. Seven or eight air-waves were also formed in all directions—violent throbbings of the entire atmosphere of the world—producing effects like those of earthquakes. Even at Pasoeroean 830 kilometres (say 520 miles) distant, walls were rent by these jerks in the air, which were very quickly communicated and—being registered at places so wide apart as Batavia, Wellington, Dunedin, Melbourne, St. Petersburg, and London—they form, as it were, a register of the successive explosions, and are exceedingly interesting. The air-wave following the 10.5 eruption seems to have travelled three and a quarter times round the world before it allowed the atmosphere to regain its normal condition; journeying at the rate of 674 or 706 miles an hour according as it passed to the east or to the west, *i.e.*, according as it was assisted or retarded by the upper currents of wind (Col. Strachey, Royal Society). Besides this "atmospheric shudder," as Ellery graphically calls it, there were enormous sea-waves—tidal-waves as they are improperly called—formed by the tumbling-in of the burnt-out mountain, or the falling into the sea of vast bodies of ashes, or by submarine explosions or otherwise. These waves were, as you know, awfully destructive to human life—perhaps carried off 100,000 people. To show their force and rapidity, I may state that they reached Geraldton in Western Australia so early as the 27th, Mongonui and Timaru, New Zealand, on the 29th, and Nelson on the 30th. Shortly afterwards they reached places more distant still, even the coast of France. Verbeek computes that 18 cubic kilometres—nearly twenty-five thousand million cubic yards—of solids, and more of gas, were ejected. The steam cloud rose to the height of 11,000 metres (nearly seven miles) even on 20th May, when the eruption was trifling, and probably to the height of 20,000 (over thirteen miles) on the 27th. But naturally enough, nobody in the vicinity on that exciting day was sufficiently calm to note with accuracy such phenomena. Before the eruption the Island of Krakatoa contained 33½ square kilometres (nearly thirteen square miles), now it contains only 10½ square kilometres, that is, less than one-third of the old area. It consisted of three large peaks, one of which was 2,500 feet high; the two smaller of these and a cleanly-cut half of the largest one have disappeared entirely, and the sea over the place where they were is now over 1,000 feet deep. The whole neighbourhood is changed. One island, Poelsche Hoedje, has vanished entirely. Others are trebled in size. Within a radius of 15 kilometres (say nine miles) the ashes are 20 to 40 inches deep, and an area as large as Germany, Holland, and Belgium put together is covered to a less extent. A locality subject to visitations of this kind, with sixteen active volcanoes, some of them 12,000 feet high, and many more only quiet for a time, is well called "The Lid of Hell," and after such a visitation to any one part of the world, we need not wonder at all to see curious meteorological phenomena as a consequence, even in very distant places.

But, as I have already pointed out, this eruption of Krakatoa was by no means the only outbreak through the earth's crust during last year. That of Hecla on 26th March, and that of Alaska, were anything but insignificant. The latter especially must have resulted in the throwing up of a vast quantity of matter. The whole Alaskan peninsula was in volcanic activity.

One mountain, St. Augustine, was split into two parts; another 12,000 feet high was *very* violent—threw the whole district into darkness for some time and covered every foot of the ground to a long distance with a layer of ashes five or six feet deep. An island a mile and a half long and 75 feet high was suddenly formed, and tidal-waves 30 feet high broke on all the surrounding coasts. Still even this was vastly inferior to the Krakatoa catastrophe, and almost all the prominent scientific men of the day concur in connecting our sun-glows with the latter event, although they allow that the smaller eruptions of the year may have contributed to the intensity and duration of the displays.

But it remains to be shown how that connection is established. Something unusual was evidently carried into the higher air in immense quantities in the last days of August, 1883. *What was that something?* Dust, vapour subsequently to be frozen into ice-crystals by the cold aerial upper currents, or some gas such as hydrogen or chlorine. Each of these has its advocates—perhaps the truth is that each has contributed to the result. Let us see more closely what is or can be advanced in favour of each supposition.

Firstly, as to the *hydrogen gas* there really is little to say. Several authorities (Ellery and Hazen, *e.g.*) incidentally mention it as a possible product of the eruption, resulting from the decomposition of the ejected water through electric action, I suppose. When once released the hydrogen would readily and naturally ascend to a great height, for its specific gravity is less than that of any other gas, and we can conceive it as suspended at a great altitude in great quantities, and for a long time. But granting all this, would it produce the sun-glows? Mr. Ellery thinks not, and nobody of scientific standing contradicts him. Again the heavy yellow gas—chlorine—would probably be liberated in large quantities by the pouring of sea-water into the fiery craters of Krakatoa, and in combination with other causes may have contributed to the exceptional colouring.

Secondly, there is the aqueous vapour, or rather ice-crystal theory. There is more to be said here. But, on the threshold, there is a great difficulty. Aqueous vapour in the air is no unusual thing. Often the atmosphere is heavily charged with it. But the sun-glows are phenomenal. Is it not curious that the vapour has never before assumed the condition requisite for producing such an effect? Hazen argues in favour of this theory thus: there are three conditions necessary to produce the best results in the way of sun-glows: (1) clear sky; (2) abundant refracting material; and (3) great force to carry the same high up into the air; all these conditions have been fulfilled. The universality of water secures the fulfilment of the second condition even independently of the Krakatoa eruption; and for the fulfilment of the third condition we have electricity, which during the past year has been in great force as shown by electrometers—incessant volcanic eruptions, a maximum development of sun-spots (Secchi and others offer testimony to this also), and the striæ gathering about the setting sun. One of the three conditions (clear sky) being occasionally absent, the glows would naturally be intermittent. The frost particles in the upper air would produce the colouring by diffraction, and being transparent, would not hide the stars from view. The persistence of the phenomena through many consecutive months is certainly against this theory; and the absence of the rain band is a very strong objection, but not so strong as it looks; *because frozen water does not produce the rain band like aqueous vapour: e.g.*, before a light rain a rain band of 70 degrees has been observed, but before a heavy snow storm only one of 10 degrees (F. W. Cory).

All this is very plausible it must be allowed, but against it one may ask, Where has the upper-air moisture gone to—whether liquid or ice? It certainly has not been precipitated, and the glows have ceased or are ceasing. Russia (*Times*, 11th July) has been excessively wet, but *per contra* an English writer says, about July last—"we are passing through a droughty summer, the driest we have had since the famous one of 1868;" and the *Times* summarizes the great defects of the English climate from 1st January to 26th May as—(1) prevalence of cold searching dry air causing frequent frosts at night and (2) absence of rainfall. Nevertheless, there are many little facts which may be gathered all along the line telling in the same direction as Mr. Hazen goes. Lockyer, for example, mentions that he has seen a green sun through the mist on the Simplon Pass, and every one who has travelled in an alpine land knows the beautiful effect, which I think the Germans call Alpenglûhen, produced by the rays of the setting sun falling aslant through the keen icy air upon glaciers and masses of névé snow. The most gorgeous as well as the softest colours play about the mountain peaks. Every icy crystal coruscates and flashes like a diamond, and the sky all around is flushed with the golden glow beneath it. I once saw this to perfection, standing in the valley of Lauterbrunnen and gazing towards the glaciers of Breithom and the Tschingel Alp. Never will the picture leave my memory! Again there is the strong argument drawn from the accounts given by those who have voyaged in polar regions. There, glows and coloured suns seem to be of frequent occurrence.

Thirdly and lastly we have the *volcanic dust* theory of which Dr. Taylor says, or rather said, a few months ago—that "there is a general consensus of opinion, now that the microscope and polariscope have been brought into the discussion of the question, that it is the true theory." It is stated in

"Knowledge" to have been first advanced by G. T. Symons in a letter to the *Times* of 1st December. But in these colonies the theory was advanced, I feel pretty sure, long before that date. It was repudiated in fact by Mr. Ellery on the 15th November, before the Royal Society of Melbourne, and had been advocated both here and in Victoria some time before that.

It will be well perhaps if we consider in the first place the various points that are in favour of this view.

1. We have already by anticipation considered the certainty that there was something unusual projected into the upper air, and that it was thrown there by the Krakatoa eruption, which, as says Professor Rees, was the greatest eruption on record.

2. The immense quantity of dust ejected from Krakatoa suggests that dust was the thing thrown into the higher atmosphere. As Langley says—"Krakatoa ejected millions of tons which would not soon sink." Thirty miles away from Sunda the ashes fell in such quantities as to make pitch darkness at noon-day. Java was like Holland in its garb of snow. White dust fell on the decks of vessels from 300 to 400 miles away.

3. Dust in the upper air is not an inherent improbability, because the air at all heights is always more or less charged with quantities of dusty particles, as is easily seen when an isolated ray of light is admitted into a dark room. The motes are always in the sunbeam. The smoke of Chicago was seen, again, on the Pacific Coast, so that dust in the air travels far; and Nordensfeld found the fissures in Greenland ice full of fine dust. Where *did* this come from if not from the air? In Italy from time to time also there occur veritable showers of sand brought over by the sirocco from Africa. Piazzi Smyth, in 1872, noted such an occurrence in Palermo Bay and, if I mistake not, I have read somewhere that the red sand of the Sahara, carried by the Harmattan and other desert winds, finds its way to immense distances across the Atlantic. Dr. Taylor says that the air on the very summit of Monte Mazo, 9,000 feet high, is full of Bacteria, mould, spores, etc. In fact, though ordinary dust is not carried very high and is always denser in the lower strata of the atmosphere, which was demonstrated by Tyndall's experiments on the Bel-Alp, there is always dust in the air in greater or less quantities. This is clearly shown by the phenomena of radial polarization of light (*i.e.* the reflection or refraction of light so that it has new properties—sides as they are called of different intensities), and to some extent it is also shown by the beautiful effects which we call twilight and dawn, though the principal cause of these is the reflection of light from the air itself and the clouds and vapour suspended in it. Professor Langley says that there is a zone of dust to the height of three miles all round the earth. In 1878 he wintered on Mount Etna and he

found the air full of dust not local in origin. So Piazzi Smyth also found on Teneriffe at the height of a mile; and on Mount Whitney, in South California, 15,000 feet high, Langley found a sea of dust 6,000 feet deep. Tyndall says, "What mainly holds the light in our atmosphere after the sun has retired behind the earth is, I imagine, the suspended matter which produces the blue of the sky, and the morning and evening red. Through the reverberation of the rays from particle to particle, there may be at the very noon of night a certain amount of illumination. Twilight must continue with varying degrees of intensity all night long, and the visibility of the nocturnal firmanent itself may be due, not as my excellent friend Dove seems to assume to the light of the stars, but in great part to the light of the sun scattered in all directions through the atmosphere by the almost infinitely attenuated matter held there in suspense" ("Hours of Exercise in the Alps"). Incidentally, I must remark that this probably gives us the true cause of the remarkable light that has been observed at midnight in different places during the period of the most intense glows. Given exceptionally large quantities of dust in the air, and assuming the correctness of Tyndall's theory, exceptional luminosity at night-time is just what we should expect.

4. In the next place, notice particularly Mr. Lockyer's argument that the order of the first appearance of the sun-glows in different parts of the earth is, upon the whole, in proportion to the distance of those places from Krakatoa, and therefore such as we should expect if dust were the reflecting or refracting medium of which we are in search. Generally speaking the tropics first witnessed the displays, and first of all those parts of the tropics nearest to Krakatoa. The temperate zones were reached at a later time, and more irregularly—the irregularity of winds in the temperate zones accounting for this naturally enough. I believe, if observations had been carefully made at all the different centres of population, the steady onward progress of the upper-air dust, as it radiated outwards from Krakatoa, would be even more apparent and convincing than it is now,—but to understand that progress thoroughly we ought to know more than we do as to the upper currents of wind in the earth's atmosphere.

5. Dust in the upper air is *sufficient* to account for sun-glows, coloured suns, and all the other phenomena. In the Loes district of China, where the air is often laden with yellow dust, blue suns are constantly seen. F.A.R.R., a writer in "Nature," 12th June, says that the weather in the upper air must have been unusual, for ordinarily whatever matter may be there assists the blue rays of light and scatters them, whereas lately the blue rays have been absorbed. Now, a stratum of larger particles than ordinary, 20 to 40 miles high and descending at the rate of 1,000 feet a day,

would produce the effects with which we have been familiar. Such dust would cause a green reflection to be seen, followed by a yellow one. Then there would be competition between the red-arresting upper dust and the blue-dispersing lower air. Lower still the yellow would pass to orange, pink, and crimson—more striking as darkness increased. Perhaps there is some analogy to this decomposition of white light and reflection of certain component rays, in the green colouring of the ocean, which Tyndall regards as resulting from the interruption of the usual green rays by impurities suspended in the water. If this matter be absent and the sea be deep as well as pure, it is of a blue colour. On Mount Whitney, Langley found the dust itself bright red, but the sky, as seen through it, violet; but near the sun quite white. He says red rays are transmitted with the greatest ease through our air, the variation of colour depending on the size of the particles of dust therein contained. Krakatoa may have charged the air, or a belt of it, with dust large enough to scatter the red rays and partly absorb the others. G. F. Chambers, at a January meeting of the Astronomical Society, mentioned the case of the crushing of seaweed by steam machinery at Eastbourne. The engineer of the works there says that he frequently sees the sun blue and green through the fine dust in the air. Dr. Buddle, in "Nature," on the 20th December, refers to the Frenchman in Algeria, who said one day when looking at the sun, *C'est la première fois que j'ai vu le soleil bleu*, and was informed that the dust from the Sahara was the cause of the novel colour. Ranyard's explanation is this: the particles of dust, when small compared with the wave-length of light or of invisible spectrum, disperse different proportions of red and blue—the larger the wave-length the less the intensity of dispersed light. Usually the colour of the sun is not affected by dust in the atmosphere. But when that dust is much increased in amount, the intensity of the dispersed light is much increased also, and the blue colour of the light between us and the sun affects the colour of the sun itself. Lockyer at first thought that the particles floating in the air were themselves blue and red, and thus that the colours we have witnessed were simply the result of reflection, and Hardwick's "Science Gossip" recently spoke of the blue and red particles remaining suspended in mid or upper air. But no such coloured particles have fallen, and so this hypothesis has been, I believe, generally abandoned.

Ranyard in "Knowledge" refers to the blue sun in the tropics becoming green as it neared the horizon, and sinking red. At Trincomalee, in Ceylon, from the 9th to the 12th September the sun rose green, and continued to be of that colour till it reached the height of 10 degrees above the horizon, then it became blue, and at noon bright blue. During its declining, similar changes were noted, but in the reverse order. The moon was similarly tinged. According to the size of the particles suspended in the air, would be their effect by refraction upon the rays of light falling on them. Gravitation would naturally bring the heavier particles down first, and so it is conceivable that for some months perhaps the air was filled with strata of dust, whereof the lower were composed of heavier, and the upper of lighter particles. Hence, as it seems to us, the change in the colour of the sun as it mounted in the heavens, and again in reverse order as it descended, was just what it was natural to expect. But if you ask me why the abnormal colours of the sun were not seen daily like the sun-glows, I can only suggest that the dust varied in density and character from day to day according to winds, or that for the most part some counteracting influence, moisture *e.g.*, was at work, so that the coloured sun and moon were rare phenomena. Even the after-glow is a result which dust in the air might be expected to produce; for this species of second twilight is not by any means unusual in the Nubian Desert, and Sir T. Herschell referred it to a second reflection of solar light in the atmosphere (Chambers' Encyclopædia, "Twilight"). I do not know that this circumstance has hitherto attracted any notice in this discussion, but it seems to me that it deserves to do so.

6. Chemists and microscopists have been busy in many different places in collecting from rain- and snow-water the dust brought down from the atmosphere, and have, generally speaking, from the analysis subsequently made, come to the conclusion that the matter so collected is volcanic in its origin; further, that it corresponds to the dust ejected from Krakatoa. M. W. Beyerinck, of Wageningen, says that *this is beyond doubt*. That rain- and snow-water have for some time back left considerable deposits in the rain-gauge and otherwise seems pretty certain. Whether such sediment has been collected and examined here in Nelson, our local microscopists can tell us. The deposits have been collected at places very wide apart, *e.g.*, Queenstown (Cape Colony), Launceston (Tasmania), Harrow (England), Sandhurst (Victoria), Unaluska (Alaska), and in parts of Norway. But as there is always more or less dust in the atmosphere, and as in some places from local causes, such as iron and other manufactories, dust storms, strong desert winds, etc., it occasionally becomes abnormally charged with additional matter, accurate and careful analysis alone will help us here. Such analysis would need to be made by most skilful experts, or it would not be trustworthy as the basis of argument. But when we find such men as M. Daubrée, of Paris, and M. Renard, of Brussels, agreeing with Macpherson, Murray, and Diller, as to the analysis and identification of the dust, scepticism becomes less justifiable. The Royal Society of England has recognized the great importance of the investigation, and specially

appointed a Commission to collect all observations and documents bearing thereupon. It appears that the Krakatoa ashes contain abundance of vitreous matter and elongated gas-bubbles enclosed in pumice, volcanic sand, and ashes. The two first-mentioned are almost characteristic, and, if so, make the Krakatoa dust less difficult of identification than one might suppose. Diller says he has found glass always most abundant in Krakatoa dust collected on the Java coast; Macpherson, in dust collected from Madrid, found crystals of hypersthene, pyroxene, magnetic iron, and volcanic glass, all of which Daubrèe found in the Javan volcanic ashes. Verbeek, by microscopic examination of Krakatoa dust on the spot, found therein glass with oval vacuoles, felspar, pyroxene, and magnetite in grains, and octahedra. He also gives the chemical analysis, which I need not repeat. Unfortunately the enquiry is complicated by the circumstance that the vitreous and mineral fragments found near Krakatoa are similar to those found in deep-sea deposits, *i.e.*, such as have fallen from time to time through countless ages from the air into the sea, and which may be either of meteoric or cosmic origin or both. Further, Mattieu Williams on the 5th December last got a black sediment from 75 ounces of snow which fell at Harrow. In this he found much black oxide of iron readily attacked by the magnet and containing nickel. This, he says, is a characteristic of meteoric iron, and cannot possibly have come from Krakatoa, being too heavy. But too much weight must not be attached to this either, for it is evident that the recent fall of Krakatoa dust in different parts of the world would not be likely to stop the supply of meteoric or cosmic dust that the earth is continually receiving. Altogether, this sixth argument at the present date, in the absence of fuller information, is very difficult to work out, and I do not ask you to lay much stress upon it.

7. The occurrence, as we have already said, of similar phenomena after the volcanic eruptions of 1783 and 1831, furnishes a *strong* argument for associating our sun-glows with the Krakatoa eruption, and, of the various materials cast out by Krakatoa, *dust* seems more likely than water or gas to be the operative cause of the colouring.

8. The very gradual disappearance of the sun-glows is what we should expect if the volcanic dust theory were a correct one, for the dust would fall from the atmosphere very slowly—the heavier particles first, then those of medium weight, and last of all, and after perhaps a long period of time, the most minute and insignificant.

9. Where, as in this case, a proposition does not admit of positive demonstration, the occurrence of a number of arguments all tending to show its probability must be allowed to have preponderating weight—particularly if the objections thereto can be satisfactorily answered.

Let us, therefore, in the last place examine the *objections* that either are or can be, in my humble opinion, urged against the dust theory.

1. The *amount* of dust that would be requisite to form even a thin belt over so large an area of the earth's surface as is comprised, say, between the 52nd parallel of north latitude (that of London), and the 44th parallel of south latitude (that of Dunedin),—that is to say, roughly speaking, about 150 millions of square miles,—would be so enormous that it is difficult to believe that it could all have been thrown up by Krakatoa. We must allow this to be a forcible objection; but reflect at the same time on what has been said as to the gigantic scale of the operations at Krakatoa, and furthermore consider two points:—(1) That the dusty cover need not have been, as far as I know, very thick, and the third dimension, the thickness of the cover, would materially affect the total amount of its solid contents; (2) That the dust was probably not distributed equally thickly or densely over the whole of the vast area; indeed one can well understand that it hung suspended only in particles, for there were undoubtedly periods of intermission in the displays, and these intermissions may have been occasioned by the temporary absence of the causal medium as well as by other counteracting atmospheric conditions. What do we really know for certain about either the exact amount of dust ejected from Krakatoa or that requisite for producing the phenomena? Very little I imagine.

2. It is said, even if dust had been shot up to an enormous height by the Krakatoa eruption, from its inherent weight it would soon have *settled down* on the earth again (Professor Rees). Undoubtedly the heavier particles would have done so, and actually did so; but in proportion to the minuteness of the particles in all probability would be the distance and time they would travel. The heavier dust fell at Krakatoa, but we have read of thick dust falling on a vessel at sea many hundred miles away. One writer suggests that the air may possess some *viscosity* which would check the tendency of the dust to settle. Moreover, Professors Preece and Crooke say that minute particles ejected into the upper air would be negatively electrified, and therefore repelled by the earth and by one another (which, by the way, would account perhaps in part for their rapid diffusion) and so would probably remain at a high level for a long time. Besides the lower strata of the atmosphere itself might be denser than the foreign matter of the upper strata—even though not composed of exceptional gases ejected from Krakatoa. Rollo-Russel points out, too, the vesicular nature of pumice, each particle really consisting of a bubble of glass—which, when shot high and removed from the action of vapour and weather, would be easily carried to the most distant parts of the globe ("Hard. Sci. Gos."). Very fine dust

of any kind settles from the air on a surface warmer than itself very reluctantly. Once in the higher air, therefore, dust would be perhaps able for a long time to resist gravitation. Professor Trowbridge believes that the upper currents of air would tend—by their motion, I presume—to keep the dust in suspense. Of these said upper currents our knowledge, as Lockyer remarks, is really very limited; but the investigation of these sun-glows and a careful comparison of the dates of their appearance in different places may perhaps extend our knowledge in this respect as well as in others. And this brings up

3. The actual *dispersion* or *diffusion* of the dust as a great difficulty. As Hazen says, the currents of the upper air, if they caused the diffusion, must have acted in opposite directions, whereas we have always understood that the upper air moves steadily in one current from west to east. In answer to this I can only repeat what has been said. Nothing is certainly known about the higher aerial currents. And as I have just now ventured to suggest incidentally, the electrical repugnance of the particles of dust to one another may have had something to do with their diffusion.

4. Hazen regards the *rapidity* of the dust dispersion as a stumbling block. The upper currents or something else must have carried the dust 12,000 miles (to Barinas, Venezuela) in 150 hours, *i.e.*, at the rate of 80 miles an hour; whereas *observations* on Pike's Peak, 14,134 feet high, show the current there to be running at the uniform rate of 20 miles an hour. To this the reply at once occurs: an observation at the height of, say three miles, is not conclusive as to the rate of the wind throughout the upper regions, and we do not know at what height the line of dust was spread out. Moreover, Symonds thinks that the rapidity of the westerly dispersion may perhaps be accounted for by the rotation of the earth from west to east, so that the dust was as it were left behind by a process analogous to that which causes the trade winds in the tropics. But this would, it appears, only account for a progress of 440 miles a day, whereas that to Barinas was at the rate of 1,700 miles a day. Then, again, Symonds suggests that perhaps the dust got quite out of the earth's atmosphere, and so was left a whole hemisphere behind, which idea Cowper Ranyard will not entertain at all, and I confess that I do not understand it. That the dispersion of the unusual material in the upper air (for the difficulty is the same whether dust was the material or not) was exceedingly rapid in some directions, particularly to the west, is certain. But, perhaps, the earth's rotation, the upper-air currents, and the electrical repulsion combined, were sufficient propelling causes. It is, you will notice, in connection with this branch of the subject that accurate observations of the dates of the first appearances

of the sun-glows in different places are so important; *e.g.*, we could tell the rate of progress of the dust to us in Nelson pretty well if we knew for certain when the glows first appeared in Port Darwin, Brisbane, Sydney, and Nelson. Unluckily people did not attach much scientific importance to the phenomena when they first appeared, and so made no notes.

5. The *intermittent* nature of the phenomena, also, Hazen thinks, is against the supposition that dust is the cause; but I see no force in this. It is only natural that the appearances should vary in intensity with varying meteorological and atmospherical conditions, and, as I have already said, the dust may not have been very evenly distributed.

6. Hazen's last objection is that ashes are *opaque*, and the appearances indicate a transparent something. Another writer (in the "Sci. Amer.") puts this objection in this way:—He says, earthly or lunar volcanic dust cannot be the cause of the glows at the rising and the setting of the sun, or the ordinary light from sun, moon, Mars, Jupiter, etc., would be affected. But there is no diminution of this light. Therefore the cause of the glows lies far beyond the sun's orbit.

But are the premises in this argument true? Have we not already stated that a haziness of the sun has been observed at several places—*e.g.*, at Seychelles and Tokio? And is not a change in the colour of the sun and moon virtually a change in the intensity of their light? Moreover, although individually the particles may be opaque (which their intense character leaves open to doubt), collectively they do not constitute an opaque mass, being exceedingly minute and widely scattered. Also, before we can attach much importance to this objection we must know accurately what the photometer has to say on the subject. As the writers quoted do not tell us this, we may presume they speak from conjecture only.

7. Some may say that the volcanic force of Krakatoa, however great it might be, would scarcely be great enough to force up such a vast amount of ashes *to so great a height*. It is generally considered that the dust cloud, or whatever it was, lay very high indeed; but what gigantic forces were at work at Krakatoa! An electrical force was in violent action also, for simultaneously with the outbreak all the telephones in Singapore were unworkable, and on one line reports like pistol shots and a mighty roar were continually heard; and again the heated air, emanating from the crater of Krakatoa, would carry with it to unknown heights vast volumes of dust, etc.; and incidentally I may mention that the heated air of the tropics ascending as it always does, to be replaced by cooler air from the north and south temperate and polar zones, would account to some extent for the dispersal of the dust.

8. Again it may be asked, if dust were the cause of the sun-glows, why were they not seen *in the daytime*? Whatever foreign material in the upper air caused the glows, this difficulty would remain the same. Probably the greater perpendicularity of the sun and therefore the greater intensity of his light during the daytime account for the glows then being absent. Towards night and morning, also, his rays would traverse a greater length of the dust-laden upper air.

9. Lastly, if dust caused the green and blue suns and the air is always dust-laden, why do we not have such phenomena *more frequently*? Ordinarily the dust in the air is not very high, and the particles near the earth are large, and aqueous and gaseous vapour counteract the effect of dust by absorbing more light at the blue end of the visible spectrum than at the red.

In conclusion, there is no reason, as far as I know, why we should confine ourselves to any one theory. Perhaps many causes have co-operated accidentally to produce one phenomenal result. If we *must* have only one theory, I incline to the Krakatoa dust theory, because I think the balance of evidence is in its favour. In any case, whatever the upper-air medium may have been, it certainly seems to have emanated from the Straits of Sunda during the memorable eruption of 27th August. However, when we come to speculate upon the nature of the substance thrown into the upper currents, difficulties and objections and doubts meet every suggestion or supposition. We shall, therefore, if we are wise, guard ourselves against all dogmatism on the subject, particularly as fresh facts and fresh theories are coming forward daily.

Even as I write there appears, in the notes on popular science by Dr. Taylor in the pages of the *Australasian*, a modification of the aqueous vapour theory which is well deserving attention. It appears that Dr. Prince, a well-known meteorologist, thinks the phenomenal sunsets are due to the crystallization of saline particles from masses of sea-water ejected in the form of vapour into the upper air by the Krakatoa eruption, and he argues that the greatest displays having occurred in the coldest weather, can only be accounted for on the theory that the crystallization of saline products is a great factor in their production. So long ago as last January, M. Beyerinck, of Wageningen, collected from rain which fell during a storm succeeding a fine after-glow a remarkable quantity of common salt. Again, I find in "Nature" of 3rd July, that M. Gay, in a paper read before the Paris Academy of Sciences on the 23rd June, not only connects the recent sun-glows with the Krakatoa eruption, but thinks that the persistent rains of this year are owing to the same cause, directing attention to the fact that after the volcanic eruptions of 1783, 1831, 1856, and 1862, there came not only the sun-glows to which we have several times made reference, but also abundant rains. And in "Knowledge" of 6th June, Mr. Neison, Director of the Government Observatory at Natal, is quoted as saying that in his colony they had the sun-glows so early as February, 1883, but that they became most vivid on the 28th and 29th of August, and from 31st August to 5th September, after which they vanished for four months,—whereas in Transvaal, 250 miles distant, they were first noticed on the 2nd September, and continued very vivid till January of this year.

Evidently, we have not either heard or said the last word on this subject yet, and we must retain that philosophic attitude so absolutely necessary in many matters—suspension of the judgment. During the next few months the problem may become easier of solution. Some one of our members may then take it up again and give us the benefit of the later lights. I trust we may then be the better able to see our way, for the long consideration you have kindly allowed me to give to the matter to-night. I must indeed apologize for the length of my paper, "*Dum brevis esse laboro, obscurus fio.*" Brevity may be bought at the expense of perspicacity. And much as I have said on this subject, there is far more that can be said. It is astonishing with how many departments of natural science and natural philosophy the enquiry is connected. But, as says a great thinker, "From every natural fact invisible relations radiate, the apprehension of which imparts a measure of delight; and there is a store of pleasure of this kind ever at hand for those who have the capacity to turn natural appearances to account." I must apologize also for treating this subject so much in the Dr. Dryasdust fashion. So beautiful, and weird, and heavenly a display as the recent evening glows should have been treated poetically,—but man is like some long-winged sea-birds, which rise from sand-hills with great difficulty. And after all, the imagination had to be kept well in hand, for, as it is, have we not been led by our enquiry into the volcano's crater, and down to the depths of the sea, and up to the blue ether, and to the furthest parts of the earth.

Art. XLIX.—*Red Sunsets.* By Wm. Ringwood.

[*Read before the Philosophical Institute of Canterbury, 1st May, 1884.*]

Plate XIX.

The equatorial diameter of the earth is 7,901 miles, and the circumference is 24,825 miles, and, as she revolves once on her axis in 24 hours, a place on the equator moves through 1,034 miles per hour, but at any depth beneath the surface the velocity is less in proportion to that depth; in like manner, if we look on the atmosphere as part and parcel of the earth, at a certain height the velocity is greater in proportion to the height.

The whole world has been greatly interested during the last seven or eight months by the beautiful phenomena of coloured suns and brilliant sunsets, and the liveliest interest has been exhibited as to their origin. Lockyer was the first, I believe, to point out the fact of the phenomenon of coloured suns appearing first in the east and then gradually shifting to the west. He traces them to Panama, and then speaks of them as having been seen on a north and south line; but it strikes me that after leaving Panama the phenomenon passed still further westward, seen on the 3rd September 4,000 miles west of Panama, and at Honolulu on the 5th, and struck India and Ceylon on the 8th September, thus performing more than a complete circuit of the globe; moreover, I am of opinion that it may be traced still further westward, where it was seen in lat. 24° 06′ N., long. 140° 29′ W., by Captain Penhallow of the barque "Hope," on the 25th September, having then performed $2\frac{3}{4}$ revolutions of the globe.

All the information that I have collected, and from which I have compiled the following tables, has been obtained from "Nature." The time column has been deduced from the time and date of the phenomena appearing at the different stations, reduced to Krakatoa time. In some instances great difficulty has been experienced, especially in reference to the time at Maranham in Brazil, and at Trinidad, and it has been concluded that at those two stations the times are late, because it was seen at Panama before the time given at them, which we suppose to be an error. Likewise in the case of the Gold Coast, in one place the date given is the 30th August, and in another the 1st September, but from the general result it would appear that it reached that locality about midnight 30th–31st August.

The tables, I trust, are sufficiently clear. The first column of miles represents the mean diurnal velocity that the cloud travelled at between Krakatoa and the different localities *en route*; and in the subsequent columns are given the same from each station in rotation. Of course it will be understood that a small error of an hour or two in the time at the stations comparatively close to the eruption would make a large difference were we to show the *diurnal* velocity: and as I have had only a week's notice to prepare this paper, I trust that any errors that may be hereafter found will be treated with that consideration.

Table I., showing the Mean Diurnal Velocity, in English Miles, of the Phonemena of Coloured Suns and Brilliant Sunsets, in the Northern Hemisphere :—

—	Time from Java to	Java.	Seychelles.	East Coast of Africa.	Gold Coast.	Maranham.	Trinidad.	Panama.	4000 miles W. of Panama.	Honolulu.	India.
Seychelles	H. 45	1802									
E. Coast of Africa ..	58	1817	1873								
Gold Coast	D. 4	1846	1969	1932							
Maranham	5	2020	1950	1896	1904						
Trinidad	5½	1968	2080	2040	1940	2176					
Panama ..	6¼	2059	2040	2176	2324	1930	1986				
4000 miles West of Panama	8¼	2061	2424	2210	2493	2370	2338	2000			
Honolulu	9½	1900	2084	2080	2036	1909	1748	1716	1122		
India ..	12¼	2162	2278	2192	2328	2212	2084	2200	2310	2244	
Lat. 24° N. Long. 140-30 W.	29¾	2132	2246	2206	2268	2165	2400	2170	2460	2316	2192
Means (arith.)		1976	2105	2091	2185	2127	2111	2022	1964	2280	2192

Arithmetical mean .. = 2105 miles per diem.
True mean of 1st column = 2095 ,, ,,

The true mean of the first column, viz., that under the head of Java, is obtained by adding the distance between Krakatoa and each separate station together, and dividing the aggregate by the gross total number of days. The way by which the distance between any two stations is derived is by multiplying the difference in degrees of longitude by the value of a degree in English miles, for the mean latitude of the two places. It must be remembered that between India and the last-named locality on the list, the dust cloud is supposed to have performed over a revolution and a half of the earth.

I place great confidence in the result obtained from the observations deduced from India, because there there are scores of trained meteorological observers whose duty it is to immediately report any phenomenon that may take place, and such as that concerning which I speak could not have escaped their immediate notice: so we may conclude that the hour of its arrival there is very accurately determined, which gives a mean diurnal velocity of 2,162 miles: and taking the velocity from its journey and a half round the world from India to lat. 24° N. and long. 140½° W., we find it to be 2,192 miles a day, or 30 miles only in excess of the other computation.

But if we take the whole journey from Krakatoa to that locality, about two and three-quarters revolutions round the globe, we find the mean to be 30 miles less than the first, or 2,132 miles, and this will be accounted for through the diminished value of the degree in longitude, at the mean latitude between Java and lat. 24° N.

The mean diurnal velocities obtained from the intermediate stations between Java and India agree very closely when we consider that at those several places the phenomenon was wholly unexpected, and thus, in most instances, the dates and times given appear to be somewhat late, it being quite possible and natural that it escaped notice at least once; in India, however, we may conclude that they were on the alert, and consequently the mean velocity deduced from that place ought to bear great weight. There is another thing that ought not to be lost sight of—viz., that without this list of stations, more than encircling the globe, one might suppose that the *cloud* after leaving Krakatoa stretched away westward, and as I gather from Lockyer's paper by his *North–South* line, to have extended to the north and south, forming a letter V with the apex at the Straits of Sunda. Now, Lockyer tracks it to Panama, to which place we see it to have had a diurnal velocity of 2,059 miles, and from Panama to India I made it 2,200 miles a day, which makes me believe that the cloud was performing a spiral path northwards round the globe.

Before proceeding I will now refer to the observations in the southern hemisphere in order to see whether the same has taken place there. This table has been prepared in like manner to the former—viz., the dates and times are reduced to that of Krakatoa, and the distances in English miles obtained from the difference in degrees of longitude reduced to the value of the mean latitude of the two places.

TABLE II., showing the Mean Diurnal Velocity in English Miles of the Phenomena of Coloured Suns and Brilliant Sunsets in the Southern Hemisphere:—

—	Time from Java to	Java.	Mauritius.	Adelaide.	C. of Good Hope.
Mauritius	Hours. 44	1680	..	..	..
Adelaide	Days. 21¼	2041	1980	..	..
Cape of Good Hope	24	2082	2047	2010	..
Christchurch	29¼	2134	1990	2120	2070
Means (Arith.)	—	1984	2005	2065	2070

Arithmetical mean .. = 2031 miles per diem.
True mean of 1st column = 2100 " "

The marked similarity between these two tables is most striking, and, as in the first table, the greatest discrepancy is found between Krakatoa and Mauritius, where the time is reckoned in so many hours, in which case an hour or two makes a material difference in the diurnal velocity.

At present I cannot find any station reporting the phenomenon between Mauritius and Adelaide, but we may conclude that after it passed Mauritius it crossed Africa, the South Atlantic, and South America, whence we may expect to hear of it as there are many competent observers in that part of the world; it then traversed the great South Pacific Ocean and North Australia, and, after performing another such journey round the world, was seen at Adelaide in South Australia about the 17th September. I conclude, as Mr. Todd, the Government Astronomer there, says in his report to "Nature," that it was visible during the last fortnight of September. We next hear of it at the Cape of Good Hope on the 20th September. It again crossed the South Atlantic and South America about the latitude of Buenos Ayres, and a third time traversed the South Pacific, striking the coast of New Zealand on the 25th September, the date of my first seeing it, on which occasion the western sky at sunset presented all the colours seen in the pearl shell. Since then the western and eastern skies have presented those beautiful crimson tints that have delighted and astonished the world, and on many occasions have I seen it almost in the zenith two hours after sunset. During some evenings it has quite illuminated the western face of buildings with a bright red glow, as from a fire, and on others it has been very faint and sometimes not discernible, giving to my mind the idea of its not being a continuous band, but a series of dust clouds with clear spaces between.

From an investigation of the two foregoing tables, it will be seen that the mean diurnal velocity in the northern hemisphere was, during the first revolution, about 2,162 miles, and during the second it increased to 2,192, or 30 miles per diem extra. And the same increased velocity is observed in the southern hemisphere, where we find the approximate velocity during the first two revolutions, viz., on its reaching Adelaide, to be 2,041, whereas during the next revolution from Adelaide round to New Zealand it was 2,120 miles, or an increase of 80 miles a day.

It will be further noticed that in the northern hemisphere the time occupied in its first revolution was about 11 days, and the same rate is observed during the next revolution and three-quarters—or, in other words, within the tropics it encircled the world in 11 days. It is the same within the southern tropics, where it took $21\frac{1}{4}$ days to reach Adelaide in its second revolution; but it performed the next revolution in about $9\frac{1}{2}$ days, reaching New Zealand in $29\frac{1}{4}$ days after the eruption. Thus it performed two revolutions and three-quarters ($2\frac{3}{4}$) in the northern hemisphere in $29\frac{2}{3}$ days, and in the southern hemisphere it performed two and seven-eighths ($2\frac{7}{8}$) revolutions in $29\frac{1}{4}$ days, showing that the initial velocity at starting has only very slightly fallen off in even latitude 45° south. So in the following discussion, I will adopt a mean diurnal velocity for the dust-cloud of 2,083 miles, or 87 miles an hour to the westward.

As I showed at the beginning that if the atmosphere be considered as part and parcel of the earth, a particle of it at a certain height will cover a greater distance in a certain time than that part of the earth immediately beneath would: so if we know the rate per hour that a certain thing *apparently* moves to the westward, or seems to lag behind the diurnal revolution, we can ascertain the height. We know that it lags behind at the rate of 2,083 miles a day, which added to the circumference of the world gives the circumference of a circle 26,908 miles ÷ 3·1416, gives a diameter of 8,565 miles, or 664 greater than that of the earth, or at a height of 332 miles above the surface. Or putting it this way,—we may assume that at the latitude of Krakatoa the earth has an hourly velocity of 1,034 miles, and that any matter ejected thence into the upper regions of the atmosphere would retain the same rotary velocity as it had before, viz., 1,034 per hour to the eastward; but we have material under our observation which cannot keep its zenithal position at starting, by 87 miles per hour, showing it to be at an elevation of 332 miles.

Now the spectroscope tells us that the red colour is produced through dust of almost ultra-microscopic fineness, and in some specimens of this dust that have already fallen, the microscope shows the existence of salt crystals, which fact in itself almost proves it to be of volcanic origin, and not meteoric or cosmic dust. Now Professor Helmholtz states that "the reflecting medium, whatever it was, over Berlin on the last three nights of November, was about 40 miles above the earth;" and if we work on these data, we have a circle whose diameter is 80 miles greater that of the earth, or a circle of 7,981 miles, which × 3·1416 gives a circumference of 25,073, or 248 miles more than that of the earth, which divided by 24 shows an excess of about $10\frac{1}{3}$ miles per hour above the surface velocity of rotation. But we want to account for an excess of 87 miles per hour, so if we accept Professor Helmholtz's statement, we must only suppose that at the altitude of 40 miles there is an easterly current, or one moving to the westward, of 77 miles per hour. For, assuming as we do from the foregoing tables and calculations that the earth rolls from under the cloud at the rate of 87 miles per hour, and that, unless we admit of an easterly current, we cannot stop short of that enormous height of 332 miles, unless we suppose that the power of gravitation has only a feeble hold on those most minute dust particles at the altitude of 40 miles, where the air has not the many thousandth part of the density it has on the surface of the globe.

Mr. W. H. Preece writes, stating his opinion that the mass of matter ejected retained the same electric sign as that of the earth, and as long as that was the case the repulsion force would be sufficient to keep the matter afloat: and, in reference to that theory, Mr. Crookes writes to state that with the rarefaction of one millionth of the atmosphere, two pieces of electrified gold leaf repelled each other at a considerable angle for 13 months; and goes on to state that that rarefaction is attained at an altitude of 62 miles, and that the air there is a perfect non-conductor of statical electricity without interfering with the mutual repulsion of similarly electrified particles; and when we bear in mind that the particles of minute dust are many thousands of times smaller and lighter than the gold leaves operated upon, there is every reason to believe that electrified dust, even projected 50 or 60 miles high, might remain there many years.

Before proceeding further, I must draw your attention to the fact that at the time of the great eruption, and during September, the mean temperature at Batavia and throughout Java generally is at its maximum; consequently we may conclude that the equatorial belt of calms and uprushing air, that encircles the globe, was lying over that district at the time. This uprush is caused through the heated atmosphere rising and the two trade winds, the north-east and south-east, feed it. When this heated air has reached its proper altitude, it flows off to the north and south, but the rotation of the earth causes it to flow towards the north-east in the north hemisphere, and to the south-east in the south hemisphere, and these winds are called by some the return trades, and by others the south-west and north-west upper currents respectively, and are of great altitude, probably ranging up to 50,000 feet.

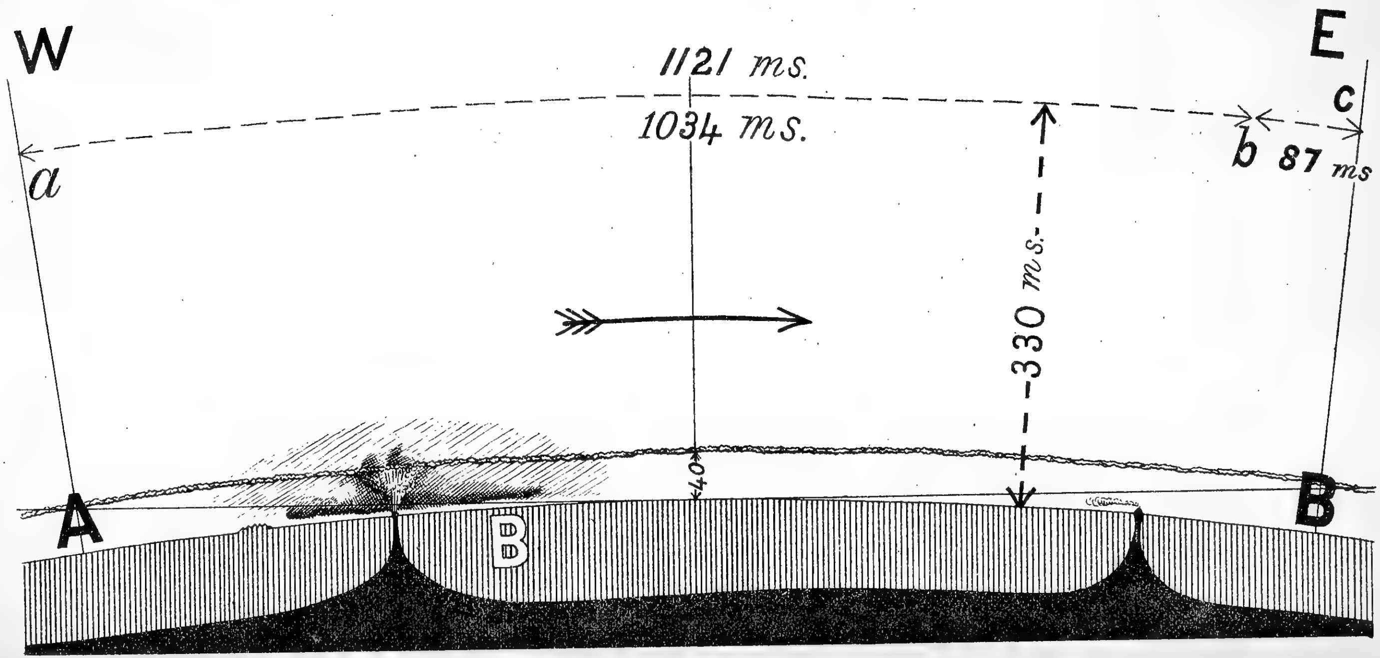
Well, the most bulky masses cast upward by the eruption of Krakatoa would immediately fall, and the less bulky would fall later, according to their size, but the great portion of the dust and ash would be caught, on its downward course, in those upper currents just alluded to, and be carried by them to the north-east and south-east. Such we find to be the fact, for the ship "Meda," when to the westward of Cape North-west, Australia, or about 1,050 miles south-east of Krakatoa, experienced a fall of dust like fuller's earth, which covered the vessel, on the night of the 30th–31st August. And Captain Tierney of the brig "Hazard" on the 1st September, near New Britain and New Ireland, a distance of 3,850 miles due east of Krakatoa, saw the coloured sun, which was no doubt due to the presence of dust in the atmosphere drifted eastward with the upper current.

Now, turning to the north-east quarter, or the direction in which the south-west upper current of the north hemisphere proceeds, we find that in Japan during the 29th, 30th and 31st August, the sun was of a copper

Diagram exhibiting the Equatorial velocity of the earth per hour

SCALE

50 ms. per inch.



colour and had no brightness in it. At Yokohama Mr. Hamilton states that on the 29th and 30th the sun was of a blood-red colour and appeared to be obscured. This is at a distance of about 3,000 miles from Krakatoa, which gives a velocity of the upper current, or return trade-wind, of about 62 miles per hour; this is not excessive, as I have often measured the velocity of the north-west upper current at Adelaide as over 80 miles per hour.

You may remember that I did not continue the tracking of the dust-cloud from that position assigned to it by Captain Penhallow, in lat. 24° N. long. 140½° W., on the 25th September, because the European and American reports are so peculiar. Apparently, it was seen in England *before* the rest of Europe, viz., on the 4th and 9th November, in California on the 20th, San Francisco 23rd, Italy 25th, New York 27th, and at Berlin on the 28th. So you see that the geographical arrangement is rather mixed in reference to the order of dates. This may be accounted for by the fact that there was a very severe volcanic eruption in the Alaska Group and Peninsula in October I think; it was very intense and quite capable of ejecting a dust-cloud that would envelope the polar and temperate regions of the northern hemisphere: of course it was not nearly so terrific as that of Krakatoa. So you will see that we must be careful before we assert that the brilliant sunsets of Europe are of Krakatoa origin.

The phenomena of coloured suns and brilliant sunsets, I may tell you, have been seen before, both in Europe and America, in connection with Vesuvian and Iceland outbursts. Mrs. Somerville, the famous geographer, gives an instance of them being seen in Norway, and traced their origin to a severe eruption in Iceland. And H. C. Russell, B.A., F.R.A.S., F.M.S., Government Astronomer, Sydney, in his book on the climate of New South Wales, pp. 187 and 188, gives some most interesting instances of historical accounts of darkened and coloured suns. I will quote them in their chronological order:—

> "At certain times the sun appears to be not of his wonted brightness, as it happened to be for a whole year when Cæsar was murdered, when it was so darkened that it could not ripen the fruits of the earth." *Virgil,* Geor., Liber I., etc.

In 1090 there was a darkening of the sun for three hours.

In 1106, beginning of February, there was an obscuration of the sun.

In 1208 there was a darkening of the sun for six hours.

In 1547, 24th to 28th August, the sun was reddish, and so dark that several stars were visible at noonday.

In 1706, 12th May, about 10 o'clock in the morning it became so dark that bats commenced flying and persons were obliged to light candles.

In 1777, 17th June, about noon, Messier states he perceived an immense number of black globules pass over the sun's disc.

In 1783 there was a *dry fog*, and many attributed it to volcanic action, and it is well known that in February that year fearful earthquakes in Calabria took place, followed by a long list of volcanic eruptions in the world.

In 1831, there was an extraordinary *dry fog*, which excited public attention throughout the world. It appeared on the coast of Africa on the 3rd August; at Odessa, on the 9th August; in South France, on the 10th August; at Paris, on the 10th August; New York, on the 15th August; Canton (China), at the end of August. This fog was so thick that it was possible to observe the sun all day with the naked eye, and without a dark glass; and in some places the sun could not be seen till it was 15° or 20° high. At Algiers, United States, and Canton the sun's disc appeared of an azure blue, or of a greenish colour. Where the fog was dense, the smallest print could be read even at midnight.

In 1873, of the *dry fog* which came on suddenly in June, it is recorded that it extended from the northern coast of Africa, over France, to Sweden, and over great part of North America, and lasted more than a month. Travellers found it on the summits of the Alps. Abundant rain in June and July, and most violent winds did not dissipate it; and in some places it was so dense that the sun could not be seen until it had attained an altitude of 12°; and throughout the day-time it was red and so dull that it might be looked at with the naked eye. The fog diffused a disagreeable odour, and the humidity ranged from 57 to 68, while in an ordinary fog it is 100. It had a phosphorescent appearance, and the light at midnight was compared to that of full moon.

Here was exhibited a diagram (pl. xix.), drawn correctly to a scale of 50 miles to an inch, showing the arc (of 15°) of a circle whose radius was 6 feet 7 inches, or a diameter of 13 feet 2 inches. The Himalayas were shown in their correct proportion; so was the smoke from Cotopaxi, estimated by Whymper, while on Chimborazo, at 40,000 feet; he saw, at 5·45 a.m. of the 30th July, 1880, a dense column of smoke shot up straight into the atmosphere with prodigious velocity, which in less than one minute had risen 20,000 feet above the crater, giving the total height of 40,000 feet above sea-level. The dust, he goes on to state, fell on Chimborazo after six hours, and he estimated that each particle did not weigh the one-twenty-five-thousandth ($\frac{1}{25000}$) part of a grain, and the finest were still lighter.

Some people—and very rightly too—express wonder and unbelief at the possibility of *dust* being capable of being shot up to such a height as that ascribed to it, as to cause the red sunsets, but here I have quoted the fact of such as seen by a man of known repute; the dust and ash *were shot up* to that great height; and not only that, but as the dust cloud came between Mr. Whymper and the sun, he saw the phenomenon of the coloured sun. The same may be seen during any very heavy dust storm anywhere, when the cloud is between the observer and the sun.

In this description, given by Whymper, we have a good illustration of the tremendous force Nature usesin these convulsions,—a force that could throw the finest dust to a *height* of 20,000 feet is almost inconceivable to the human mind,—and in that phenomenon we have, I may say, only an every day occurrence when compared with that giant eruption of Krakatoa. Let us draw a comparison: At the destruction of Pompeii, situated at the foot of Vesuvius, where the city was enveloped with darkness from the density of the dust and ash cloud that shrouded it, and that ultimately buried it;—but now contemplate the tremendous power that ejected from a mountain a sufficiency of dust and ash to envelope a city in total darkness for 36 hours, *eighty miles distant.* On that diagram I have sketched an imaginary picture of the eruption, and eighty miles distant is represented by a little over $1\frac{1}{2}$ inch, where you see the letter B., showing to your mind the relative distance of Batavia from Krakatoa. You can form in your imagination some idea of the great height the dust cloud ascended: to my mind twice forty would not be too great. Then again we have the ship "Charles Bal," which, when *30 miles distant*, was enveloped at noon-day in pitch darkness through the *mud-fall.*

Furthermore, as Lockyer says, the sound, the least part of the affair, was heard over an area of 4,000 miles in diameter, viz., in Ceylon to the north-west, at Saigon to the north, and throughout North Australia to the south-east. In the last quarter, the reports were at 15 minutes' intervals, and sounded like ship guns, but as the hearers were from 150 to 200 miles from the coast, such cause could not be assigned. All that can be said is, that it is beyond the human mind to conceive of such gigantic forces, and therefore absurd to throw doubt on the result; by which I mean, that if the laws of refraction show that the substance, whatever it may be that causes the red glow, is at an altitude of 40 or 60 miles, it is ridiculous to doubt that result, when one cannot conceive the magnitude of the power that operated.

It was not only one eruption that took place, but several during the 26th, the following night, and up to 11·15 a.m. of the 27th, about which time the grand finale is supposed to have taken place. These eruptions followed each other in rapid succession, and are thought to have been caused by the rapid conversion into steam of vast quantities of water that found admittance into the bowels of the earth. Later on, the influx of water was too much, and the result was that a tremendous power was generated, so much so as to cause the north part of the island to be blown away, and fall eight miles to the north, forming what is now called Steer's Island. This was followed by a still greater eruption, when it is thought that the north-east portion was blown clean away, passing over Long Island, and fell at a distance of seven miles, forming what is now known as Calmyer's Island. These suppositions are almost proved to be facts, from the marine survey of the Straits just concluded, from which it will be seen that the bottom surrounding these new islands has not been raised, which would most naturally have been the case had they been caused by upheaval; but if anything the bottom shows a slightly increased depth in the direction of the great pit that now occupies the position that the peak of Krakatoa did the day before. These incidents are cited to show you the awful nature and magnitude of the forces brought into play, so you can the more readily satisfy your minds as to the great height the dust and ash were thrown to.

As I said before, this dust-cloud may probably be denser in some parts than others, owing that fact to the relative period of time elapsed between each eruption; where it is dense we may assume that they followed each other rapidly, and where it is less dense the interval of time was greater. For you must remember that it was shown to you that the cloud apparently moves to the westward, or that the earth moves from beneath the cloud at the rate of 87 miles per hour, so that during each hour of the eruption there was a long streak of smoke and dust being formed. These densest parts were no doubt the cause of the coloured suns, and, as some observers state, "the sun appeared to shine with lessened strength," others, "that it was rayless and giving no heat;" so we may look upon that dust-cloud as playing the part of a great screen, shutting off some of the heat of the sun from us.

In these southern latitudes we have experienced those brilliant sunsets for over seven months, and I have no hesitation in expressing my opinion that the remarkably cool and wet summer just passed in New Zealand was due to that dust-cloud shutting off the sun's heat in a great degree. And I see from the Adelaide report that the mean temperature there during January was over 4½ degrees cooler than the average of the previous twenty-five years, and on only one occasion during that period was it so low, viz., in 1869. At Melbourne also the weather was more like winter than summer. Whereas in North and Central Australia, or I may say down to latitude 30°

in that continent, the weather was fine, clear, hot without rain, giving me the idea that the sun had less power than usual, consequently the north-west monsoon was very feeble, not penetrating far inland, the result being that the interior of Australia has undergone one of the most disastrous droughts on record. But now that, as we may suppose, the equatorial regions of the atmosphere have parted with the greater part of their dust, if not all, the sun has regained his usual power, and the north-west monsoon its usual strength, penetrating the heart of Australia with refreshing rains and thunderstorms. So we have here an instance of a most terrific phenomenon that not only brought death and destruction to thousands at the time, but that indirectly caused the death of thousands and thousands of cattle through drought; and it would be most interesting and instructive to learn whether or not such consequences were experienced in other parts of the southern hemisphere.

It would be beyond the province of this paper to enter on a history of the tidal and atmospheric waves that resulted from this eruption, but I will state two facts to finally clinch your mind of its magnitude. When the earth opened her mouth and swallowed that vast quantity of water the down-rush that accompanied the closing-in of the surrounding crust was so much as to produce a tidal wave that passed and repassed twice, I believe, round the globe. The other fact is, that the tremendous explosion that accompanied the final eruption produced such a vacuum as to cause atmospheric waves to start, and which traversed and retraversed the earth to the antipodes of Java no less than four times. Some astronomers have thought that the whole phenomenon may be accounted for by supposing the earth to be passing through a dense meteoric track. To my mind, however, the greatest difficulties brought to bear against the volcanic theory are child's play when compared with the possibility, about ten thousand millions to one, of a meteoric track so formed as to have its path, either at perihelion or aphelion, so remarkably co-incident with that of the earth as to keep company with her for seven or eight months. Besides, if it were either meteoric or cosmic dust it would have been seen all over the earth at the same time and would be visible all night. No, the only extra-terrestrial argument that would bear investigation is that of its belonging to the phenomenon of the zodiacal light, which argument, I believe, was adopted by my friend Charles Todd, of Adelaide, at first; but, as time goes on and more information is gathered, the volcanic theory, I believe, will be finally accepted.

Art. L.—*On a System of Technical Education for Artizans.*

By C. W. Purnell.

[*Read before the Philosophical Institute of Canterbury, 3rd April,* 1884.]

The discussion which has recently taken place on the subject of the public library has brought into prominence the fact that, twelve years ago the Provincial Council of Canterbury was enlightened enough to set apart no mean area of the public estate as an endowment for primarily a School of Technical science. I do not propose to criticize the use to which that endowment has hitherto been put further than to observe that no such school exists, no attempt has been made to establish one, nor have any of the proceeds of the endowment been permitted to accumulate for the purposes of such a school; but I think that the time has arrived when active steps should be taken towards opening technical schools in Christchurch and the other large towns of the colony, and I invite you to consider the following arguments in support of that proposal.

Our costly and elaborate system of education will in the course of a few years flood the country with highly-educated men, but highly-educated on a literary type. From our primary schools upwards we insist that superior knowledge shall mean superior scholastic attainments. Now, the bulk of the male pupils attending our primary schools must expect to earn their livelihood when they become men by manual labour. The manufactories which are fortunately being established in all parts of the colony will form the natural theatre of employment for a large proportion of these lads, and should be the arena where those who possess superior abilities and energies might reasonably calculate upon winning success. Yet the education which they are receiving at the Government schools, does not in any way fit them for becoming successful artizans. If a lad displays exceptional ability at his tasks, his reward is a scholarship, whereby he is enabled, not to acquire technical knowledge which would help him to obtain distinction as an artizan, with the usual result of becoming in the long run an employer of labour, but to proceed with the acquisition of much book-learning, tinctured probably with a dash of science; his final reward being a University degree. Thus the end and crown of his mental toil, possibly of pecuniary sacrifices on his parents' part, is his removal from his natural sphere of labour, where his talents if properly trained might have raised him to prosperity and an honourable position; while instead he must look for occupation either to the professions, which are daily getting more overcrowded, or to mercantile pursuits. If he chooses the former, he finds himself confronted with a multitude of competitors, more lightly handicapped in the race of life than himself, and possessing friends capable of assisting them to establish themselves in their avocations. If he turn to mercantile pursuits for a livelihood, he discovers that his education has unfitted him for commerce almost as much as it has done for manual labour, and before he can hope for success in this direction, he will not only have to learn everything peculiarly appertaining to ordinary business, but he must likewise divest himself of the habit of mind which has been engendered by his hardly-acquired literary accomplishments.

A consideration of these facts leads to the conclusion, perhaps not a particularly novel one, but still one which we have practically ignored, that our secondary educational system is at fault, in that it casts all its pupils in the same mould; and while we need not interfere with, but rather for many reasons which I shall not dilate upon, should carefully cherish the principles of literary training to which it now seeks solely to give effect, we ought also to let it branch out in a fresh direction, so that it may supply the real wants of the working as well as of the richer classes of the community, by furnishing our artizans and their sons with a facile means of acquiring special knowledge of a character which is likely to be useful to them in their daily employment. What I ask is, that schools and colleges shall be opened where artizans and trade apprentices can receive a technical education suited to their respective callings, and distinctions acquired in which shall be deemed of equal value with those conferred for literary attainments; in other words, new academical degrees should be founded for successful students of technical science, which would give them an equal status in our University with that held by the possessors of the present degrees.

Besides the reasons already adduced, another and most cogent argument is available for this project. In England the apprenticeship system which, until within the last few years, furnished a means whereby a lad intended for an artizan was enabled to gain a competent knowledge of his trade, has been much weakened, but in New Zealand it hardly seems to exist in the proper sense of the word. Many a lad in this colony picks up his trade haphazard, without indentures at all, while in cases where indentures are entered into, both masters and apprentices commonly treat the tie as a slight one, the indentures being made and cancelled, and the apprentice shifted and changed about from one master to another, in a fashion calculated to prevent him both from acquiring a thorough knowledge of his trade and from feeling a proper interest in it. This is largely due to the unsettled habits of our population, but we need not trouble ourselves about the cause. What we must keep in view is the effect upon the technical capacity of our future artizans. Lads brought up in New Zealand seldom stand a fair chance of becoming first-class workmen, and while they enter upon their career as artizans with an imperfect knowledge of their craft, they are doing so at a period when industrial invention is more prolific than it ever was before; when not only are fresh contrivances daily springing from the brains of skilful mechanics, but the remarkable discoveries which have been made by scientists during the last century are being utilized in all directions for industrial purposes; so that year by year a more and more refined and comprehensive knowledge and skill are demanded of the handicraftsman. The whole community, too, is vastly better educated than it was half-a-century ago, and in numerous trades an artistic style of workmanship is demanded, which requires from the artizan, if he wish to rank as a good workman, a knowledge of art which was formerly needless on his part.

Moreover, and this I beg to urge most strenuously upon the notice of the Institute, our artizans will at no distant date be exposed to the competition of thousands of workmen trained in the technical schools and colleges of England and the Continent, where they will not only have learned the use of their tools and machinery from the best masters, but will also have been thoroughly grounded in the scientific principles of their respective trades, gained through a special education, in which everything necessary to their accurate comprehension of those trades has been included, and from which everything unnecessary has been carefully excluded, so that the student's energies have been focussed and concentrated upon the one object of becoming a master of his craft. What chance will the average colonial youth, learning his trade in the loose fashion which I have already indicated, stand against such formidable competitors when he arrives at manhood? Not only will these rivals possess a precise knowledge of their trade, of which he is utterly destitute, but with the aid of their special education they will also be able to follow and adapt themselves to new inventions in a manner beyond his reach.

I have just spoken of the Technical Schools and Colleges of England. The words may sound strange to the ears of old colonists, but recent arrivals from the mother country will be aware of how much has been done there in this direction of late years. Manufacturers and others concerned have vigorously exerted themselves to obtain for the British workman an opportunity of acquiring that technical education in matters relating to his daily employment which has hitherto been denied him, although it has been enjoyed to some extent by his Continental rivals. The practical outcome of the movement has been the establishment by the combined efforts of the Corporation of London and the City Guilds of an institution in London for the technical training of artizans called "The City and Guilds of London Institute for the Advancement of Technical Education." This was started in 1879, and already a very large sum of money, apparently some £120,000 or £130,000, has been expended upon it.

In connection with this institution a number of technical schools and colleges have been founded in different parts of the country, the funds being provided by the trade companies, the manufacturers, and from other local sources, a technical school having been opened at Manchester as recently as September last. A similar school at Bradford, which has been in existence for some time, moved last year into a new building, which had been erected and fitted up for its accommodation at an expense of upwards of £30,000. In localities where sufficient money has not been available for the establishment of a properly equipped school, classes have been formed, whose pupils are registered on the rolls of the Institute. Altogether, according to the report presented at the annual distribution of prizes in December last, there are over 4,000 pupils receiving instruction in the registered classes of the Institute, and the system of technical examination undertaken by the Institute extends to more than 150 centres in different parts of the country. These numbers, however, give a very imperfect idea of the extent of the efforts which are being made to diffuse technical education amongst English operatives, as many technical classes are in existence which have not affiliated themselves to the Institute. Classes, for example, have been established in connection with the Young Men's Christian Institute at the old Polytechnic Institution in London, and were last winter attended by no fewer than 5,500 persons, while measures are being taken to increase the accommodation, so as to provide room for 8,000 students.

The principal college of the City and Guilds Institute is the Finsbury Technical College, opened in February, 1883, and which has been equipped in the most elaborate manner. Further, the Department of Science and Art is erecting a Technical College at Kensington, upon which a sum of £75,000 has been expended, in order that it may serve as a centre for the entire technical educational system of England, and more especially as a training school for teachers of technical science, whose want has been much felt. Hence, when the system gets into full swing, its influence can hardly fail to be marked, and in after years the men and lads who have been trained at the various technical colleges and schools will form an appreciable element in the industrial classes of Great Britain.

Looking at the superior field which this colony affords for individual enterprise, can it be doubted that these highly trained workmen will emigrate in considerable numbers to New Zealand? They will come here and occupy the positions of foremen and the best paid hands in the workshops, while our colonial-bred artizans will have to content themselves with subordinate posts.

We may depend upon it that the movement in England is full of vitality, and will grow to large dimensions. England's industrial supremacy depends upon her furnishing her artizans with a proper technical education, which they have hitherto lacked, and she cannot afford to let that education be either imperfect or confined within a limited circle of students. The Government have taken the matter in hand, and in 1880 appointed a Royal Commission, which I believe has not yet sent in its final report, "to enquire into the instruction of the industrial classes of certain foreign countries in technical and other subjects, for the purpose of comparison with that of corresponding classes of this country; and into the influence of such instruction on manufacturing and other industries at home and abroad."

England, it must be remembered, although of all countries the most interested in the technical education of artizans, has been the last to take up the subject. Technical schools have existed in Germany for a long period; indeed, the system recently inaugurated in England is, I believe, modelled upon the Bavarian system. France possesses several good technical schools, the principal one, viz., the School of Arts and Trades at Paris, having been founded so far back as 1857. Switzerland has also a fine Polytechnic School in Zurich, which in 1879 was attended by as many as 1,000 students. Sweden is also well supplied in this way, there being technical schools of various grades, so as to suit different classes of workmen, the course of instruction being expanded or contracted with the object of meeting the pecuniary means and leisure times at the disposal of the persons attending the classes. Even in Russia, which is commonly supposed to be backward in educational appliances, technical education has not been forgotten. There is a large technical school at Moscow, while in some of the Government factories classes have been formed under the auspices of the Government for the purpose of furnishing technical instruction to the artizans. The proprietors and directors of some of the larger factories on the Continent have opened technical classes for the benefit of the hands in their employ; in fact, throughout the Continent, wherever manufactures are carried on to any extent, means of some kind exist for giving to artizans and apprentices to trades a special training suited to their ordinary avocations, and calculated to enable them to perform their daily tasks with an amount of intelligence and skill which cannot be expected from workmen who have not enjoyed the advantage of a technical education.

The Continental Governments recognize what the New Zealand Government, fairly zealous as it has shown itself in the promotion of new industries, has overlooked, viz., that if manufacturing industries are to permanently flourish in any country under the altered conditions of modern times, it is essential that the workmen should receive a technical education, and hence they treat it as one of their ordinary functions to supply this want. A manifestation of this feeling was given when the French Government, wishing to stimulate the watch trade in France, opened schools for teaching watchmaking, the effect being to materially augment the home production of watches, and to diminish the importation of watches from Switzerland. The Swiss met this movement by reorganizing and enlarging their technical school system, so far as it related to the watch manufacture, and by this means recovered a part of their lost trade. In the United States, too, although less has been done for the cause of technical education than might have been expected from a people which has made such vigorous exertions for the establishment of manufacturing industries, some thirty technical schools are in full activity. Japan has a far greater number. In 1882 she possessed 98 technical schools, with 975 professors and teachers, and which were attended by 8,828 pupils.

Technical education must not be confounded with a scientific education. Science forms an essential feature in the course of instructien given in a technical school, but just so much science is taught as, and no more than, the student requires to know for the proper comprehension of his trade.

I will illustrate my meaning by quoting some remarks made by Mr. Cosee, the then President of the American Institute of Mining Engineers, in 1879, when announcing the intention to establish technical schools for the instruction of workmen engaged in the Pennsylvanian Iron Ore Works. "Our idea is to make the course of instruction as complete as possible. In mineralogy we shall require the student to become familiar with the principal types of minerals only. In geology much attention will be paid to the rocks and mineral deposits of Pennsylvania. We shall devote a large amount of time to the subject of framing, ordinary foundations, and the construction of such buildings as are required on our coalfields. In machinery attention will be paid to pumps, hoisting engines, apparatus for preparing coal, steam drills, etc. Mine surveying will be gone into with a great deal of detail, and in chemistry we shall try to impress upon the minds of the pupils those laws and phenomena which are of importance in understanding the ventilation of mines and the use of water in steam boilers." This course of instruction is to a considerable extent that of a mining school, but it suffices to illustrate my meaning.

The science which is wanted is not that which is supplied in our High Schools and Colleges, hence it cannot be argued that I am asking for something which already exists. The object of a technical school is not to turn out scientific men or artists, but competent practical handicraftsmen. In the technical schools of England and the Continent the use of tools forms a prominent item in the course of instruction. One of these schools is indeed a workshop, in which the apprentice or artizan is taught the use of his tools and the management of machinery by first-class teachers, while he is at the same time inducted into such branches of science and art as are requisite to enable him to understand the principles of his trade. Further, if he wishes it and the time at his disposal allows of it being done, he is taught collateral subjects, such as foreign languages, which are likely to be useful to him in his avocation. The Finsbury College is divided into four departments—viz., the mathematical and mechanical, the physical, the chemical, and the applied art department. In the day school such subjects as French and German are likewise taught. This will give an idea of the comprehensiveness of the course of study.

In these technical schools, as I have said, the course of instruction is varied considerably, to suit the purses and the time at the disposal of the pupils. There is the richer class of students, who can afford to attend the classes during the day, and are probably looking forward to becoming managers of factories or occupying similar positions. This class of students is able to go through a more elaborate course of instruction than the others, and to compete for certificates of the highest class. Then there is the class of artizans who are engaged in actual labour during the day, whose means are small, and who expect to receive instruction during the evening. To this class workshop practice is of prime importance. In Sweden, to meet the wants of artizan students, some of the technical schools are open not only every evening in the week, but on Sundays also. Finally, there is the class of apprentices, of whom the future workmen are to be made, who, like the artizans, are unable to attend classes during the day, although having all their lives before them they can afford to enter upon a more lengthy course of instruction, but at the same time their pockets must be consulted in the shape of reduced fees. For the purpose of dealing with these different classes of students, the City and Guilds of London Institute holds its examination in three grades, (1) honours, (2) advanced, (3) elementary. The first is intended principally for foremen, overlookers, and similar persons, or for persons intending to qualify for such positions; and the third for apprentices, but candidates for examination are permitted to enter themselves for any grade they choose.

It will convey a better idea of the eminently practical character of the instruction now being given through the means of the City and Guilds of London Institute, if I enumerate the principal subjects for examination this year:—Alkali manufacture, iron and steel manufacture, lace manufacture, photography, milling and flour manufacture, electro-metallurgy, electric engineering—including telegraphy, electric lighting and transmission of power, electrical machine making, metal platework, plumbers' work, silversmiths' work, watch and clock making, wood working, metal working, mechanical engineering, carriage building, carpentry and joinery, mechanical preparation of ores, marine surveying. The various schools and classes devote themselves to such branches as are likely to be most useful to the artizans of the localities in which they are respectively situated.

In order to make technical schools available to those for whom they are designed, the school fees must be fixed at a low figure, especially for apprentices. On the other hand, the cost of foundation and maintenance is considerable. They are not self-supporting institutions. Hence, if such schools were established in New Zealand, it could only be by outside assistance. In England the principal part of the cost is defrayed by the city guilds and the trade companies in different localities, although the Department of Science and Art is lending important aid in the shape of the Central Institute at Kensington. On the Continent such schools appear to be supported partly by the Government, partly by the local bodies, and partly by aid given by private individuals. In New Zealand, however, nearly the whole cost would have to be paid out of the public purse in some way or other. That, however, is not a reason why we should refrain from taking steps for the establishment of technical schools. The expenditure of money upon this object could be justified by the same reasoning which justifies us in giving bonuses for the encouragement of new industries, only it would yield a hundredfold greater results. I admit that the present cost of education is excessive compared with the colony's means; but I do not think that the outlay involved in the opening of technical schools at the principal centres of population, say at Auckland, Wellington, Christchurch and Dunedin, (which would serve as examining centres for numerous classes in other places), would add perceptibly to the colony's burthens.

Viewing the matter in the aspect which I do, viz., as a remodelling of our system of secondary education, it would be a legitimate application if a part, and a substantial part, of the splendid endowments which have been set aside in New Zealand for secondary education were devoted to the establishment and maintenance of technical schools. These endowments have hitherto been exclusively applied to the support of scholastic institutions of great merit, but which are to a large extent a luxury beyond the means of the colony; while these institutions are in many cases bestowing a refined education upon persons to whom it will prove a curse rather than a blessing, and whose valuable energies will be virtually lost to the country for want of a sufficiently ample field for their exercize. Nor can we shut our eyes to the fact that our High Schools and Colleges are an eyesore to no inconsiderable section of the working classes, who feel that as a body they have neither part nor lot in them; while they afford a cheap education of the higher kind to the children of rich men. I do not assert that these feelings are justified; I merely observe that they exist. Still they are well-founded, to the extent that our system of secondary education is not being conducted on sufficiently comprehensive lines. Much as I admire the noble High Schools and Colleges of Canterbury, I should rejoice to see some one of them in Christchurch replaced by a well-equipped Technical College, where our handicraftsmen and their sons could obtain a special education, which would enable them to hold their own against all-comers, and to easily advance with and adapt their methods of working to the changes and improvements which are being so rapidly introduced into the industrial arts, while at the same time their intellectual desires would be slaked, honourable and recognized distinctions would be within their reach, and the social *status* of the artizan would be raised in a marked degree, to the satisfaction of his own just ambition and the benefit of the community. The working population of Canterbury, at all events, have a right to ask this at our hands. They are entitled to demand that the wise intentions of the Provincial Council in their behalf should be carried into effect at the earliest possible moment.

Without however dwelling too much on this point, although it is an important one, I do maintain that we ought to interpret the term "secondary education" in a larger sense than as meaning the teaching of literary subjects and abstract science only. Doubtless it bore that meaning—and even a more restricted meaning—once, but the world has rolled on, and the statesman in this and other countries is now called upon to solve the great problem:—Given a working population, forming the mass of the community, who have eaten the fruit of the tree of knowledge, and whose wants and desires, both mental and physical, have been sharpened and increased thereby, how will you keep them contented? The way to do so is by raising the *status* of the workman. It is not sufficient to tell him that his employment is honourable, and that no citizen is more useful to the State than he; you must give him a larger scope for his energies and in his own avocation, so that he may be enabled to achieve real distinction in it. We must dispel the prevalent idea—that if the artizan wants to rise in the social scale he must perforce abandon his own occupation, which is the natural field for the display of his abilities.

Leaving aside these reflections, however, our artizans are entitled to ask the rulers of the country to give them all reasonable assistance in their competition with foreign handicraftsmen. It is a reasonable request to make that technical schools should be established in the principal towns of

New Zealand, and if some of the smaller High Schools were closed, and the funds now spent upon them were used for the support of technical schools, the cause of literary education would not suffer, and our industrial classes would have much reason to rejoice. The prime object of education is to fit boys and girls for their future walks in life, but this is a fact which has been almost lost sight of by our educational guides.

ART. LI.—*On Gravitational Experiments.* By T. WAKELIN.

[*Read before the Southland Philosophical Society, 7th October,* 1884.]

PROFESSOR LODGE in a recent lecture on the functions of the ether says it is inconceivable that the earth should be drawn to the sun without any material means, and he ascribes gravitation to some action of the ether. A great many scientific men, I feel convinced, sincerely hope that this may prove to be the case. I have thought out a number of experiments to test this question. Three of these experiments I have carried out but with negative results; two of them, however, were carried out in a very inadequate manner. I think an explanation of these and other experiments will prove interesting, and perhaps will arouse some hope that this fundamental question in astronomy may be answered.

First Experiment, Heat.—If the ether produces the movement called gravitation, I thought it probable that any great disturbance of the ether should have some effect on the weight of a body placed in the midst of this disturbance. It struck me that as a red-hot mass of iron agitated the ether the reaction of the ether upon the iron would intensify the gravitational effect of the ether and cause the mass to weigh heavier. The molecular movement of a heated body would produce alternate increase and relief of pressure on the vibrating particle, and I thought it not unlikely that the former would be greater than the latter. As the experiment was easy I made it, though not with any degree of delicacy. There was no difference in the weight. Receiving afterwards Osmond Fisher's "Physics of the Earth's Crust" I was agreeably surprised to find in it the following passages:—"However, in a note to an address before the Geological Society of Glasgow, 14th February, 1878, Sir W. Thomson wrote: 'Since this address was delivered some important experiments have been carried out, at the request of Dr. Henry Muirhead, by Mr. Joseph Whitley, of Leeds. His experiments were made on iron, copper, and brass, and on whinstone and granite; and the general result hitherto arrived at seems to be tha these substances are *less* dense in the solid than in the liquid state at the melting temperature. And D. Forbes stated that glass floats on melted glass, and, similarly, Bessemer steel on melted steel.' "

These facts indicated, I thought, that the intensely agitated ether had made the heated mass heavier : I therefore made a more careful experiment. A mass of iron was heated white-hot and weighed, the weight being over twenty pounds. After cooling for more than half-an-hour it was weighed again ; and after being made cold in water it was weighed a third time, but there was found to be no distinct difference in the weight; if there was any difference, I think it must have been less than a quarter of an ounce. Both times, however, the iron was weighed when cooling, while the reverse of this would have been more likely to show a difference in the weight.

Second Experiment, Mechanical.—The ether is so marvellous that I should not have thought of trying to make any mechanical experiment if I had not read an account of the wonderful action of a saw called "Reese's Saw." This saw was described as a disc made to revolve with an enormous velocity —at a velocity, as far as I can remember, of from one to two thousand revolutions per second. It was said to *cut bars* of steel *without touching them.* Mr. Reese himself ascribed this to the action of the disc upon the ether—the ether entering near the axis and being thrown out at the circumference, it was supposed. If any action of the ether produced gravitation I considered that this rapidly revolving disc should have very little weight. I thought by making the disc a very thick one that a moderate velocity would show some difference of weight. The disc that I had made was about seventy pounds, and could be driven so as to make about thirty revolutions per second. The oscillations were, however, so great that it could only be weighed when making three or four revolutions per second. Various modifications were made but with scarcely any improvement; no appreciable difference in weight could be detected. Experiments would have to be made with nicely fitting mechanism of a comprehensive character to enable a high velocity to be obtained, but a comparatively moderate velocity might produce an appreciable difference in the weight.

Third Experiment, Magnetic.—Light, heat, magnetism, and electricity are believed to be manifestations of one agent—the ether. Now, if some action of the ether also produces gravitation, I thought it very probable that when a strong magnetic pull was exerted horizontally it would weaken that vertical action of the ether which I supposed might produce gravitation. I tried the experiment with a permanent magnet but with no definite result. I do not profess to be well acquainted with electrical facts, though I have read most of the best standard works on electricity and a good deal more besides, so an important experiment made by Faraday was unknown to me till the last few weeks, when I saw the following account:—" The quality I refer to is 'electric conductivity,' and the result of that quality in the experiment I am now going to describe is, that a piece of copper, or a piece of silver, let fall between the poles of a magnet, will fall down slowly, as if it were falling through mud. I take this body and let it fall, many of you here will be able to calculate what fraction of a second it takes to fall one foot. If I took this piece of copper, placed it just above the space between the poles of a powerful electro-magnet and let it go, you would see it fall slowly down before you; it would perhaps take a quarter of a minute to fall a few inches."*

Professor Tyndall in one of his works speaking of this condensation between the poles of powerful magnets says that it takes as much exercize of force to make a knife go through this magnetic matter as it would take to cut a piece of cheese. My memory may be at fault here, but I am certain that he spoke of the resistance as something wonderful. Now this magnetic matter may displace a gravitational medium, or it may be connected with it in a way so as to weaken it. It seems to me, if one medium produces both electrical and gravitational effects, that if one effect is disturbed, the other must be disturbed also. Let us suppose the above experiment to be repeated with this modification. To the piece of silver placed between the poles, let another piece exactly equal be fastened by a wire long enough to let the second piece hang so far below as to be altogether out of reach of the influence of the electro-magnet; there is a resistance to motion of the piece of silver due to the thickness of magnetic matter. If the weight-giving force act *equally* on the two pieces of silver, the force overcoming the magnetic matter being doubled, the pieces of metal will fall about twice as fast as in the original experiment. If, however, the bodies are made to fall by some physical agent, then, if the magnetic matter displaces this agent, or modifies its gravitational action in the piece of metal between the two poles, the addition of the lower piece of silver has *more than doubled the force*, and the pieces of silver fall *more than twice as fast*. And if the experiment was tried, and this was found to be the case, we should reasonably infer that gravitation was produced by some physical agent.

Fourth Experiment, Electrical.—The electric medium is believed to be continuous, just as the luminiferous ether is believed to be continuous. " We may say that all electric forces are transmitted by strains of the ether, but that the ether in different insulators is modified in some way which will account for the difference of transmission."† I suppose an electric

* From Sir W. Thomson's "Lecture on the Senses," published in "Nature," 6th March, 1884.

† A Physical Treatise on Electricity and Magnetism, by Gordon, p. 22.

current in such a medium not to be a rapid motion of translation, but a transmission of pressure, and believe in the opinion expressed by Silvanus Thomson, that electricity is *one* thing and not two. If the ether, then, among its other functions, produces gravitation, an intensification of its electrical action might reasonably be supposed to augment its gravitational action. Let us suppose a loop of wire to form part of a circuit, the loop being free to turn on an axis as the handle of a bucket is. When the loop is horizontal, like the handle of a bucket when resting on the rim, it must be supported, or else it will hang down. Let it therefore be supported from a delicate spring balance by means of a silk thread. If a powerful current be then sent through the loop, it will intensify the action of the ether, and if the ether produces gravitation the loop of wire should, I think, become heavier while the current was passing through it.

Whatever gravitation may be, surely there is no reason to despair of finding out whether it is caused by something material or not.

Art. LII.—*Is Life a Distinct Force?* By R. H. Bakewell, M.D., Fellow of the Royal Medical and Chirurgical Society of London, etc.

[*Read before the Philosophical Institute of Canterbury, 3rd July,* 1884.]

The question I have placed at the head of this paper is one not yet settled, although it may be admitted that there is a preponderance of opinion in favour of a negative reply. For this reason it is well worthy of discussion, and as it is one on which I have thought much and in connection with which I have made many experiments, I have selected it for discussion this evening.

As this is not intended to be a metaphysical paper nor to lead to a discussion on mere abstractions, certain postulates will be requisite. Let it be granted then that matter exists as ourselves and not ourselves, that it is manifested to our senses by phenomena, that it is acted upon by certain forces or energies, and that two kinds of matter may be discerned, living and non-living.

Definitions.—We define non-living matter to be that which possesses no power of motion in itself, nor of self-nutrition, nor of producing any change within itself by the action of its own parts, nor of reproduction.

Living matter is an albuminoid compound, characterized by the possession of motion in itself, that is, independent of the action of any external force, by being able to assimilate food or nutriment, and by being able to reproduce its like.

With the other qualities of living matter I shall not at present deal; these three are essential to any form of living matter, and are found in all, from the humblest of the Protista up to man.

Life then I should define to be,—that force or combination of forces which gives to protoplasm its power of motion, of self-nutrition, and of reproduction. In this definition it will be observed that I avoid assuming that life is *a* force—it may be the result of a combination of forces.

Life is either somatic or molecular. In the simplest forms of living beings, the somatic and molecular life are inseparable, as the individual consists but of a single cell. If you kill an *Amœba*, for example, you destroy both the somatic and molecular life at the same time. But except the simplest organisms, whether vegetal or animal, living beings are built up of corpuscles, sometimes in the form of cells, sometimes in more complex tissues formed originally out of cells, each endowed with life, which is to a certain limited extent independent of the life of the whole organism. This is what is called molecular life. The life of the organism as a whole is called somatic life. It is possible in many of these organisms, particularly in what are called the higher or more complex ones, for somatic life to cease long before the individual molecules of which the being is built up have lost their vital properties.

Living protoplasm, as I have before said, is an albuminoid substance. It consists of carbon, oxygen, hydrogen, and a little phosphorus and sulphur.

On Motion as a quality of Living Matter.—It is admitted by every one that non-living matter, in whatever form it may be found, cannot move of itself, nor unless acted on by some external force. But living protoplasm, as long as life exists, is endowed with motion. A simple cell like the *Amœba* (I use the word cell for convenience—the *Amœba* is not properly a cell) or a leucocyte, and many of the simpler forms of vegetal and animal life can be seen to move about in the medium in which they exist. But the higher forms of vegetal life, it may be thought, do not move unless acted on by some external force. A lichen seems to cling to the rock on which it has fixed itself; and even those plants like the sensitive plant, or the sundew, or Venus's fly-trap, which are known to move and grasp objects brought into contact with them, may be thought not to move spontaneously, or without being acted upon from without. This appearance of inertia is however fallacious, for whether you examine the lichen or the forest tree that has been rooted to its native earth for a thousand years, you will find that in every part of its structure change is going on—fluids are circulating; vessels and ducts and fibres are being produced, removed, and renewed; the reproductive process is going on; water is being absorbed or given off;

carbonic acid is being decomposed and carbon absorbed; evaporation is taking place which requires that the root-fibres should take up water, and that by some mysterious means, contrary to gravity and certainly not owing to capillary attraction, the juices of the plant are sent to a distance of sometimes hundreds of feet. All these changes imply motion. So also does the growth of the plant. This is slow indeed in many cases, and particularly in cold or temperate climates, but so rapid in tropical regions where there is abundant moisture in the soil, that plants may almost be seen to grow.

This motion is sufficiently powerful to overcome in the majority of cases the force of gravity, and might be measured in foot-pounds. It will also overcome the force of cohesion, as is seen where root-fibres penetrate dense clay or split up solid rock.

Motion caused by life alone is seen in the circulation of the blood, and especially in that part of it which takes place in the capillary vessels. If, as I have often done, you snip off the transparent part of the tail of a small fish or a tadpole and place it under the microscope, you may see the blood corpuscles rolling rapidly along for at least half-an-hour; in some cases I have watched them for an hour and a half, still in motion, although during the latter part of the time the motion is much retarded: it seems to continue until some physical change has taken place in the capillaries, the result of their death. If at a suitable temperature suitable pabulum be supplied, the motion of the blood in the capillaries may go on for hours after somatic death has taken place. In some experiments I made a few years ago in New South Wales I found that when portions of tadpoles' tails placed under the microscope were supplied with a mixture of egg-albumen and water, and kept at a temperature of 80° to 90° F., the circulation continued as long as nineteen hours. The note made at the time is as follows:—

"11th (month not mentioned, probably February), 3 p.m. Put four pieces of tadpoles' tails in albumen and water; they floated; corked the bottle loosely with lint; water was filtered but not boiled. Day hot; temperature 88° F.

"Put three other pieces at the same time into some of the same water, in the same kind of bottles stopped in the same way."

"12th, 10 a.m." (nineteen hours afterwards). "Night had been very hot. Tails placed in water shrivelled slightly (shrunken) and extremity of tail curled up. Under microscope numbers of detached round red corpuscles and quantities of Bacteria; no leucocytes nor cell-growth of any kind."

"3 p.m. Innumerable monads developed in water surrounding tails; began to smell offensively." [Thrown away.]

Now, contrast this picture of decomposition following somatic death with what took place when the portions of tails were supplied with nutriment. The note is that they "showed no Bacteria either at 10 a.m. or 3 p.m., and, of course, no monads; quantities of young cells, particularly upon and near the cut surface. *Circulation slowly continuing in large vessels.* In the fluid floating about were quantities of young cells exactly resembling leucocytes." Even at 10 p.m., although the day was excessively hot, the portion kept under the microscope showed no sign of decomposition.

It is evident that this motion of the blood in the smaller vessels cannot be from capillary attraction, for, after the first few moments, the blood in the capillaries must have attained its equilibrium. Place a coloured fluid containing solid non-living particles in a capillary glass tube under the microscope, and you will find that, in a few moments, the particles will be at rest.

The following experiment shows the length of time the capillary circulation will continue without nutriment—"10th March, 1878, end of tadpole's tail, circulation continued for thirty-five minutes after separation; not much slower than natural; block at bifurcation of artery; went against gravity." This note refers to a rough drawing made in my note book of the appearances presented at two periods after the separation of the tail.

I have other notes of this phenomenon, but not many, as it was of such invariable occurrence that I soon ceased to note it. It may be seen by anyone who will take a microscope to a slaughterhouse, and obtain a portion of peritonæum or other transparent tissue from animals just slaughtered.

In the lower animals the ciliary motion is a very marked and frequent phenomenon. It is chiefly by this that they procure food. It seems to continue without cessation during the whole lifetime of the animal, and to be quite independent of anything like what we recognize as muscular tissue in the higher animals. So also is the curious pulsation in some of the Radiata, the extremely rapid contraction of the stalk of the *Vorticella*, and the protrusion of the pseudopodia of many other Radiata. All these, and many more that might be mentioned if time permitted, are manifestations of the power of life to produce motion in living protoplasm.

The higher animals not only move about by means of their locomotory organs, but in every part of their bodies there is a continual circulation of nutritive fluids, of secretions or of excretions, and there is continual motion of the organs of circulation, respiration, and digestion. In addition to these there is the motion produced by the rapid waste and renewal of tissue that is constantly going on in their bodies.

The major portion of even the obvious muscular movements of the higher animals, such as the vertebrates, is made either independently of the will of the individual, or quite unconsciously, like the automatic motions of the organs of speech in reading aloud when the mind is distracted, etc.

Thus breathing is carried on by the action of muscles which in ordinary respiration are not voluntarily exerted. The action of the heart is another example of muscular motion entirely independent of our will. The peristaltic action of the intestines, the action of the sphincters, and the coordination of muscles to retain us in an upright position, are other examples.

Muscular contraction and relaxation are therefore going on continuously during life, as are the ciliary movements of some of the mucous membranes.

Motion, therefore, is one of the invariable concomitants of life. But it may be said that this is merely the result of the conversion of other forces into motion.

I. There are two arguments which seem to me conclusive against this view. The first is that organic motion is carried on to a large extent in opposition to the other forces, especially to gravity, cohesion, and chemical affinity.

Many of the higher Vertebrata afford striking examples of the opposition between the action of the muscles and gravity. The usual position of these animals when living and awake is rarely maintained if they are suddenly killed. It may be said that this arises from relaxation of the muscles of the limbs. But when an ox is pithed—that is, suddenly killed by dividing the spinal cord as it issues from the skull—the muscles are not relaxed, but are thrown into violent tetanic convulsions—yet the animal drops instantly. In the same way if a fowl is killed by suddenly beheading it, the headless trunk flutters and springs about for several minutes, but it never stands upright for a moment. You could not make a human skeleton stand upright even if all the joints were stiffened by the ligaments being allowed to dry on them.

The fact that even when we are standing upright we are unconsciously balancing ourselves is shown in certain cases of disease of the spinal cord, by blindfolding the patient and then asking him to step out a few paces. He will fall if not supported, because he cannot see where to place his feet. In the healthy state the cöordination of the muscles required for balancing ourselves takes place unconsciously.

II. In considering the question whether the force which endows protoplasm with these powers is of a special kind, or merely a combination of the other forces or energies of nature, we must remember that a mere blind or unintelligent combination of forces would never produce the results we see. The process by which a seed becomes a tree, producing other seeds like that from which it sprang, is clearly not the result of any one single force, unless we assume that that force was created and designed *ad hoc*; neither heat, nor motion, nor light, nor electricity, nor chemical affinity, could alone cause the growth of a tree from a seed. Expose a seed to an amount of heat which will kill it without changing its chemical composition, and all the forces of nature will not enable that seed to germinate. What then do we kill? Even suppose that a living seed, exposed to the influence of heat and moisture, will swell by the mechanical process of endosmosis, suppose even we allow that the ovule will germinate, what possible combination of these or any other forces could make the radicle invariably push its way downwards into the soil, and the plumule as invariably thrust itself upwards towards the light? What combination of forces acting mechanically and without intelligence could enable the cells of the young part to differentiate themselves and form the various tissues of which the plant is composed. Forces such as light and heat must always act under similar circumstances in the same way, unless guided and directed by a Supreme Intelligence. We are therefore driven, as it seems to me, to the conclusion that the force or energy which produces the phenomena that we collectively designate life, must be a force or energy of a special kind, created, if I may be allowed such an old-fashioned expression, *ad hoc*. In other words, that there is a vital force, which, acting on protoplasm, enables it to move to nourish itself, and to reproduce its like.

I need say nothing about the other two qualities which enter into the definition of living matter—self-nutrition and reproduction—as it is nowhere disputed that these powers belong exclusively to living matter.

Though, as I think, I have proved the vital force is a distinct and special force, it has so much relation to the other forces of nature as to be convertible into them. Thus in warm-blooded animals it is convertible into heat. That their animal heat is not the mere product of the chemical actions going on in their bodies is proved by the fact that precisely the same actions are going on in cold-blooded animals which do not maintain themselves at a heat above that of the surrounding media. The muscular movements of a lizard, for instance, in the tropics are extremely active, far more so than those of most of the warm-blooded vertebrates—yet the lizard is much cooler than the surrounding atmosphere. We see another proof that the vital force of warm-blooded vertebrates is converted into heat, in the extreme difficulty of maintaining the animal heat of those who are weakly. Among human beings we who are practical physicians have constantly to recognize this fact. The same external temperature which is pleasant and even inspiriting to persons in vigorous health is depressing and injurious, and indeed often fatal, to those who are weak.

Vital force may be converted into electricity, as we see in the *Gymnotus* or electrical eel, and with light, as we see in the glow-worm, the firefly, the phosphorescent animalcula of the sea. It would seem probable, however, that for the most part the vital force of the higher and more complex organisms is simply transferred by their death to lower organisms, of which the germs are always ready at ordinary temperatures to germinate in the tissues of the higher organisms.

There seems to be a constant process of transference of vital force from lower organisms to higher ones, and from these to the lower ones again. Some experiments I have recently been making would seem to show that all but the lowest forms of vegetal life are fed by the Bacteria. I have recently been examining a number of different kinds of soil, taken from various heights above the sea-level, some from the tops of the hills near Sydenham, and some from marshy soil, some from ordinary garden mould, some from gravel deposits, and some from clay dug out at a depth of from two feet to three feet nine inches below the surface. I find them all swarming with Bacteria to such an extent that when shaken up with water in a tube, and allowed to rest for a few days, a layer of Bacteria is formed visible to the naked eye, while the supernatant water never becomes clear, but is constantly opalescent from the presence of these minute organisms.

Now when we find Bacteria present in such abundance, and that too in soils which have never been exposed to light since the day they were deposited, it is only natural to enquire for what object they exist, or what end they serve. Are they merely the result of the death and decomposition of higher organisms?

This can hardly be the case, because if so they would not be found in such abundance, or at such depths below the surface. Several feet below the surface of soil in which only a few weeds or a little grass is growing we find them in myriads. Now we know that these minute beings can but live a few hours, and that when dead they very speedily disappear. A very simple experiment will prove this. Boil a little garden mould for a few minutes for two or three days running, so as to destroy all Bacteria and their germs, and then let it stand a day or two in hot weather, and it will soon begin to smell offensively.

May not these Bacteria be intended for the nourishment of higher organisms, animal and vegetable, but chiefly the latter; and may not their abundance explain the fact that the rootlets of plants descend to such depths in search of nourishment? It seems to me highly probable that the rootlets of the higher plants do not receive nourishment directly from the inorganic constituents of the soil, but do so only by means of these Bacteria, which themselves act as feeders and intermediaries between the inorganic matter of the soil and the roots of the higher plants. I throw this out merely as a suggestion, but I think the question well worthy of further investigation, particularly as I find that these Bacteria are most abundant in clay, the inorganic constituents of which can hardly afford nourishment to the roots which so abundantly penetrate it.

The transmutation of vital force would then seem to go in a perpetual circle—the higher organisms deriving theirs originally from their parent forms, and then constantly recruiting it, as it is dissipated or converted into other forces, from the lower forms, and then giving it back to these in the process of transformation, decay, or death.

I believe that the numerous discoveries of Bacteria made of late years in morbid products of the human body, in the bodies of the higher vertebrates are merely expressions of this fact; that the Bacteria are simply the results of the morbid processes, and not their causes. All diseased or unhealthy tissues are in a state of incipient death—their mode of nutrition, their process of growth and development not being the normal ones, they are more likely to become the nursery grounds of Bacteria than the healthy tissues are, which have an inherent power of resisting the presence of these lower forms of life; but to enter fully into this subject would lead me too far from the main question of this paper.

To conclude then, I maintain that,—

1st. A living being is a form of protoplasm which possesses within itself the power of motion not derived *ab extra*, of self-nutrition, and of reproduction.

2nd. That the force or combination of forces which gives to protoplasms these qualities and powers is called life.

3rd. That, if life results from a combination of forces, these must be endowed with intelligence, and act towards a common end.

4th. That the ordinary forces of nature—such as light, heat, chemical affinity, gravity, motion, and the others—are not thus endowed.

5th. That therefore the force which we call for convenience the vital force is a distinct and special force.

ART. LIII.—*Description of Mayor Island.*

By E. C. GOLD-SMITH, District Surveyor, Tauranga.

[*Read before the Auckland Institute, 11th August,* 1884.]

MAYOR ISLAND, or Tuhua, is situated in the Bay of Plenty, twenty-three miles north of Tauranga Harbour and about sixteen miles from the nearest part of the coast of the North Island. Its name was given to it by Captain Cook, who discovered it on the 3rd November, 1769, when on his first voyage to New Zealand.

The island contains 3,154 acres, its greatest width being three miles and its least two miles, with a coast-line of eleven miles, whilst the highest point on it, Opuahau, is 1,274 feet above sea-level.

The formation is volcanic, and it has been well named by the natives Tuhua, that being the Maori for obsidian or volcanic glass, of which, with basalt, the island principally consists; cliffs, reefs, boulders, etc., being composed of this mineral, or a conglomerate of it mixed with other volcanic matter.

The island is very picturesque with its grand coast scenery, consisting of majestic arches and deep rugged caves and caverns in the basaltic rock. It has also its hot springs and large crater, which latter is five miles in circumference, with well-defined walls, the sides of which are composed of various kinds of volcanic *dêbris*, affording a grand field for geological study. The island is, however, of no use for settlement, the whole surface being very broken, and with the exception of two small lakes, situated in the crater, which are difficult of access, badly watered. A few very small springs are to be found, but they would not supply sufficient water for an European population or for stock. There are no running streams of any description.

The climate is very mild and pleasant. During the time I was there, viz., from the 23rd January to the 16th February, 1884, the mean shade temperature taken each day at noon was 79°, the maximum being 90°, the minimum being 72°, with a pleasant breeze blowing off the sea. I was informed by the natives that no frost is ever experienced—the place is therefore well suited for the growth of some kinds of fruits. Bananas, apples, peaches, grapes, figs, raspberries, strawberries, and Cape gooseberries, were seen in a flourishing condition on various parts of the island. Tobacco grows very well, the natives having some very fine specimens of it in their cultivations, in addition to potatoes, kumaras, and maize.

At one period the Maori population must have been very large, pas, now in ruins, are found scattered over the island on every commanding hill or point of vantage. At present the inhabitants number only nine, viz., three men, four women, and two little girls, who all belong to the Urungawera hapu of the great Ngaiterangi tribe, and these lay claim to the ownership of the island.* Of the former inhabitants many have left for the main land, where they now reside on a reserve at Katikati; others have been cut off by sickness, more particularly about the year 1862, when sixty of them died within a few days of some epidemic. The greater number of the old inhabitants were, however, killed in the numerous battles which took place in

* Mr. J. A. Wilson in his "Story of Te Wakaroa," says that in 1835 they numbered 70 people.

defending themselves from invasion by other tribes, who endeavoured to wrest it from them. In these attacks Te Arawa, Ngatimaru, and Ngapuhi, took a principal part. The latter tribe in 1832 landed on the island under Te Haramiti, and by surprise killed and ate many of the inhabitants; but the majority took refuge in their impregnable pa at the east end of the island, and thus escaped the fate of their friends. All the old pas have a history, which the natives delight in recounting. The people were generally able to hold their own against outsiders, though losing many of their number. The handful of them still left all reside in Opo Bay, at a village called Te Panui.

The live stock of the island consists of one horse, a few pigs, fowls, and peafowls. There are not many birds, but most of those still living on the main land are represented here. I noticed the following:—Pigeon, tui, korimako, kaka, ruru, piwakawaka, toutouwai, kingfisher, duck and teal in the lakes, and pukeko in the swamp, and various sea birds. Acclimatized birds are represented by the sparrow and blackbird, the latter being a late acquisition from the main land. The common locust and grasshopper were seen, and the poisonous katipo spider is also to be found, but strange to say that troublesome pest the sandfly is absent. The little brown lizard has found a home here, but the great tuatara only inhabits a small island or rock called Motuoneone, situated about a hundred feet from the shore.

There is nothing particular to note in the vegetation, as it is similar to that on the main land, though possibly a botanist might find treasures that would remain unnoticed by an ordinary observer. Common fern, tutu, tea tree (very thick), koromiko, and a little grass, form the ordinary vegetation, whilst the few clumps of trees consist of pohutukawa, mapou, manuka, rewarewa, akeake, whau or corkwood, pukapuka, and a few puriri, which, however, is of little value, being very scattered, and ruined by fire. Locomotion is very difficult, as all the old native tracks are grown over, and never used by the people, as they prefer to travel by water on the rare occasions when they leave their settlement.

There are no rare shells; I had expected to find the *Bulimus* or land-shell, but could discover none. In certain winds the delicate paper nautilus sails into Opo Bay and is there caught by the natives; I was able to obtain one fair specimen. The fishing off the island is very good, there being abundance of hapuku, kokiri, kohikohi, maumau, schnapper, kahawai, tarakihi, in addition to plenty of shell-fish such as koura or cray-fish, crabs, paua, etc. The mako shark, so well known for its beautiful teeth, which are highly prized by the Maoris as ornaments, is found off this island and nowhere else in the world I believe, but the natives told me it was getting very scarce. Beyond this there is nothing to note as peculiar to the island if we except the vast cliffs of obsidian. Possibly there are many geological treasures amongst the volcanic *dêbris* in the crater, many of the specimens brought away being new to me, but my knowledge of geology is very limited.

I propose now to describe the principal places and objects of interest in detail, starting with the landing place at Opo Bay, which is the only one of any size in the island. It is situated on the south-eastern curve, and is well sheltered from all but east or south-east winds, and affords a safe refuge for small craft, the anchorage being good and the landing on a nice sandy beach equally so. The bay is very picturesque, having most beautiful arches washed out in the basaltic cliffs by the action of the waves, which are overhung with grand old pohutukawas. It is a fine sight to see a heavy south-east sea breaking into this bay, dashing its waves into the caves and against the glittering cliffs of obsidian. In the south-west corner of the Bay is situated Te Panui, where all the present inhabitants live, and on the flat on the south side are their cultivations, about 25 acres in extent; here they cultivate potatoes, kumara, corn, and tobacco, and, in the way of fruit, strawberries and raspberries, all of which grow very well.

The pa before mentioned is a very strong position; from the seaward side it is only accessible by climbing up perpendicular cliffs of basalt, pumice, and obsidian. The natives make use of a rough ladder, by which they descend to the foot of the cliffs, where hauled up on the beach they keep their canoes. The pa is situated about one hundred feet above sea-level. In the good old times of Maori history many a hard fight and cannibal feast took place at this pa. There are also in addition two other pas of note situated in the same bay, viz., Okotore and Tikitikinahoa, both of which are very strong positions, particularly the latter. Tough fights have taken place here, the ground being full of the bones of those who fell in the fray; a heavy gale blowing into the bay during the time that I was camped there, the waves washed out many skulls, which in some cases showed the impression of the crushing blow which ended some warrior's career. Turning from war to peace and industry, we find situated near the centre of the bay two weather-boarded sheds, which were built by the natives some eight years ago as the nucleus of a whaling station, the timber having been brought from Tairua in a cutter. They also purchased whaleboats and all necessary gear, but the enterprise turned out a failure. I asked one native, why? He replied, "that the whales would not stop to be caught!"

At the head of one of the wooded glens, running inland from the bay, and about twelve chains from the beach, is situated one of the few springs to be found on the island. It is a bad one, the supply being very scanty, the water only dripping from the rock slowly into a hole made to receive it, and you have to dip it up cup by cup. During my stay of three weeks on the island, in which we only used the water for tea and cooking food, this meagre supply was nearly exhausted. The spring in question, and one other of the same kind, is all that the inhabitants of the three pas had to depend upon for their water supply. A few chains from the spring, in another pretty glen, are growing a few fine bananas, which bear fruit that ripens, but not of a large size. They were brought to the island by a Kanaka some years ago. Cape gooseberries and peaches are also plentiful, though the latter here and generally over the island are a very bad kind. It is into this bay that the fragile nautilus sails at certain seasons, and it is also the landing place of excursionsts, the other places of interest being most conveniently approached from its shore. Leaving this beautiful bay with its charming scenery and perfect sea-bathing, and passing an open bay with high rugged cliffs, we arrive at Ruakikino Point, which presents to view a fine specimen of wild coast scenery—the sea having washed its way far into the basaltic rock which forms the point, and scooping out most beautiful caves and channels winding through the rock, these chasms being spanned by grand rugged arches. On a very calm day it is possible to take a boat up these channels and underneath the arches into the dark caves beyond, where the echo of the voices and the dashing of the waves produce a very weird impression. About a mile off this point is situated the Karoa Reef, which is the best fishing ground for hapuku, and the home of the mako, a small shark much prized by the natives for its teeth, which they use as earrings. These mako, however, are not often caught. There is one objection to this fishing ground, viz., its great depth of water of one hundred fathoms. The sea here and all round the island is beautifully clear, objects being visible at a great distance from the surface.

Passing on past Waitangi Bay with its crags and beetling cliffs we come to a small open bay, in the north-west corner of which (between Taratimi and Taumou Pas) is the lip of the crater. It was here that the sides of this large crater were broken through, and the lava poured into the sea. The cliffs here are about one hundred feet high, and it must have been a grand sight to have seen the glowing lava falling into the blue sea over this fall of one hundred feet.

The crater is five miles in circumference and is very well defined, being marked out by lofty hills and ridges which vary in height from 1,162 feet down to 100 feet. The interior sides of this vast amphitheatre are very precipitous, and composed of a great variety of volcanic *débris*; obsidian and pumice are, however, the principal minerals found: the obsidian in some places having evidently cooled in layers, which gives it a stratified appearance; at other places you find it in rocks, boulders, lodes and reefs, which, glittering in the sun's rays, produce a very pretty effect. On some parts of the sides one finds a conglomerate of minerals, all of which have been in a state of fusion.

I obtained specimens of all the varieties, many of which are very interesting; I have one particularly fine specimen of obsidian which has a high polish all over it, also a piece of petrified wood in obsidian, which is very curious. Some of the obsidian is marked by a blue pattern, which appears to have been stained upon it by the decomposition of some vegetable matter, which got into the obsidian when it was in a state of fusion.

There is one very well demonstrated fact noticeable in places within the crater, viz., that mud volcanoes were in operation—the consolidated layers of mud with sharp edges being still to be seen, giving an appearance to some parts of the sides similar to that now to be seen at the active mud volcanoes of Rotorua, the only difference being that the mud in this old crater has hardened.

In the bottom of the crater are two lakes, connected by a swamp, the larger of which, Aroarotamahine, is thirty chains long by seven chains wide; the smaller, Te Paritu, is twelve chains long by five chains wide. These lakes can hardly be called pretty, as their general appearance is very sombre. I had no means of sounding them, but they appear to be very deep. They are at present about sea-level, but there are indications which show that they obtained a much higher level at one period, though it must have been many years ago. The water in them is clear and good for general purposes.

Standing on the banks of the lakes one obtains a grand view of the vast amphitheatre formed by the precipitous sides of the crater. The thought passed through my mind: Will it ever break forth into life again? If so, it will be a grand spectable.

At the north end of Aroarotamahine Lake is situated the best pohutukawa bush upon the island, and on the east side of it, and running towards the other lake, there is a fine tea-tree bush. The natives cultivated the flats by these lakes some years ago, and, as might be expected, obtained very good crops.

In the north-west corner or curve of the crater there is a most peculiar hill called "Tarawakoura," with a strong pa on its summit; it is connected with the crater edge by a narrow ridge, and, from its appearance, was a volcano. It is about seven hundred feet high. Its slopes are not very steep, and are covered with large blocks of scoria, over which has grown a dense vegetation of stunted rewarewa, pohutukawa, tea-tree scrub, fern and tutu, etc. The natives point with pride to the pa on its summit, and narrate how it is that it has never been taken by an enemy; even their dreaded foe the Ngapuhi, who, being the first Maoris to possess guns, thought, like Alexander the Great, to conquer the world, could not take it, at which I am not surprised, for with no enemy to pay me delicate attention, it was all I could do to cut my way a little distance up one of the slopes, the travelling being very difficult, owing to having to climb over the large scoria blocks, and force one's way through the dense vegetation. All the walking round the seaward side of the crater, which is a mere wall of volcanic *débris* with precipitous sides, is very dangerous, footing being very difficult to obtain and keep.

Another very strong pa is situated above the lip of the crater, named Taumou. It is on a crag 500 feet high. This is the strongest pa on the island, in fact their citadel, and has never been taken. The Ngapuhi, owing to the advantage they had in the possession of guns, were able to drive the natives of the island from pa to pa, until they retired to Taumou and Tarewakoura (before mentioned). Here the Urungawera made their final stand, and defied every effort of the Ngapuhi to dislodge them ; and finally with the help of obsidian drove them off with heavy loss.

The pa as before stated is situated on a crag on the side of the crater, with precipitous slopes on three sides, and with only a very narrow steep approach to it up a ridge of obsidian which the pa commands. There are large quantities of obsidian about the pa, in blocks of from a few pounds weight up to many tons. This the Urungawera used with great effect against the Ngapuhi, hurling the blocks of obsidian down on their heads as they rushed to the attack, which it is no wonder failed, for the heavy blocks of obsidian with their sharp edges must have caused great havoc in their ranks.

Another of the few springs in the island issues at this pa in a place where one would not expect to find it. It is situated at the root of a small pohutukawa which grows out of the steep cliff, about two hundred feet above the sea, on the seaward side of the pa.

Leaving the crater with all its wonders, and passing Okawa, which is a rugged, low-lying rocky point, on which the sea breaks heavily, we come to an open bay with steep cliffs of basalt and pumice, and a reef of obsidian. In this bay is Motuoneone, a small island or rock, which is the home of the tuatara lizard. This island is about 100 feet off shore. The lizards, like the inhabitants of Tuhua, appear to have expected an attack from the sea, for the sides of the rock are quite perpendicular for a height of 80 feet, and it is therefore impossible to get at them without the aid of ropes and ladders. I therefore could not get any. They are the same species as those on the Karewa Island. I brought twenty of these lizards home with me on my return from surveying that island, many of which I turned out in my garden, and have thus had many opportunities of observing their habits, an account of which may not be uninteresting. The lizards which I turned out thrived very well, and were quite at home. They lived under the fir trees and in the earth banks and ditches, subsisting on snails and any insects which came in their way, being particularly partial to the large fat green caterpillar. The cats and dogs did not take any notice of them at all. I also had some of them shut up, but they did not do well. One of them presented me with twins, but they, after a few days, vanished. I am afraid that their unnatural parents made a meal of them. They are of great use in getting a place rid of rats. There were a number of these pests in my shed when I turned some lizards in, and in a few days the rats had disappeared. Others have found the same thing, the rats always going. I do not think they kill them, not being quick enough to catch a rat; but whatever they may do, the desired end is gained, for the rats vanish. They can bite very hard, and if they get a hold, hang on like a bulldog. Returning to their home, Motuoneone, I cannot understand why they are only to be found on this rock and not on the island, the rock at one time being connected with and having formed part of the main island (Tuhua).

Leaving Motuoneone and its quiet inhabitants, passing Paretao, a low-lying point which has been under cultivation, we come to Turanganui Bay. This small bay is very picturesque, having frowning basaltic cliffs all around it, studded with obsidian, from 50 feet to 100 feet high, with the exception of the two corners, where a landing can be effected on a rough boulder beach; but only in fine weather. This bay is very deep, and the water being very clear, fish, sea-eggs, etc., can be seen at the bottom—producing a very pretty effect. On the north side of the Bay is Wharenui Point. This is a flat point, with some fine pohutukawas growing on it; it has all been under cultivation. One of the principal wahitapu or burial-grounds of the natives is here in the centre of the pohutukawas. Passing round this point, we come to Orongatea Bay. In this bay are the hot springs, situated about its centre, on a boulder beach. Scattered about the bay are pillars of basaltic rock, about 100 feet high, which with their clearly-defined weather-beaten sides and majestic elevation, give a very picturesque appearance to the inlet.

The hot springs are very small, being only little pools of warm, not hot, water, a few inches deep, scattered over about a chain of rough boulder beach. They are below the present high-water mark. To obtain a bath you have to wait until the tide goes out; you have then to clear away the boulders to make your bath; you can then recline on the hard sharp boulders and enjoy yourself, if possible! I found the boulders a little hard. The natives informed me that these springs are very good for the cure of skin diseases, etc. The pillars in the bay have at one time formed part of the island, and this fact—together with that of the hot springs being below high-water mark, and numerous other indications all round the island—point to the rapid encroachment of the sea. The cliffs in this bay are very precipitous, being about 300 feet high, and they extend to the end of the range below the Taupiri trig. station (585 feet), where they terminate in a bold bluff, the hills then running inland, leaving a flat, named Te Ananui, of about one hundred acres in extent, which has all been under cultivation. There is a small pohutukawa bush upon it. The landing-place to this locality is in an open bay called Hurihurihanga, and is a very bad one, all amongt large rough boulders. Inland, about half a mile from the flat, in a small patch of mixed bush, and at the foot of Opuahau Hill, is Opuhi, where the best spring of the island is situated, where there are also numbers of the korimako, or bell-bird, to be found—a bird not often now seen in the Bay of Plenty.

The flat before mentioned is bounded on the east by a range which crosses the island in a generally northerly direction, the principal peak of which, Opuahau (1,274 feet), is the highest point on the island. The termination of this range, called Tekopua, which forms the eastern boundary of Te Ananui flat, is very singular. The bluff falls from Te Ohineiti hill, 897 feet high, with a gradual fall for a few chains. The whole range has then slipped away into the sea, and now forms a huge slope, at about one in one, with about 600 feet fall. This slope is composed of pumice sand, pumice, obsidian, and other volcanic *dêbris*, into which one sinks up to one's knees. This loose material in a wind or rain slides away into the sea, and from the appearance of it has been doing so for years. It is very dangerous work crossing it, the whole huge slope having an inclination to slide down with you into the sea, some 600 feet below. At Tumutu Point, about a quarter of a mile from Tekopua, is an immense cave, washed out by the action of the sea in the side of the range. It is a very wild-looking spot, and when a heavy sea is breaking into it, and dashing the spray up its rugged sides, the effect is very grand.

From this point to Mawai Bay there is nothing interesting, it being the most dismal aspect of the island, consisting only of a mountain slope falling from Opuahau with a steep incline into the sea, and covered with a growth of tea-tree scrub and fern, without any bush or interesting feature.

Mawai Bay.—This is a very pretty little bay, with a boulder beach, and some fine pohutukawa trees growing round it; and in the little glens leading up from the bay are some fine peach trees, the best to be found on the island. These small glens have all been under cultivation at one time or other. Passing round a rocky point with obsidian cliffs, about 20 feet high, we arrive at

Oira Bay.—This is a very picturesque bay, having a good sandy beach, but owing to its being so open, it is difficult to land upon, except in very fine weather, there generally being a sea running. At the head of the bay is a small bush of fine old pohutukawas, and scattered along the beach are a number of kauri logs, which have been washed up by the sea; they come from the sawmills at Tairua and Mercury Bay, and are much prized by the natives. The land around this bay is pretty level for Mayor Island, and also very good soil. It has all been under cultivation. In a little glen there are some fine flax bushes (*Phormium tenax*) planted by the natives, and which they still use for fishing lines, &c. At the southern end of the bay, on a rugged rocky point, is the picturesque pa of Te Ruamata. It is a very strong position. The ditch which cuts it off from the main island is very deep, and must have been hard work for the natives to excavate with their primitive spades of obsidian. This point is highly "tapu." Off it and south to Whatipu for about half a mile out to sea, the ground is very foul, being covered with sunken rocks, which are only awash at high water, being very dangerous for boats. At Whatipu Point is one of the beautiful arches which go so far towards making the coast scenery so picturesque. This arch is very well defined and about 40 feet high by 20 feet wide. One can take a boat through in calm weather, when the effect of its rugged architecture is very grand. Round this point we come to

Otiora Bay.—This is the only bay (except Opo, the landing place) with any shelter for boats, and it is not a good one, being open to the south and south-west, and even in a north-west wind a nasty sea rolls into it. At the head of the bay there is a nice sandy beach on which you land, and very pretty wooded glens run inland from it, a few chains up one of which there is a small spring; at the head also of these glens are some very fine "corkwood" trees about one foot through, the largest I have seen; this wood is called "corkwood" by bushmen from its being, like cork, very buoyant in water. On the east and west sides of the bay the cliffs are very steep, about 200 feet high. On the west side and running down to Te Whatipu Point, was situated the second important settlement of the island (Te Panui, the present one, being the principal). This land has all been cultivated, and the ruins of old whares are still to be found; and such cultivation shows that at one time it must have had a large population. Between here and Te Panui ruins of old houses are to be found in every favourable spot, though in most cases the inhabitants had a long way to go for water, there only being the two small springs—one at Otiora Bay and the other near Te Panui—a distance of a mile and a half. A good track runs from Otiora Bay to the present settlement on Opo Bay.

From Otiora Bay to Waikawa the coast and inland scenery is much the same, the cliffs being about one hundred feet high and very precipitous. The country inland falls from the top of the hills which form the crater in a steep slope for about half a mile, it then spreads out into a fairly level country, though it is cut up by small ravines, down which the lava flowed on its road to the sea from the crater. The soil on the bottom of these ravines is very good, and peaches, fern, tutu, etc., grow luxuriantly. Off Waikawa Point is another pillar of basaltic rock, about seventy feet high and two chains off shore—another sign of the encroachment of the sea. In a ravine close by is the spring, a very small one, which, with the little spring in Opo Bay before described, is all the natives have to depend upon for their water supply. Close to the spring in question are growing bananas, grapes, apples, figs, and peaches, also flax, all doing well, the latter being cultivated. We next come to

Omapu Bay.—This is another very pretty little open bay, with a good sandy beach, and is one of the principal landing places. Inland from here is a nice little flat, having a good pohutukawa bush growing upon it, one tree of which is the largest I have seen in New Zealand; the whole of this flat has been under cultivation. At the east end of the bay are the present cultivations of the natives, which extend across from this bay to Opo Bay. Going round to Tokomata Point to Te Moreotemaiterangi, the south-east point of Opo Bay, the coast is very rugged and picturesque, the cliffs being about 200 feet high, overhung with fine old pohutukawas; the cliffs have reefs of obsidian in them, which at a distance look like bronze; on the top of them, and all over Otutawaroa Point up to the settlement, the country has a park-like appearance, being in rough native grass, dotted about with clumps of pohutukawa, and, with the patches of native cultivations, looks very pretty.

We have now made the circumference of the island, and arrived back at our starting-place, Opo Bay.

Tuhua, or Mayor Island, does not offer any very great attraction to the ordinary tourist; but to the geologist, student of nature, or artist, it is very interesting.

ART. LIV.—*On the Establishment of a Grand Hotel and Sanatorium in the Rotorua District.* By JAMES STEWART, M.Inst.C.E.

[*Read before the Auckland Institute, 27th October*, 1884.]

THE purpose of this paper is to endeavour to draw attention to what may be done by the initiation on a grand scale of a combined sanatorium and hotel for tourists in the Rotorua District, comprising also the management of detached residences and boarding establishments suitable to the tastes of all invalids and travellers. It is a subject which has engaged the writer's attention during the last five or six years. In that period he has been more or less engaged in the work rendering the lake country directly accessible to Auckland, and he has had many opportunities of studying the wondrous sources of health and profit placed ready to our hands by nature, and of the operations necessary for their utilization by art.

It is not the purpose of this paper to enter into arguments for or against any of the possible methods of effecting this end, but to sketch an outline of the particular scheme which the writer believes would realize to the utmost the results which ought to follow the systematic adaptation of the gifts of nature which are here placed within our reach.

Both the hydropathic and tourist branches of the establishment should be on a magnificent scale as regards amount and variety of accommodation, so as to be suitable for all tastes or requirements. The poorest invalid or most frugal pleasure seeker would find appropriate accommodation, attendance, and welcome; and at the same time luxury and refinement in the use of the waters, and enjoyment of residence, would be within the call of all who so desired. The natural features of the locality are almost unique, and the design and scope of the undertaking should be worthy of them. Therefore, nothing less than the scale of a first-class continental spa should be aimed at, and the result should be worthy of being advertised in the language of every civilized country. The attractions can well be made irresistible to the thousands who now yearly crowd the famous spas and watering-places of the old world. A very small share of these would affect most favourably, and at once, the Auckland Provincial District; but it would not long continue to be merely a small share, for soon the yearly influx of visitors would be a matter of great importance to the colony at large.

The locality which the writer believes is most eminently suitable as a site for this great establishment is Whakarewarewa, near Ohinemutu, Rotorua. A full comparison of all the advantageous points belonging to this place with other situations need not here be entered into. It is sufficient to say that if any other place can be shown to be better, let such be selected. The present object is to sketch the scheme and fill in a few details where necessary. These will be nothing more than are essential to success, and being adapted to Whakarewarewa, and possible there, the inference is that that place possesses all the features necessary.

The leading features, then, which in the writer's opinion must be found in any site fit for this scheme, are as follow:—

1. A great variety and abundance of thermal springs, varying from almost pure hot and boiling water, to the strongest mineral and medicinal wells, hot and tepid.

2. A variety of jets of dry sulphurous vapour, for use in obtaining vapour-baths, or for increasing the strength of sulphurous waters, will probably be an important feature, and prove of great value in the hands of a skilful medical superintendent.

3. All springs and waters for use ought to be at a good elevation above drainage-level, sufficient to allow of the waters being led by gravitation to any point suitable for the bath-buildings, and used as plunge, douche, shower, or swimming baths, and to facilitate them being mixed, cooled, increased, or reduced in strength, as may be found advisable.

4. It is necessary to have an abundance of clear cold water also, at an elevation sufficient to command by gravitation all the bathing-places. A good command of water-power is also of great value and an important feature in this scheme.

5. The situation must be easily accessible, beautiful, and diversified in landscape. It must afford superior sites for all sorts of residences, some close to the thermal waters, and others as far from these as will ensure the purest air at all times. The soil ought to be good and fit for the formation of extensive orchards, gardens, and pleasure-grounds. All the most wonderful features of the Lake Country must be within easy distance.

6. The situation must be near to, and within easy reach of, agricultural and pastoral supplies of all kinds. The consumption of these would be very large, and such a thing as scarcity of any one article, as sometimes occurs now in that country, must not be possible in an establishment like this.

Whakarewarewa presents all these points in a high degree of excellence, and in some is unapproached by any other place. It is situated two and a half miles southward of Ohinemutu. The new township and suburbs of Rotorua extend within a few hundred yards of it. The thermal and medicinal springs extend from Turekore, the famous spout bath, to nearly the Taupo Road, about three-quarters of a mile along the south-east bank of the Puarenga, at elevations from the level of to, say, twenty feet above the stream. This river, the name of which, Puarenga, means Lily Flower, is a considerable volume of water, forming cascades, rapids, and deep pools on a rocky bed. There is probably more than one hundred horse-power available, and easily obtained by placing wheels in picturesque positions for the purposes to be hereafter noted.

The situation cannot be surpassed in the Lake District for beauty. The hills, part of the range enclosing the Rotorua Basin, and through which the Puarenga has cut a narrow gorge, give shelter on the south-west and south, leaving the aspect open to the north-east, north, and north-west. On the north bank of the river are a few low hills, from which extends an almost level plain to the lake. On this plain is situated the new township of Rotorua, and that part of it between the suburbs and the Puarenga would form an admirable position for the hothouses and portions of the recreation grounds.

On a plateau-looking depression in the hills to the southward, elevated about 250 feet above the plain, and commanding a most magnificent view of the whole basin of Rotorua, is an admirable site for the main sanatorium buildings and hotel residences, with an atmosphere ever clear, and free from the vapours inseparable from the vicinity of medicinal springs. This plateau, and adjacent hills, with the slopes to the level of the plain, and extending between the Taupo and Wairoa roads, would form the area on which the art of the landscape gardener would be chiefly employed. It is now quite open and fern-covered, but exhibits a combination of features favourable to landscape improvement which would be difficult to find surpassed.

Towards the north-east of the general situation are two picturesque headlands extending into the lake, called Owhata and Owhatiura, whereon could be located a number of detached villas in variety of design, giving accommodation for the large number of visitors, who, desiring to remain a few weeks or months, would prefer to live near the lake. Near Ohinemutu there are two other beautiful headlands, called Koutu and Kawaha, and on all these places private enterprise would soon furnish abundance of detached accommodation, the initiation or nucleus of which is only required to be provided by the sanatorium.

To the eastward of Whakarewarewa is the road to the great attraction to tourists, Rotomahana, and to the west the road to Taupo. The soil on the hills and the slopes at their base is all that can be desired, while that of the plain, though light and sandy, is all the more suitable for the higher horticultural operations invited by the abundance of natural heat flowing to waste, and *apropos*,—the writer's attention has been drawn to an account in the journal of the Society of Arts, of date 27th June, 1884, of the utilization of a hot spring at the baths of Acqui, in a hothouse, by means of which semi-tropical vegetables were ripened in spring season. This application of the natural heat of the Lake District has long been a favourite idea with many besides the writer. Its extent of adaptability is almost unbounded where a natural fall of hot water exists, or where it can be economically raised and circulated by water power.

The waste water at Whakarewarewa, at a moderate computation of its volume, and an average of 700 units of heat available from every gallon, would furnish per diem heat equal to that derived from the combustion of six tons of coal in the same time.

The facility with which refrigerating operations can now be carried on, and the abundance of water-power in the Puarenga, suggest a further application of the forcing system in horticulture, viz., the possibility of obtaining a perfect winter crop of tropical fruits by resting the plants during the summer by means of an artificial winter. This could be easily produced in any degree of severity by circulating cold air under the glass and iced water in the ground pipes.

The general characters of the Whakarewarewa waters are pretty well known; anyhow, a detail description of them here would be superfluous. It may suffice to say that of all places in the district they have been most resorted to by invalids for residence at the baths, and numbers of very wonderful cures have been effected. It would be easy to compile a large and authenticated list of these extending over the last seven or eight years.

The supply of agricultural and pastoral produce will be abundant as soon as wanted. It is not so now, however, but the necessary and indispensable prelude to this establishment is the completion of railway communication between Auckland and Rotorua. That means the settlement of many thousands of acres of admirable agricultural land with a population of small farmers who, with steady markets at both ends of the line of railway, will form a prosperous community.

We may now proceed to sketch the outline of the several features forming the scheme in contemplation, with only such details as are necessary to explain the working and purposes of some of them.

Baths.—A very faint outline only can be sketched of the variety possible to be obtained in baths at Whakarewarewa. The subject expands in capacity every time it is considered. The waters would be collected into suitable reservoirs, having a natural appearance given to them. Pipes, chiefly earthenware, would lead to baths situated along both sides of the stream, wherever convenient, taking care to have ample room for extension and improvement, as experience would be gained of the direction of popular favour. Bathers would have a choice not only of the kind of water, but the temperature and manner of use. Tepid and cold swimming baths ought to be attached to each set, and separate sets enclosed and set apart for ladies.

These bath buildings must be designed with great care, and present the most thorough ventilation and at the same time freedom from draughts. The architecture of the whole bathing arrangements, including reservoirs and conduits, should harmonize with the volcanic and eruptive surroundings.

The general bathing arrangements should be open to visitors and invalids from any part, and not confined to those living at the sanatorium, but the more medicinal and highly curative of the springs should be under the control of the medical superintendent. A certain class, also, of accommodation of all the waters should be ensured to all, at a very low minimum fee.

Buildings.—Probably two sets of block buildings would be required, one at the foot of the hills, and the other on the high level plateau before referred to. These would comprise the usual accommodation of a first-class hotel, with the assembly rooms and social arrangements usual at fashionable watering places. The residences on the hills would be connected with the low grounds and baths by cable tramways, and winding drives and paths through the ornamental grounds on the slopes.

At suitable places on the hills and lake headlands detached villas and gardens would be built, having from three or four to six or eight rooms. These could be erected as the demand increased, and be let furnished with board and attendance if necessary. But as before mentioned, nothing in the way of monopolizing the residential amenities of the district should be attempted. The object of connecting villa residences with the scheme is to ensure a certain amount of that accommodation being available under known rules and management.

As a matter of course the buildings would vary in architectural design with their situation and purpose, but a few points must be observed in construction, to ensure stability and permanence, when situated near the sulphurous vapours always arising from the waters in most repute in any locality. The foundations and basement floors must be of concrete. All doors and windows must have galvanized hangings and fastenings. All nails must be well punched in and stopped. All paint must be silicious, all roofs slated and nailed with galvanized nails. But on the high levels, and on the borders of the lake, and a short distance away from the hot springs generally, no such precautions are necessary. Another point of extreme importance may be noted, viz., the disposal of sewage. Here, we must begin as all towns in England are being compelled to end, and no sewage should ever be discharged into the lake. From the first, all the well known and generally practised arrangements must be enforced, to preserve the purity of the waters.

Gardens and Recreation Grounds.—These ought to be made one of the most attractive features in the whole regions of travel. First-class soil exists on the hills and on the slopes extending from their base to the river. The plain is sandy and light in soil, but well suited for gardens, lawns, and hothouses. Being under command of easy irrigation, and of the inexpensive method of obtaining the tropical heats or frigid winters above alluded to, it seems that everything that can be desired in the way of horticulture and floriculture may be produced in perfection and great abundance.

Water-power and applications.—Frequent allusion has above been made to water-power. The Puarenga in its course from the gorge to the lower level of Whakarewarewa furnishes means of obtaining probably 100 horse-power. This can be developed by several wheels or turbines, placed in convenient situations, and treated picturesquely in design. This power would be applied to various purposes, some of which have been already alluded to; these are,—

1. The circulation of hot water in the hothouses: this need not be further dwelt on.

2. Refrigerating machinery: this would be applied principally to the production of ice, the preservation of meats and fruits, the cooling of air, and water for sanatory purposes. Skating and curling rinks of ice could be always at command, and, as before mentioned, an artificial winter obtained for horticulture.

3. Electric light: this would be easily obtained by dynamos driven by water-power, and storage in secondary batteries. A system of arc-lights for the grounds, and incandescent lamps for the interiors of the whole establishment would cost only the maintenance of dynamos and lamps.

4. The working of cable tramways connecting the upper and lower establishments, and on other routes having much traffic.

5. Pumping cold water to reservoirs situated above the level to which it would flow by gravitation, and also supplying the residences with hot water for house baths in special cases.

Water supply for domestic purposes cannot be obtained in sufficient purity from the Puarenga, and would depend on one or more of remarkably pure and clear streams of spring-water. One of these, flowing perhaps one million of gallons per diem, is very conveniently situated for supplying Whakarewarewa. Another group of these streams at the foot of Ngongotaha Mountain, on the north-west of the lake, will form the water-supply of the large Rotorua population in the immediate future.

Branch Establishments.—It may be found necessary to have branches, or outlying lodges, at various points of interest, such as at the Pink Terrace, Rotoiti, Orakeikorako, etc.

Hiring Department.—This might with advantage be attached to the scheme, and would comprise the management of all omnibusses, tramways, carriages of all kinds, hire of horses, donkeys, sailing and rowing boats; guides, and the conduct of all excursions by land or water, and also sports, would be under this department.

Extent of Grounds necessary.—On the township side of the Puarenga, the grounds should include the area of the flats and downs, extending to the line from Tangatarua to the crossing of the Puarenga by the Wairoa Road.

On the south of the stream, the grounds should extend from the Taupo Road on the west to the Wairoa Road on the east, and southward as far as Rotokakahi, taking in the Waipa Plains for the purpose of forming a park. And in order to conserve most beautiful natural New Zealand scenery in a domain, Moerangi Mountain and Tikitapu Bush and Lake should be included. These hills and forests should by every possible means be preserved as specimens of native grandeur to all time. Probably 6,000 acres would be required for all purposes.

Promotion of the Scheme.—This will require very careful study. The Whakarewarewa Springs have lately been passed through the Native Lands Court, and are vested in two hapus of the Ngatiwhakaue and Tuhorangi tribes. But the Court must settle many subdivisions before the lands could be purchased. The ownership of all the other land necessary has been determined, and can be dealt with under the Thermal Springs Act, or by special legislation.

An association should be formed with a small capital sufficient to promote the scheme, by conducting all the necessary negotiations for concessions of rights to waters and purchase of lands, obtaining surveys, and detail information relating to all the springs, such as volume, analysis, known curative results, etc. An Act of the Legislature would be necessary in order to consolidate the working of the scheme, and, while conferring the necessary compulsory powers, to preserve the interests of the native owners and the public. When all this is done, and the exact cost of land and water rights ascertained, the association ought to promote a company in England, with a capital sufficient for the whole scheme as finally decided on.

Judging from the numbers of tourists from many parts of the world, whose names are registered in the books of the three hotels now at Ohinemutu, it cannot be deemed extravagant to put the number who would patronize such an establishment as herein sketched, within two or three years after its opening and connection with Auckland by eight or nine hours' railway journey, at an average occupancy of 500 persons. Taking the gross receipts from this number, exclusive of wines and returns from hiring business, at only 10s. per diem each, the daily revenue would be £250, and the nett profit say one-third of that, or more than £30,000 per annum. And when it is considered that the season, which in old world Continental spas has so short a duration and is within limits sharply defined, would here practically extend round all the year ; also, that even now we in New Zealand are in accessibility nearly on a par with what not many years ago Germany and Switzerland could boast of, we may reasonably predict that in point of favour and patronage the Rotorua Spa will, in a very few years, hold the premier position in the world.

The association for the promotion of this should be formed as soon as the railway to Rotorua is a certainty, and a certain amount of planting of fruit and ornamental trees ought to be undertaken at the earliest possible date. Not an hour that can be saved should be lost, in furthering this project, and the writer commends it to the careful consideration of all his fellow-colonists, desiring in any way to promote the prosperity of the country at large, and our own provincial district in particular.

ART. LV.—*Cat's Eye Bay.* By DONALD SUTHERLAND.

[*Read before the Wellington Philosophical Society, 13th February,* 1885.]

Plate XX.

ON our way to House-roof by boat from Milford Sound last July (1884) we went into Cat's Eye Bay. As it is the only bay on this coast that I have not visited I intended to have a look at it, so we made a stay of about ten days, and I will send this sketch of it on to you as well as I can make it out. The entrance to this river is not unlike the one at Transit Beach; the bar is about dry at low water, then about 200 yards further in it deepens from 4 to 5 feet for about 400 yards; here there is a second bar being about 3 feet above low water-mark and having about a foot of water running over it at low water. The bar is about 200 yards long, then it deepens again from 2 to 18 feet, and this depth runs up about two miles, that was as far as we could get with the boat. We went up the river with the boat from the bar about two and a half miles—the river runs back about five and a half miles; there is a saddle about 800 feet high on the south branch of this river, which is the largest of the two; over this saddle the valley runs back some miles at about the same level as far as I could see towards the south-east; the north branch is very small.

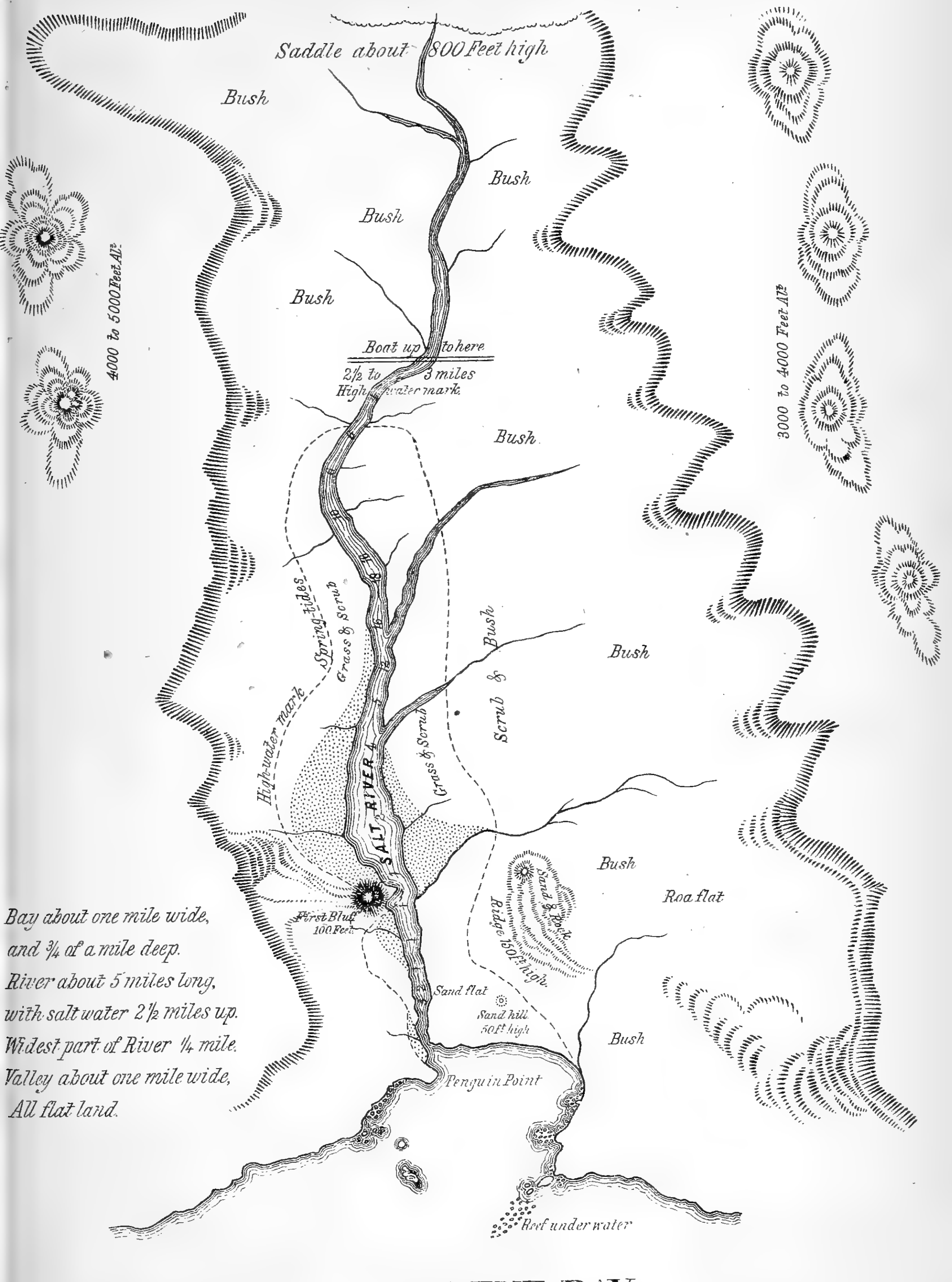
The formation about here is much the same as at most of the other sounds. I could find no trace of any one being here before. Kakapos, kiwis, and roas, are plentiful on the south side of the river, and there are plenty of penguins on the north-east side of it. I found some wreckage of a vessel and some copper rings on the beach. With a very high tide most of the flat is covered at high water. There are a good many reefs, mostly white quartz. I think the valley that runs to the south-east in the bay runs into the lake valley to the north of the head of George Sound. I went up to the head of George Sound after leaving Cat's Eye Bay and had a look around there, and by the bearings I took I think I am right. The Cat's Eye Valley is 400 to 500 feet higher than the lake, cutting it at about right-angles about seven or eight miles from the head of George Sound.

There are large shoals of the pilchard at the head of the Sound. They are from 6 to 10 inches long. They finished spawning on the 2nd or 3rd of this month (December). Tons of them are on the beach in Freshwater Basin.

We have had very fine weather here during October and November, only three wet days, and only 5 inches of rain fell in the three days.

I intend to try House-roof again if I can see my way clear, if not, I may go into Little Bay for three months next winter.

On the 4th and 5th of December the tides in Milford Sound were 1 foot 6 inches higher than the ordinary spring tides, and on the 6th was the highest, being 21 inches higher than usual, the weather being fine. These are the highest tides that I have seen since I have been here.



CATS EYE BAY.

Donald Sutherland, del.

NEW ZEALAND INSTITUTE

NEW ZEALAND INSTITUTE.

Sixteenth Annual Report.

Meetings of the Board have been held on the following dates: 3rd August, 1883; 20th December, 1883; and 20th March, 1884.

The three members who retired from the Board in conformity with clause 6 of the Act were: Mr. W. T. L. Travers, the Hon. Mr. G. Randall Johnson, and Dr. Hector; Mr. Travers and Dr. Hector were reappointed, and the Hon. Mr. G. M. Waterhouse fills the place of the Hon. Mr. G. R. Johnson.

The members elected under clause 7 of the Act are: Mr. James McKerrow, Hon. Mr. Rolleston, and Dr. Buller.

A distinguished honorary member of the Institute has been lost in Dr. Ferdinand von Hochstetter, the news of whose death lately reached here. Dr. Hochstetter was among the first to be elected in 1870. There are now three vacancies in the roll of honorary members.

The following are the number of members now on the books of the Institute:—

Honorary Members ...	27
Ordinary Members—	
Auckland Institute	305
Hawke's Bay Philosophical Society	111
Wellington Philosophical Society	246
Westland Institute	110
Philosophical Institute of Canterbury	163
Otago Institute...	193
Southland Institute	70
Nelson Philosophical Society ...	86
Total	1,311

The volumes of Transactions now in stock are: Vol. I. (second edition), 400; vol. II., none; vol. III., none; vol. IV., none; vol. V., 48; vol. VI., 47; vol. VII., 146; vol. VIII., none; vol. IX., 150; vol. X., 180; vol. XI., 60; vol. XII., 65; vol. XIII., 68; vol. XIV., 90; vol. XV., 203; vol. XVI., not fully distributed.

The printing of Volume XVI. of Transactions of the year was commenced the latter end of January and completed the end of April, and issued early in May. The volume contains fifty-seven articles, and also addresses and abstracts of articles which are included in the Proceedings and Appendix. There are 639 pages of letter-press and forty-four plates. The following is a comparison of the contents of the volume with that for the previous year :—

	1884. Pages.	1883. Pages.
Miscellaneous	72	90
Zoology	324	236
Botany	118	124
Chemistry	4	—
Geology	13	60
Proceedings	46	26
Appendix	62	50
	639	586

The Honorary Treasurer's statement of accounts is appended, from which it will be seen that there is a liability amounting to £67 16s. 11d., the balance due on account of printing of vol. XVI,, against which there is a sum of £39 5s. 1½d. in the hands of the London agent, making a deficiency on the year's accounts of £28 11s. 9½d.

James Hector,
Manager.

Approved by the Board, 30th September, 1884.

Wm. F. Drummond Jervois,
Chairman.

New Zealand Institute Accounts, 1883–4.

Receipts.	£	s.	d.	Expenditure.	£	s.	d.
To Balance in hand, 3rd Aug., 1883	77	14	7	By Balance due for printing vol. XV.	76	11	4
Parliamentary vote for 1883-84	500	0	0	Printing vol. XVI. (on account)†	543	10	8
Contribution from Wellington Philosophical Society, one-sixth of annual revenue	35	3	6	Miscellaneous items	0	2	1
Sale of volumes*	7	6	0				
	£620	4	1		£620	4	1

* Exclusive of balance in hands of London agent, £39 5s. 1½d.

† Liability for printing vol. XVI., £67 16s. 11d.

Arthur Stock,
Hon Treasurer.

30th September, 1884.

PROCEEDINGS

WELLINGTON PHILOSOPHICAL SOCIETY.

ADDRESS BY THE PRESIDENT.

[*Read before the Wellington Philosophical Society, 13th February,* 1884.*]

ABSTRACT.

Referring to the Transactions of the Institute, Dr. Buller stated that he wished, having said so much in praise of the annual volume, to call attention to what appeared to him a very serious defect in it. He referred to the extreme paucity of articles relating to the Maori inhabitants of the country, their mythology, their manners and customs, their traditions, their habits of life, their treatment of the sick, burial of the dead, and so forth. The ethnologist of the future will naturally look to the "Transactions" for reliable information on all these points. Newspaper literature is ephemeral, and not always reliable; but the fact that every paper is vouched for by the name of the author is some sort of guarantee that none but well-authenticated facts will be found in the pages of the "Transactions."

Looking to the fact that the Maori race was dying out very rapidly, and that, in all probability, five and twenty years hence there would only be a remnant left, it was of the first importance, from an ethnological or ethnographical point of view, to collect and preserve, while yet there was opportunity, a faithful history of so interesting a people. He (Dr. Buller) had often heard Maoris themselves speculate on their speedy extinction, saying in a melancholy way, that as the Norwegian had destroyed the native rat, and as the indigenous birds and shrubs were being supplanted by the introduced ones, so surely would the Maori disappear before the pakeha. And this was no mere fancy. The abnormal condition of the population—the females far outnumbering the males—was the surest indication of national decay. Every successive enumeration of the people told its sad tale, and the decrease must of necessity go on in a progressive ratio. In Cook's time the Maori population was estimated at a hundred thousand; at the period of our first colonization of the islands at seventy thousand; and his own opinion was that at the present day they do not number, men, women, and children, more than thirty thousand.

He knew of districts swarming with Maoris in former years, now depopulated. He had known whole hapus disappear, and he had seen an entire family die out in the course of a year. Twenty years ago he was stationed as Native Resident Magistrate at Manawatu, and he had then under his nominal control and management some 2,500 Maoris. It would be difficult now within the same district to find as many hundreds. In 1866 he was present at Rangitikei when Dr Featherston paid over the purchase money of the Manawatu Block, amounting to £25,000, and there were some 1,500 natives present. It was proposed to pay over to the natives, in a month's time, double that amount, for the Otamakapua Block, and he doubted whether in the same district 300 will be brought together for that purpose, even counting the Hawke's Bay contingent! Last week he was at Otaki, and took some visitors to the Maori church. There, where formerly about 1,000

* This abstract was supplied too late for insertion in its proper place in vol. xvi., p. 557.

natives assembled to the ministrations of Archdeacon Hadfield (our present Bishop), it seems now difficult to fill the front seats. In the settlement itself—veritably a "deserted village"—where formerly there were hundreds, it would be hard now to find scores; and, in answer to enquiries on all hands, the response is "kua mate."

And in this connection he mentioned a curious feature in the mortality of the race, namely, that the children and middle-aged people are the first to succumb; the old stock, who appear better able to resist the new order of things, generally holding out the longest. That the race was doomed he had no doubt whatever in his own mind. What had happened in other parts of the world must inevitably happen, and indeed is happening, here. The aboriginal race must in time give place to a more highly organized, or, at any rate, a more civilized one. This seems to be one of the inscrutable laws of Nature. And, if true to our watchword of progress—social, intellectual, and physical—he could scarcely believe that even the most earnest Philo-Maori would deplore the change. He had often reflected on an observation of the late Dr. Featherston, on their first meeting, just twenty-eight years ago: "The Maoris (he said) are dying out, and nothing can save them. Our plain duty as good, compassionate colonists, is to *smooth down their dying pillow.* Then history will have nothing to reproach us with."

Accepting these facts, Dr. Buller insisted on its being the absolute duty of the Society to collect materials for the future historian of the race. He said he had gone carefully through the fifteen volumes of "Transactions," and out of more than a thousand articles on a variety of subjects, only three dozen had any reference whatever to this subject. He then gave the meeting a rapid review of the more interesting of these papers, and stated his own views as to their relative value. Of some of the contributions by Maori experts, he spoke in terms of disparagement, and gave his reasons. Mr. Colenso, he said, had been the most diligent contributor, and his papers were replete with information. But to his mind the best written, most interesting, and most philosophical of the papers on this subject were those contributed by a former president, Mr. W. T. L. Travers. His "Life and Times of Te Rauparaha," he considered one of the most important contributions to Maori literature yet published. Sir George Grey, when Governor of New Zealand, took advantage of his exceptional opportunities, and formed a very extensive collection of "Poems, Traditions, and Chants," which had been published without, as yet, any translation. Much of this poetry was highly figurative and beautiful; and he quoted from the preface to that volume to show how difficult a task it was to catch and reduce to writing this oral poetry, the knowledge of which was confined chiefly to the old men and *tohungas.* Professor Max Müller, whom he had met at Oxford, spoke in high praise of this work, and said that for years he had been looking out anxiously for the promised translation.

In addition to these historical records, it appeared to him of the utmost importance to form a complete ethnological collection illustrative of the race, which was becoming every day more difficult and would be soon impossible. He had himself enjoyed very favourable opportunities for doing this, and during many years past, with the active co-operation of Captain Mair, he had diligently employed himself in forming such a collection. There was much yet to be done; but, even now, he ventured to say, his private museum was far more complete than any other of the kind in existence. Besides embroidered mats, carvings, and implements—domestic, warlike, and industrial—to illustrate the former habits of the people, the collection contained some objects of special historical interest; for example the identical human-bone flute on which

Tutanekai played to his lover, Hinemoa, on the banks of the Rotorua Lake, three hundred years ago; the curiously carved nose flute, on which, in ancient times, the tohungas of the Ngatiraukawa practised their sacred music; the genealogical stick by which "King Tawhiao" traces back his ancestry to the earliest of *tupunas*; and so forth. He had also employed the well-known Austrian artist, Lindauer, to paint life-size portraits of several of the more prominent chiefs of the day, all in Maori costume, and typical faces of both sexes. The work had been admirably executed, and he felt sure that this series of pictures would possess great interest in after times. It must be remembered, however, that individual effort laboured under many disadvantages, and it appeared to him that an exposition of this kind, possessing a kind of national interest, should be undertaken by the Government, and on a far more comprehensive scale. Dr. Buller concluded by saying that it was his intention, during his presidential year, to do his utmost to promote and encourage this particular branch of local research, and he then resumed his seat amid general applause.

The Hon. Mr. Waterhouse said he had listened with great pleasure to the address, but was surprised to hear so decided an opinion expressed as to the rapid decline of the Maori poople. He thought this view was scarcely borne out by the official statistics; but that, on the contrary, the Maoris throughout the colony were rather on the increase. The census returns might be accepted as relatively correct, and it appeared to him, from an examination of these returns, that there was a larger percentage of children among the Maoris than among the French. If true, this would go to prove that the Maoris were really on the increase. The subject was one of great interest, and he was glad to hear from Dr. Buller that he intended, during the coming year, to contribute some papers to the "Transactions," because there was probably no one more competent to deal with the matter. As to the value of the "Transactions," he entirely agreed with the president. He had long thought that it would be a wise thing to reprint the more interesting of the papers in a popular form for general circulation.

The Hon. Mr. Hart said he took the same view as the last speaker. He believed that the general notion of rapid decrease among the Maoris was premature. It had yet to be proved that there was an actual diminution. So far, the statistics pointed to the opposite conclusion.

Dr. Newman said he entirely agreed with the president. He had himself on a previous occasion expressed his belief, at a meeting of the Society, that the Maoris numbered only 35,000. He thought Dr. Buller was probably right in placing the number somewhat lower. On all hands were proofs of decrease, especially in the Hawke's Bay district, with which he had been more intimately connected. He had no faith in census returns. Even Mr. Bryce had told him that these enumerations could not be relied on, as every chief was anxious to make his following appear as large as possible.

Dr. Hector said it could not be denied that this very important subject had hitherto been neglected. Although, however, comparatively few papers had appeared in the "Transactions," he was not aware that any had been rejected. He took the opportunity of saying this, because a Hawke's Bay correspondent (Mr. Colenso) had lately complained of unfair treatment in this respect, whereas his papers (which were not on Maori subjects), had only been delayed, not refused; and it seemed to him unreasonable to make this a ground of complaint against the Institute. He entirely concurred in the views put forward by Dr. Buller in regard to the Maori race. The census returns were quite delusive, as he had satisfied himself by careful enquiries in various parts of the country, and he gave the meeting several instances in point. As to the urgent necessity for collecting a history of the Maori people, he was quite in accord with the president, and would suggest that the minutes of evidence in the Native Lands Courts should be carefully preserved, on account of the historical information they contain.

The Hon. Captain Fraser said he thought the decay of the Maori people was by no means so rapid as was generally supposed. He also demurred to some of Dr. Newman's observations, and that gentleman immediately replied.

Dr. Buller said in general reply, that his conclusions were not based on the evidence of any particular locality, but were drawn from a pretty extensive knowledge of the various native districts. He had instanced the Otaki district because it was at our very doors. But other districts with which he was equally familiar—Kaipara in the far north, Waikato, Rotorua, Taupo, Wanganui, etc.—all told the same melancholy tale. These districts were populous when he first knew them, and now the natives might be counted by dozens where formerly there were hundreds. As to Maori census returns, they were mere approximations and very often misleading, as he could state from personal experience. He was much struck with the rapid mortality as disclosed also by native titles; and he mentioned several instances within his own professional knowledge, where, in a certificate of title containing from 50 to 100 names, from 10 to 15 per cent. had died off in an incredibly short space of time. Amalgamation of races had been talked of, but this would not save the Maoris. The half-castes were undoubtedly a fine people physically, but he had noticed that when they married back into the Maori race the offspring had no stamina, and seldom reached maturity. He quite agreed with Dr. Hector about the value of the Land Court evidence if carefully arranged and collated. He had succeeded once in interesting Judge Fenton on this point, and circulars were then addressed to the various Judges, asking them to hand over their note-books for public record, but he had never heard the result. For his own part, for twenty years past he had been carefully preserving everything of the kind.

First Meeting. *9th July*, 1884.

Dr. Buller, President, in the chair.

New Member.—S. Kohn.

1. "On Changes in the Hataitai Valley," by J. C. Crawford. (*Transactions*, p. 342.)

2. "On Water-worn Pebbles found in the soil in the Hataitai Valley and elsewhere in that locality," by J. C. Crawford. (*Transactions*, p. 341.)

3. "On the Punui of Stewart Island, *Aralia lyallii*, n. s.," by T. Kirk, F.L.S. (*Transactions*, p. 293.)

4. "On a Deposit of Ironstone at Kawakawa, Bay of Islands," by A. McKay.

5. "On Variation in Plumage of some New Zealand Birds," by T. W. Kirk. (*Transactions*, p. 60.)

6. "Notice of the Eastern Golden Plover *Charadrius fulvus*, near Wellington," by T. W. Kirk. (*Transactions*, p. 59.)

7. "Description of a new Species of Paper Nautilus, *Argonauta gracilis*," by T. W. Kirk. (*Transactions*, p. 58.)

SECOND MEETING. *23rd July*, 1884.

Mr. R. Govett, Vice-president, in the chair.

New Member.—Wm. Ferguson.

1. "On the Geology of Kawhia Harbour and the Mokau Country," by Dr. Hector. (*Geol. Reports*, 1883–84.)

2. "On the Suitability of New Zealand White Pine, when creosoted, for Railway Sleepers," by Dr. Hector.

A specimen presented to the Museum by Mr. Harding of Mount Vernon was exhibited, being portion of a white pine sleeper that had been treated with creosote at Crewe, England, and then buried in the ground for seven years, and which has continued perfectly hard and sound for that period.

THIRD MEETING. *6th August*, 1884.

Dr. Buller, President, in the chair.

1. "Notes on an Excursion to the Islands Tonga, Samoa, Fiji, etc.," by J. C. Crawford.

2. "Note on an Aphidian Insect infesting Pine Trees," with Observations on the name "*Chermes*" or "*Kermes*," by W. M. Maskell. (*Transactions*, p. 13.)

3. Specimens of Tin Ore from New South Wales presented by the Hon. G. Randall Johnson were exhibited by Dr. Hector, along with New Zealand specimens for comparison.

4. "Notes on *Loranthus fieldii*, Buchanan," by H. C. Field; communicated by the President. (*Transactions*, p. 288.)

5. Dr. Hector exhibited a specimen of Quartz from Collingwood, lent him by Mr. H. Travers, which showed the gold in the form of a slickenside film, and proved that the gold was in the lode previous to the later movements of the strata.

6. A list prepared by Mr T. Mason, was laid on the table, showing the plants that were injured by the severe frost on the nights of the 21st and 22nd June, 1884, at Taita, Wellington.

LIST OF PLANTS INJURED BY FROST.

Erianthemum	severely.	Lasiandra macrantha	slightly.
Cuphea (various)	,,	Oranges and lemons	,,
Verticordia brownii	,,	Ficus glauca	,,
Mackaya bella (where exposed)	,,	Acacia decurrens..	,,
Cestrum aurantiacum	,,	Campsidium filicifolium ..	,,
,, diurnum	slightly.	Eucalyptus marginata	,,
Pernettya (sp.)	severely.	,, ficifolium	,,
Wigandia caraccasana	,,	,, (name not known) ..	killed.
Ilicium anisetum	slightly.	Arduina grandiflora	severely.
Cantua pirifolia	severely.	Callistemon floribunda	slightly.
Camphora officinalis	slightly.	Tecoma stans and pulchra ..	,,
Toxicophlæia thunbergianum ..	,,	Sedums	severely.

Bouvardias	severely.	Echeverias	severely.
Stillingia sebifera	"	Solandra grandiflora	slightly.
Bougainvillia glabra	slightly.	Fuchsia splendens and soft-wooded kinds..	severely.
Callicarpa rosea	"		
Sterculia acerifolia	"	Goldfussias	"
Botryodendron latifolium ..	"	Pohutukawa	slightly.
Justitia carnea	severely.	Rata	"
Jacaranda mimosæfolia	slightly.	Aralia papyrifera	"
Polygala oppositifolia	"	Salvias, tender varieties.. ..	severely.
Vitis ovata	severely.	Tree ferns (young fronds) ..	"
Barleria cristata	"	Epacris, varieties (flowers only)	—
Seaforthia elegans	"	Rhododendron, Princess Alice ..	slightly.
Erica buccans	"	Kawakawa (where at all exposed)	severely.
Acmena kingiana and pendula..	slightly.	Karaka (where at all exposed and small)	slightly.
Grewia occidentale	"		

FOURTH MEETING. *3rd September*, 1884.

Mr. Martin Chapman in the chair.

New Members—Dr. Levinge and Maurice Richmond.

1. "Review of a Paper on the Moa, by M. A. de Quatrefages," by W. M. Maskell.

The author said that a good translation of this paper would be found in the "Annals and Magazine of Natural History" for 1884.

2. Dr. Hector described a collection of minerals made by Mr. McKay at Wade, Auckland, where serpentine contains ores of zinc and baryta. These are probably of the age of the auriferous injections of Coromandel, which belong to the cretaceous period, and not to the older reefs of Otago or Reefton. Igneous rocks from the Queen of Beauty Mine, Makara, also collected by Mr. McKay, were shown, which proved to be of the same composition and structure as those at the Thames and Wade.

FIFTH MEETING. *1st October*, 1884.

Dr. Buller, President, in the chair.

New Members.—Captain Hewitt and A. J. Rutherford.

1. Notes on the New Zealand Beeches," by T. Kirk, F.L.S. (*Transactions*, p. 298.)

2. "Description of some new Insects in New Zealand," by W. Colenso, F.L.S. (*Transactions*, p. 151.)

3. "A List of Fungi recently discovered in New Zealand," by W. Colenso, F.L.S. (*Transactions*, p. 265.)

4. "On a newly discovered Lizard," by W. Colenso, F.L.S. (*Transactions*, p. 149.)

SIXTH MEETING. *15th October*, 1884.

Mr. Govett, Vice-president, in the chair.

New Members.—Dr. Cahill and W. F. Barraud.

1. "On the Kea or Mountain Parrot," by A. McKay.

The author, by relating a number of observations, showed that the kea possessed a high degree of intelligence, and that only on the very borders of the region it occupied had this bird acquired the habit of killing and wounding sheep. The author further went on to show that the keas had the power of communicating ideas amongst themselves. Mr. McKay was of the opinion that in consequence of its superior intelligence, and the extent of inaccessible country which it inhabited, there was little probability of its ever being exterminated. An anecdote was related by the author to show the intelligence of the bird, according to which several keas, after a consultation, delegated one bird, twice in succession, to untie the knot in a string which fastened one of their number to a pick-handle.

2. Mr. E. A. Gibbon (not a member of the Society), then read a paper on Floating Breakwaters. He showed various models of contrivances intended to break the force of a heavy sea, and to retard the speed of a vessel running before a gale. The discussion that followed was not altogether favourable to Mr. Gibbon's schemes, and that gentleman admitted that he had not yet proved their practical value by experiments.

SEVENTH MEETING. *26th November*, 1884.

Dr. Newman, Vice-president, in the chair.

New Members.—Dr. A. Martin, J. D. Treanor, and J. Barnicoat.

1. "Notes on the Ornithology of New Zealand," by A. Reischek; communicated by Dr. Hector. (*Transactions*, p. 187.)

2. "Notes on the Dolphins of the New Zealand Seas," by Dr. Hector. (*Transactions*, p.207.)

3. Specimens of Gunpowder manufactured at the mills at Owake, Otago, and presented by Mr. Mackley to the Museum, were exhibited.

ANNUAL MEETING. *13th February*, 1885.

Dr. Buller, C.M.G., F.R.S., in the chair.

New Members.—A. Cook, E. Tregear.

ABSTRACT OF REPORT FOR 1884.

During the past year the society had held eight general meetings, at which 9 papers on Geology, 8 on Botany, 10 on Zoology, and 5 on Miscellaneous subjects had been read. The re-arrangement of the library had afforded members greater convenience for consulting the valuable works now belonging to the society, which would be still further increased when the printed catalogue now being prepared of the whole collection was provided. Fourteen members had been elected during the year, making a total of 261 now on the roll. From the Treasurer's statement of accounts, it appears that the receipts for the year, including a balance of £145 1s. 11d. brought forward in February, 1884, amounted to

£289 19s. 11d., and the expenditure to £94 19s. 3d.; leaving a balance in hand of £195 0s. 8d. Several members who took a special interest in microscopical work had lately formed themselves into what might be called a microscopic section of the society. Those who possess microscopes, and would like to attend the meetings of the section, could do so, Mr. Maskell, who had been instrumental in inducing members to join in that work, being willing to furnish further information on the subject.

Election of Officers for 1885 :—*President*—A. K. Newman, M.B., M.R.C.P.; *Vice-presidents*—R. H. Govett, G. W. Grabham, M.D.; *Council*—T. King, W. T. L. Travers, F.L.S., F. B. Hutchinson, M.R.C.S., Martin Chapman, James Hector, M.D., Dr. Buller, C.M.G., F.R.S., Hon. G. R. Johnson; *Secretary and Treasurer*—R. B. Gore; *Auditor*—H. F. Logan.

1. "Further Notes on *Coccidæ* in New Zealand," by W. M. Maskell, F.R.M.S. (*Transactions*, p. 20.)

2. "On a Parasite of the Penguin," by W. M. Maskell. (*Transactions*, p. 19.)

3. "Description of some newly-discovered and rare Indigenous Plants; being a further contribution towards the making known the Botany of New Zealand," by W. Colenso, F.L.S. (*Transactions*, p. 237.)

4. "Australian Cave Paintings," by Dr. Curl.

5. "Description of new Tertiary Shells," part ii., by Captain F. W. Hutton, F.G.S. (*Transactions*, p. 325.)

6. "Description of a new Species of *Erigeron*," by J. Buchanan, F.L.S. (*Transactions*, p. 287.)

7. "Cat's Eye Bay," by D. Sutherland. (*Transactions*, p. 435.)

8. Dr. Buller exhibited to the meeting and made remarks upon several new birds, full descriptions of which will appear in his forthcoming new edition of "The Birds of New Zealand." The most important of these was an Australian Swift (*Cypselus pacificus*) shot by Captain Messenger at the White Cliffs, Taranaki, this being the first known instance of its occurrence in New Zealand. Another interesting novelty was a specimen of *Procelsterna albivitta*, obtained by Mr. C. H. Robson at Cape Maria van Diemen, where it had taken refuge in a flax-bush. This pretty little Tern is a native of the sea bordering the eastern and north-eastern coasts of Australia and is said to breed on Norfolk Island.

Dr. Buller also gave an account of a new species of Albatros, specimens of which in all stages of growth had been received from the Auckland Islands; and referred to some birds recently collected by Mr. Reischek in the South Island. He proposed to distinguish the large and highly-coloured Kaka as *Nestor montanus*.

8. "Note on Geological Structure of the Canterbury Mountains," by Dr. Hector. (*Transactions*, p. 337.)

AUCKLAND INSTITUTE.

First Meeting. *9th June*, 1884.

H. G. Seth Smith, President, in the chair.

New Members.—Professor Aldis, Dr. Bond, A. Kidd, W. C. W. McDowell, D. Nolan, and C. King.

1. The President delivered the anniversary address.

ABSTRACT.

After referring to the Costley bequest, and other local matters, the President shortly reviewed the Transactions of the New Zealand Institute. In the course of his remarks, he said: "I rejoice to see that a branch of science, still in its infancy, and which may even yet have a hard struggle before its claim to be regarded as a branch of science is fully recognized—I mean the science of jurisprudence—is represented by a paper on the law of gavelkind, by Mr. Coleman Phillips. It has hitherto been considered a difficult task to convince an English lawyer that there is such a thing as the science of law. It will, perhaps, long remain a still more difficult matter to satisfy the public at large that science is in any way connected with legal practice. The writings of Sir Henry Maine, however, have laid the foundation for a new method of investigation in jurisprudence—new, that is as far as jurisprudence is concerned, though the method is nothing but the application of inductive philosophy in place of the *a priori* methods which had hitherto been adopted by theoretical writers on legal subjects—*e.g.*, Bentham, etc. A systematic study of the customs of the aborigines of these islands would probably afford valuable material for further investigations in the history of law, as the labours of Sir George Grey, Mr. Colenso, and others seem to show." He then gave an account of the theories which have been offered to explain the Sunda eruption; and proceeded to make the following remarks on Technical Education:—"The purposes for which an institute of this kind exists, should aim both at the accumulation and diffusion of scientific and other knowledge. I hope, therefore, that the time is not far distant, when we shall see established in connection with this Institute, series of lectures somewhat similar to those to which Friday evenings at the Royal Institution of London are devoted during a portion of the year. We have now in Auckland a number of men competent to undertake such a task; and I, for one, should be glad to see a portion of the revenues of the Institute, which we may now hope will increase from year to year, devoted to defraying the necessary expenses of such lectures. There is another direction in which, I believe, this Institute may do valuable service. I cannot help thinking that one of the needs of this city is a school of technical education. I would commend to the consideration of all those who are interested in the matter, the scheme for the organization of the Central Institution of the City and Guilds of London Institute, which is printed in full in the number of 'Nature' of the 21st February, 1884. The object of the Central Institution is to give to London a college for the higher technical education, in which advanced instruction shall be provided in those kinds of knowledge which bear on the different branches of industry, whether manufactures or arts. Just as the Royal School of Mines gives a technical training to mining engineers, so the Central Institution is intended to afford practical, scientific, and artistic instruction, which will qualify persons to become—(1) technical teachers; (2) mechanical, civil, and electrical engineers, architects, builders, and decorative artists; (3) principals, superintendents, and managers of chemical and other manufacturing works. The details of the scheme are of course conceived on a scale, and with a view to an expenditure of funds, which exceed all practical limits for a city like Auckland; but as I believe that the key to the future prosperity of this city is to be found in the development of her manufactures, any attempt, however humble, to afford facilities for the acquisition of technical knowledge would be acceptable as tending to further local prosperity. In this direction the combined efforts of the Institute and University College, together with such private munificence as might from time to time be available, would I believe be productive of no small results." The President concluded his address as follows:—"It is not given to all of us to divert the current of human thought, or to remodel the universe. Most of us have to be content and thankful if we can, as passing travellers, add but a small pebble to the growing cairn. The great mass of human knowledge is, for the most part, made up of the minute contributions of individuals, and, while we bow in reverence before the achievements of master-minds, we cannot afford to despise the humbler labours of the majority. The truth of a great scientific theory can only be tested by the minute investigation of details, and the discovery of some fact, in itself apparently insignificant, may be fraught with issues of incalculable importance. The only attitude that we can rightly assume is that of humble seekers after truth, humble and yet fearless of results, knowing that nothing will be permanent that is not really true, and that nothing that is true can be unimportant. What the final result may be we can leave to take care of itself. We are 'toiling upward in the night,' and who shall prescribe the limits to which we may ultimately attain—for, to quote the words of Charles Kingsley: 'Science is accused of trying to scale Olympus, by those who fancy that they have already scaled it themselves, and will, of course, brook no rival in their fancied monopoly of wisdom. . . . . And yet Science may scale Olympus after all. Without intending it, almost without knowing it, she may find herself hereafter upon a summit of which she never dreamed, surveying the Universe of God in the light of Him who made it and her, and remakes them both for ever and ever. On that summit she may stand hereafter, if only she goes on, as she goes now, in humility and patience; doing the duty which lies nearest her; lured along the upward road, not by ambition, vanity, or greed, but by reverent curiosity for every new pebble, and flower, and child, and savage, around her feet.'"

2. "Notes on a Bird called Malau," by the Rev. S. W. Baker.

ABSTRACT.

The bird Malau was stated to be found only on the little island Ninafou, to the northward of Tonga. It is confined to the immediate vicinity of a deep crater-like lake. In the light soil surrounding the lake it excavates tunnels sometimes six feet in length, and in them deposits its eggs, which are sometimes as many as twenty in number. The bird does not sit upon the eggs, but leaves them to be hatched by the heat of the sun. The young birds are fully fledged when they emerge from the egg, and take care of themselves without any assistance from the parent bird.

Mr. Cheeseman stated that Mr. Baker's bird was a species of mound-builder called *Megapodius pritchardi*. A specimen was in the Museum, which was presented some years ago by Captain Rough; and a coloured drawing would be found in the "Proceedings of the Zoological Society" for 1864. (See also Dr. Buller's account of this specimen under the name of Malan. Trans. N.Z. Inst., vol. iii., p. 14.)

3. "A Decade of new *Feroniidæ*," by Captain T. Broun, M.E.S.

Second Meeting. 14*th July*, 1884.

H. G. Seth Smith, President, in the chair.

New Members.—F. H. Edgecumbe, A. G. Gover, J. B. Hobart.

1. "New Species of *Pselaphidæ*," by Captain T. Broun, M.E.S.

2. "The Curse of Charity," by E. A. Mackechnie.

The author referred to the economy of the animal kingdom, and showed that design in all the forms of the animal framework was the same in all cases. There was no real knowledge of what life is. It existed, and was sustained by a continual regulated supply of food and other conditions of growth and life, but no one knew really what it was. A slight puncture of the brain and it was gone; a stoppage of the regular pulsations of the heart and it ceased, and when once gone no power on earth could recall or restore it. He contrasted the resemblance between the lower animals and man in many respects, and showed the degree of affection that sprang up between some members of the animal kingdom and man. His remarks on this point were illustrated by reference to "Rab and his Friends," by Dr. Brown. But, while there was such a similarity between man and the lower animals with which he was associated, the lecturer held that man in his religious feelings, depth of sympathy, power of reasoning, etc., gave evidence of the existence in himself of a power or faculty which was beyond that which any of the lower animals possessed. The law of heredity was referred to, in the discussion of which he pointed out that the physical qualities were transmitted as well as the mental, and this led to his remarks on the question of charity. With Herbert Spencer, he agreed that the exercize of charity has the effect of increasing the demands upon it. There was a kind of parasitic quality in many people, and this quality was also transmitted. He compared this parasitic, or dependent, trait of character in human beings with the habits of parasitic plants. For a time little support was derived from the plants upon which the parasites were dependent, but a time came when they would depend wholly upon the supporting tree, only to be destroyed, as the rata does the kauri. He referred to free education, and held that parents should not shift their burdens in this respect upon the State. This reduced the feeling of independence, which all should cherish, and the education given was not a useful one, as there was a tendency growing up among those who were thus educated to become dependent, with a disinclination to work, and in time they might become a burden to the careful and independent citizens. He showed that in all things there was a greater amount of care bestowed upon purely ornamental than upon useful objects. The girls should be taught household work, and learn to study books upon household economy; and boys should be educated in the several trades or occupations at which they would have to earn their living. For some time past the tendency of education had been as if the world no more required the performance of manual labour. This was a mistake, and the system of education which produced such a feeling was very defective, if not mischievous. He referred to the position taken up by the unemployed, and contrasted it with the experience of the Messrs. Chambers of Edinburgh, Nasmyth the engineer, and others, who had shown a self-reliant nature. Many illustrations were given of the dependence to which some have come, and the utter moral degradation to which some come when they are long the recipients of what is called charity. The hospital management was referred to. It was found that many here were not ashamed to apply to the hospital for free medical advice who were well able to pay for such advice. He held that, though the city was but small, it had its full share of lazy loafers and sturdy beggars, and the mental tendency of these people would be transmitted to their offspring with unerring certainty. To uproot this tendency, a good deal of severity, and, in some cases, a little harshness, would be necessary. The action of the Jews was used as an illustration of the writer's argument. They were charitable, and gave freely to Jew and Gentile, but, among their own people, while they gave, they only did so that the receivers might be able to work and help themselves. They never gave to enable any one to live a life of idleness and dependence upon others so long as they were able to work. He thought our charity was misapplied and wrong when pauperism was produced by such action. He referred to the Communism of France, the Fenianism of Ireland, the Nihilism of Russia, as the portents which hung over the world, and which might break up the civilization of the present day. If the time came when the possession of property would be generally regarded as theft, then they would realize, in its true and full import, the meaning of the words "The Curse of Charity."

Mr. Pond defended the expenditure upon our educational system, and thought that so long as primary education was confined to the three R.'s there could be little harm done in our expenditure upon education. He thought there was a greater tendency to an idle life by those who received a secondary education largely at the public expense, than among those who participated in our primary education.

Dr. J. Murray Moore hoped that what Mr. Mackechnie had said would not shut up the fountains of charity. There were people in distress in Auckland. There existed here wives and families deserted by their husbands, and others who had drunken and profligate husbands who were anything but a support to those they should sustain.

3. "Observations on Geyser Eruptions and Terrace Formations," part i., by J. Martin, F.G.S.

Third Meeting. 11*th August*, 1884.

H. G. Seth Smith, President, in the chair.

New Member.—T. Steel.

1. "Description of Mayor Island, Bay of Plenty," by E. C. Gold-Smith. (*Transactions*, p. 417.)

2. "Buddhism and its Evolution Theories," part i., by J. Murray Moore, M.D.

3. "Geyser Eruptions and Terrace Formations," part ii., by J. Martin, F.G.S.

Fourth Meeting. 7*th September*, 1884.

H. G. Seth Smith, President, in the chair.

1. "New Species of *Coleoptera*," by Captain T. Broun, M.E.S.

2. "New Species of Plants," by T. F. Cheeseman, F.L.S. (*Transactions*, p. 235.)

3. Professor A. P. Thomas exhibited some specimens obtained from the Naples Zoological Station, and made some verbal remarks thereon.

4. "Buddhism and its Evolution Theories," part ii., by J. Murray Moore, M.D.

FIFTH MEETING. *29th September*, 1884.

Dr. Purchas in the Chair.

New Member.—J. Douglas.

1. "On the Botany of Te Aroha Mountain," by J. Adams, B.A. (*Transactions*, p. 275.)

Mr. Cheeseman considered that Mr. Adams' paper was an interesting contribution to our knowledge of the distribution of New Zealand plants. The discovery of such plants as *Libocedrus bidwillii*, *Phyllocladus alpinus*, *Fagus menziesii*, *Hymenophyllum pulcherrimum and H. malingii* on the summit of the mountain was quite unexpected, and proved that much remains to be done towards fixing the northern limit of the southern and montane part of our flora.

2. Professor A. P. Thomas made some verbal remarks on the principal points of interest connected with Mr. Caldwell's recent discoveries in the development of the lower mammals of Australia.

3. "A Successful Litigant," by E. A. Mackechnie.

SIXTH MEETING. *27th October*, 1884.

New Members.—T. W. Kitt, H. D. M. Haszard, D. J. McLeod, J. Ross.

1. "On the Spiders of New Zealand," by A. T. Urquhart. (*Transactions*, p .31.)

2. "Notes on the Fertilization of certain New Zealand Plants," by T. F. Cheeseman, F.L.S.

3. "On Re-naming New Zealand," by W. H. Blyth.

4. "On the Establishment of a Grand Hotel and Sanatorium in the Rotorua District," by J. Stewart, M.Inst.C.E. (*Transactions*, p. 427.)

ANNUAL MEETING. *16th February*, 1885.

T. Peacock, M.H.R., in the chair.

New Members.—C. N. Cobbett, M.D., L. M. Grace, D. Kempt, H. J. Le Bailly, H. Shaw, A. Smith, Rev. W. Tebbs, E. Withy.

ABSTRACT OF REPORT FOR 1884.

Twenty-three new members have been elected during the year. The losses have been, by death, 7; by resignation, 9; and by non-payment of subscriptions, 7; making 23 in all. The number on the register at the present time (304) is thus the same as at the commencement of the year.

The total revenue of the ordinary account has been £687 1s. 6d., of which £297 3s. consisted of members' subscriptions. The expenditure has reached the sum of £708 16s., leaving a debit balance of £21 14s. 10d.

The amount of the Costley bequest was stated to be £12,016 1s. 10d. Of this sum £7,000 had been invested in mortgage on good freehold security, £2,500 had been applied to the purchase of freehold property, and the balance was waiting suitable investment. Portions of the landed endowment of the Museum had been sold, and nearly £900 had been received from that source.

Six meetings were held during the session, at which 20 papers on various scientific and literary subjects were read.

A short sketch was given of the progress of the Museum and Library during the year, and the principal additions were briefly alluded to.

Election of Officers for 1885:—*President*—J. A. Pond; *Vice-presidents*—H. G. Seth Smith, Rt. Rev. W. G. Cowie, D.D.; *Council*—G. Aickin, Professor F. D. Brown, B.Sc., Hon. Colonel Haultain, E. A. Mackechnie, 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., T. Steel, Professor A. P. Thomas, F.L.S.; *Secretary and Treasurer*—T. F. Cheeseman, F.L.S., F.Z.S.; *Auditor*—T. Macffarlane.

PHILOSOPHICAL INSTITUTE OF CANTERBURY.

First Meeting. *6th March*, 1884.

R. W. Fereday, President, in the chair.

1. "On Earthquakes," by Professor Hutton.

Second Meeting. *3rd April*, 1884.

R. W. Fereday, President, in the chair.

New Member.—Henry Grayson.

1. "Technical Education," by D. Blair.

2. "On a System of Technical Education for Artizans," by C. W. Purnell. (*Transactions*, p. 398.)

Third Meeting. *1st May*, 1884.

R. W. Fereday, President, in the chair.

New Members.—A. Ringwood, E. McConnell.

1. "Red Sunsets," by A. Ringwood. (*Transactions*, p. 386.)

Fourth Meeting. *5th June*, 1884.

R. W. Fereday, President, in the chair.

1. "The Diamond Fields of South Africa," by Professor F. W. Hutton.

2. "The Fresh-water Shells of New Zealand belonging to the family *Limnæidæ*," by Professor F. W. Hutton. (*Transactions*, p. 54.)

Fifth Meeting. *3rd July*, 1884.

H. R. Webb in the chair.

1. "Is Life a Distinct Force?" by R. H. Bakewell, M.D., Fellow of the Royal Medical and Chirurgical Society of London, etc. (*Transactions*, p. 410.)

Sixth Meeting. *7th August*, 1884.

R. W. Fereday, President, in the chair.

1. "The exceptional Advantage of New Zealand for Sericiculture," by G. B. Federli.

2. "Supplement to a Monograph of the New Zealand *Geometrina*," by E. Meyrick, B.A. (*Transactions*, p. 62.)

3. "Descriptions of New Zealand *Micro-lepidoptera*, (part iv., *Scopariadæ*)," by E. Meyrick, B.A. (*Transactions*, p, 68.)

SEVENTH MEETING. *4th September*, 1884.

R. W. Fereday, President, in the chair.

1. "In Memoriam—Ferdinand Ritter von Hochstetter," by Professor Julius von Haast, C.M.G., Ph.D., F.R.S.

EIGHTH MEETING. *2nd October*, 1884.

Professor F. W. Hutton, Vice-president, in the chair.

New Member.—Dr. Preston.

2. Professor Julius von Haast exhibited a Geological Map of the Canõn District of the Colorado by the United States Geological Survey, and made remarks thereon.

2. "Descriptions of New Zealand *Micro-lepidoptera*, (part vi., *Pyralidina*)," by E. Meyrick, B.A. (*Transactions*, p. 121.)

3. "Descriptions of New Zealand *Micro-lepidoptera*, (part vii., *Tortricina*—supplementary)," by E. Meyrick, B.A. (*Transactions*, p. 141.)

SPECIAL MEETING. *2nd October*, 1884.

Professor F. W. Hutton, Vice-president, in the chair.

1. On the motion of Professor Julius von Haast, seconded by Mr H. R. Webb, it was decided "That Law xv. be altered by substituting the word 'May' for 'March.'" This will have the effect of shortening the session by two months.

2. Certain recommendations from the Otago Institute *re* the New Zealand Institute were then considered, and after considerable discussion were agreed to in the following form:—

(1.) That it is desirable, in the interests of scientifie work generally in New Zealand, that the New Zealand Institute, consisting of the Affiliated Societies only, be separated from the Government Departments, and be reconstructed on the basis laid down in the following recommendations.

(2.) That the management be in the hands of a Board of Governors, constituted as follows:—One Governor to be elected by each of the Affiliated Societies; the full number of Governors (say 15) to be made up by nomination by the Governor-in-Council.

(3.) A meeting of the Board to be held during the last full week in January in each year.

(4.) The income of the New Zealand Institute to consist of the annual Parliamentary Vote, together with contributions from the Affiliated Societies; such contributions to be fixed annually by the Board of Governors, and not to exceed five shillings (5s.) annually per member.

(5.) That a responsible editor of the "Transactions" be appointed by the Board of Governors, a suitable remuneration for his services being provided out of the funds of the Institute.

Annual Meeting. *6th November*, 1884.

R. W. Fereday, President, in the chair.

Abstract of Annual Report.

One special and nine ordinary meetings have been held. At the ordinary meetings fifteen papers have been read; these papers were contributed by nine authors, and comprise six on Zoology, and two on Geology, while the rest have been on miscellaneous subjects of more immediate practical interest.

A large number of books, including a complete set of the publications of the Ray Society, have been added to the Library of the Institute by purchase, and several valuable donations have been received.

Five new members have joined during the year, but several have left, so that the total number of members now on the list is 149.

Mr. W. M. Maskell has been chosen to vote at the election of the Board of Governors of the New Zealand Institute.

The balance-sheet shows that the total receipts for the year, including balance of £47 15s 4d, amount to £161 7s. 10d.; expenditure, £148 1s 3d.; balance (on current account), £13 6s 7d; balance in Savings Bank (life subscriptions), £33 12s 7d.

Election of Officers for 1885:—*President*—Dr. W. H. Symes; *Vice-presidents*—A. D. Dobson and T. Crook; *Honorary Treasurer*—H. R. Webb; *Honorary Secretary*—C. Chilton; *Auditor*—C. R. Blakiston; *Council*—Professors Haast, Hutton, and Bickerton, Messrs. E. Dobson, G. Hogben, and R. W. Fereday.

1. The retiring President then gave a short address.

2. Professor F. W. Hutton, Vice-president, then delivered an address "On the Origin of the Fauna and Flora of New Zealand," part ii.

Additional Meeting. *27th November*, 1884.

Dr. W. H. Symes, President, in the chair.

1. "On the Age of the Orakei Bay Beds near Auckland," by Professor F. W. Hutton, F.G.S. (*Transactions*, p. 307.)

2. "Description of new Tertiary Shells," part i., by Professor Hutton. (*Transactions*, p, 313.)

3. "Analysis of Slate in contact with Granite, from Preservation Inlet, New Zealand," by A. Liversidge, F.R.S., Professor of Chemistry and Mineralogy, University of Sydney; communicated by Professor Hutton. (*Transactions*, p. 340.)

4. "On the Geological Structure of the Southern Alps of New Zealand, in the Provincial Districts of Canterbury and Westland," by Professor Julius von Haast, C.M.G., Ph.D., F.R.S. (*Transactions*, p. 332.)

OTAGO INSTITUTE.

First Meeting. 13*th May*, 1884.

D. Petrie, M.A., President, in the chair.

New Members.—Dr. D. Colquhoun, Walter Prince, and Geo. H. Moore.

The meeting took the form of a conversazione.

Second Meeting. 10*th June*, 1884.

A. Montgomery, Vice-president, in the chair.

New Members.—Miss Dalrymple, R. E. N. Twopeny.

1. "Notes on Moa Remains in the Mackenzie Country and other Localities," by Frederick Chapman. (*Transactions*, p. 172.)

2. The Secretary exhibited and remarked upon some water-colour drawings of microscopic and perishable invertebrates, which he had just received for the Museum.

Third Meeting. 5*th August*, 1884.

D. Petrie, M.A., President, in the chair.

New Member.—Major-General Fulton.

1. "On the New Zealand Institute, its Relation to the Affiliated Societies and to Scientific Work in New Zealand generally," by G. M. Thomson.

The following recommendations were adopted:—1. That it is desirable, in the interests of scientific work generally in New Zealand, that the New Zealand Institute as at present existing be subdivided into two portions—the following departments, under the care of the present manager, viz.: the Colonial Museum, Geological Survey, the Libraries, Meteorological Stations, Observatory, Laboratory, and the publications belonging respectively to these bodies, being formed into a separate Government department; while the New Zealand Institute proper, consisting of the affiliated societies only, be reconstituted on the basis laid down in the following recommendations. 2. That the management be in the hands of a Board of Governors constituted as follows:—One governor to be elected by each of the affiliated societies, the full number of governors (say 15) to be made up by nomination. 3. A meeting of the Board to be held during the last full week in January in each year. 4. The income of the New Zealand Institute to consist of the annual Parliamentary vote, together with contributions from the affiliated societies; such contributions to be fixed annually by the Board of Governors, and not to exceed one-fourth of the annual subscriptions of members. 5. That a responsible editor of the "Transactions" be appointed by the governors, a suitable remuneration for his services being provided out of the funds of the Institute. 6. That the selection of papers for publication in the "Transactions" be made in the first instance by the Councils of the affiliated societies, the final decision in each case to rest with the Board of Governors.

It was resolved to send copies of these recommendations to the various Affiliated Societies, inviting their consideration of the proposed changes, and their co-operation in carrying out the objects desired; attention being drawn to the fact that certain of the recommendations can be carried out without affecting "The New Zealand Institute Act, 1867," while others will involve the amendment of that Act.

Fourth Meeting. 12*th August*, 1884.

D. Petrie, M.A., President, in the Chair.

1. The Secretary gave a verbal account of a paper by Mr. Alex. Purdie, M.A., "On the Anatomy of the Sea Mussel (*Mytilus latus*)."

2. "Description of three new Species of *Uncinia*," by D. Petrie, M.A. (*Transactions*, p. 271.)

3. "Description of a new Species of *Carmichælia*, with Notes on the Distribution of the Species native to Otago," by D. Petrie. (*Transactions*, p. 272.)

4. The Secretary exhibited and made remarks upon—*a*. Some stuffed fishes (glycerine process), and skeletons of Skate and Torpedo (glycerine jelly process). *b*. Embryos of *Sepiola* sp., found in Dunedin Harbour by F. Bourne, one of the Museum assistants. Hitherto this genus has only been recorded in the colony at Wellington (*S. pacifica*, T. W. Kirk). *c*. A living specimen of the Laughing Owl (*Sceloglaux albifacies*), obtained at Outram by Mr. Sydney Fulton.

Fifth Meeting. 9*th September*, 1884.

A. Montgomery, Vice-president, in the chair.

Dr. Hocken delivered his third lecture on "The Early History of New Zealand."

Sixth Meeting. 14*th October*, 1884.

D. Petrie, M.A., President, in the chair.

1. "Notes on New Zealand Fishes," by W. Arthur, C.E. (*Transactions*, p. 160.)

2. "Notes on the Skeleton and Baleen of a Fin-whale (*Balænoptera musculus?*) recently acquired by the Otago University Museum," by T. Jeffery Parker, B.Sc.Lond., Professor of Biology in the University of Otago. (*Transactions*, p. 3.)

3. The Secretary exhibited a stuffed specimen of *Kathetostoma giganteum*, recently prepared for the Museum.

Annual Meeting. 11*th November*, 1884.

D. Petrie, M.A., President, in the chair.

New Members.—A. D. Bell, James H. Wood.

1. "On some Mineral Occurrences in Dusky Sound," by Professor Ulrich.

2. "Description of new Species of Native Plants," by D. Petrie. (*Transactions*, p. 269.)

3. The Secretary remarked upon some recent additions to the Museum, including the skeleton of a Fin-whale (*Balænoptera musculus?*),* and stuffed specimens of Sea-lions (*Otaria hookeri?*), including adult and young male and adult female, from the Auckland Islands.

Abstract of Annual Report.

During the present session seven general meetings have been held, including the present annual meeting. At three of these meetings eight original papers have been read, three on botanical, four on zoological, and one on mineralogical subjects.

The first meeting of the session took the form of a conversazione. At another a discussion was held on "The New Zealand Institute, its relation to the affiliated societies, and to scientific work in New Zealand generally"; at another Dr. Hocken gave his third lecture on "The Early History of New Zealand."

In addition to these meetings, three courses of popular lectures have been given: one of three lectures on "The Physiology of the Senses," by Professor Scott, M.D., in June; one of three lectures on "The Psychology of the Senses," by Professor Macgregor, M.A., in July; and a third also of three lectures on "Botanical Evolution," by Mr. G. M. Thomson, F.L.S., in September.

Eight new members have joined the Institute during the session, making the total number on the roll 170.

The receipts of the session, including a balance from last year of 7s. 7d., amount to £188 12s.: the total expenditure has been £91 11s. 4d., leaving a balance in hand of £97 8s. 3d. The Reserve Fund in the Post Office Savings Bank is now £192 2s. 2d.

Election of Officers for 1885:—*President*—Professor Scott, M.D.; *Vice-presidents*—Donald Petrie, M.A., and F. R. Chapman; *Honorary Secretary*—Professor Parker; *Honorary Treasurer*—J. C. Thomson; *Council*—R. Gillies, M.H.R., W. Arthur, C.E., Professor Mainwaring Brown, M.A., P. Goyen, J. R. Wilkinson, M.A., G. M. Thomson, F.L.S., and Dr. Hocken.

3. The retiring President delivered an address on "Some Scientific Duties of the Government."

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* See above, art. i., p. 3.

WESTLAND INSTITUTE.

Abstract of Eighteenth Annual Report.

The number of members on the roll is 110. During the year there have been twelve ordinary and two special meetings of the Institute. The revenue for the year, including a balance from last account and various subsidies, has been £318 13s. 2d., and the expenditure, chiefly on additions to the Library and Reading-room, was £251 7s. 8d.

The Committee had received a letter from the Otago Institute recommending the severance of the affiliated Societies from the New Zealand Institute. The Committee replied that they were perfectly satisfied with the present arrangements, but that, if it could be shown that the interests of science would be furthered by such a change as that proposed, they would at a future meeting be willing to consider the matter.

HAWKE'S BAY PHILOSOPHICAL INSTITUTE.

Annual Meeting. *4th February*, 1884.

The Right Rev. the Bishop of Waiapu, President, in the chair.

Election of Officers for 1884:—*President*—The Right Rev. the Bishop of Waiapu; *Vice-president*—Dr. Spencer; *Hon. Treasurer*—J. N. Bowerman; *Hon. Secretary*—A. Hamilton; *Council*—H. Hill, C. H. Weber, J. Kirker, S. Locke, T. K. Newton, F. W. C. Sturm; *Auditor*—T. K. Newton.

Mr. Colenso having resigned the offices of Hon. Secretary and Treasurer, at the suggestion of the President it was resolved, "That this meeting cannot accept the resignation of their Hon. Secretary, the Rev. W. Colenso, without putting on record their high appreciation of his invaluable services to the Institute from its beginning, and their great regret that he feels unable longer to fill the office of Hon. Secretary, though they have no doubt that he will continue to give the Institute the advantage of his zealous services as member."

First Meeting. *12th May*, 1884.

Dr. Spencer, Vice-president, in the chair.

New Members.—R. T. Walker, L. Ziegel.

1. The Vice-president made a few remarks on the opening of another session, and delivered a short and interesting address on the late volcanic disturbances in the Straits of Sunda.

2. "On the Birds of the Petane District, Hawke's Bay," by A. Hamilton.

Mr. Hamilton exhibited a large number of osteological specimens illustrating the principal peculiarities of structure in New Zealand birds.

3. Mr. Gilberd of Taradale, brought to the meeting a nice specimen of the ripe fruit of the seedless variety of Japanese Persimmon, grown at Taradale from one of the trees imported by the Hawke's Bay Acclimatization Society three years ago.

Second Meeting. *9th June*, 1884.

Dr. Spencer, Vice-president, in the chair.

1. "On the Vegetating Caterpillar of New Zealand," by A. Hamilton.

2. Mr. Hamilton exhibited a number of specimens from Te Haroto. A large number of fossils and mineralogical specimens from Mr. John Stewart of Takapau. Also two sheets of a very beautiful crested variety of *Polypodium pustulatum*, which were found by him near Petane. Mr. Hamilton also exhibited some specimens forming part of an old herbarium, many of which had been gathered more than 100 years. He also exhibited

fragments of moa bone, and the greater part of a moa's egg which he had found, together with the femur of a *Notornis* in a tertiary deposit on an island at the mouth of the Petane River.

THIRD MEETING. *14th July*, 1884.

The Right Rev. the Bishop of Waiapu, President, in the chair.

New Members.—A. V. Macdonald, C.E., G. P. Donnelly, Rev. G. Penty, Miss M. Evers, John Harding of Mount Vernon, A. B. Thompson, E. Wake, F. Fulton, J. Holt, and Rev. A. S. Webb, M.A.

1. "Observations on some Hybrid Ducks," by Taylor White of Glengarry.

The author gave details of the plumage of several broods of ducks, a cross between *A. superciliosa* and *A. boschas.*

2. Mr. H. Hill exhibited a fine *Tellurium*, and drew attention to the variety of physical phenomena which could be illustrated.

3. The Hon. Secretary exhibited and made a few remarks on some specimens of an ore of manganese, obtained by him near Waimarama.

A number of moa bones from Raukawa and Mahunga were exhibited by the Hon. Secretary.

A collection of beautiful corals from Port Darwin was sent for the inspection of members by Mrs. Grimwood, of Hastings.

It was announced that Dr. Forrester Matthews had presented the Society with a valuable entomological cabinet.

FOURTH MEETING. *11th August*, 1884.

Dr. Spencer, Vice-president, in the chair.

New Member.—G. Ormond.

1. "A Plea for National Education," by H. Hill, B.A., Inspector of Schools.

2. The Hon. Secretary drew the attention of the meeting to a number of rare birds sent for exhibition by Mr. H. Baker, of Waipawa. Two of these were Kakas (*M. meridionalis*), one a red variety, the other nearly a pure albino.

A living specimen of the Kea was examined with much interest.

A stuffed specimen of a pied variety of the Black Stilt Plover (*H. novæ-zealandiæ*), obtained by Mr. Hamilton at Petane, was on the table.

3. Mr. Hamilton then exhibited a collection of Echinoderms from Hawke's Bay, and gave a short description of their peculiarities.

FIFTH MEETING. *8th September*, 1884.

The Right Rev. the Bishop of Waiapu, President, in the chair.

1. "On a Species of Cuttlefish (*Ommastrephes sloanii*)," by A. Hamilton.

This fish was taken in the bay; the author exhibited a life-size coloured drawing of the specimen, and included in his remarks a variety of interesting information on the economic value of Cephalopods in various parts of the world.

SIXTH MEETING. 11*th October*, 1884.

Dr. Spencer, Vice-president, in the chair.

New Members.—J. Hindmarsh of Rakaumoana, and J. Large.

1. "On the Effect of the Scientific Societies of New Zealand on the Character of the Nation," by A. Hamilton.

2. A fine specimen of sponge sent by Mr. Harding, of Castlepoint, and prepared in the usual manner, proved to be of a marketable kind, though of low value.

3. Dr. Forrester Matthews presented to the Museum of the Society a specimen of the "Vegetable Sheep," (*Raoulia*), from the Nelson mountains.

ANNUAL MEETING. 2*nd February*, 1885.

The Right Rev. the Bishop of Waiapu, President, in the chair.

ABSTRACT OF ANNUAL REPORT.

Four papers were read before the Institute at its ordinary meetings and three addresses were delivered.

Thanks were accorded to those members who had contributed specimens for exhibition at the meetings.

During the past year twelve meetings of the Council were held for the transaction of the business of the Society and six ordinary meetings were held. There were 11 resignations received during the past session and 25 members joined the Society, thus making a total of 121 members on the roll.

The Council have made arrangements for obtaining a much larger room than at present. It is intended to use the largest part of the room as a local museum.

The accounts show a balance of £28 4s. 8d. remaining to the credit of the Institute, in addition to £150 fixed deposit in the bank.

ELECTION OF OFFICERS FOR 1885 :—*President*—W. Colenso, F.L.S. ; *Vice-president*—Thomas Tanner ; *Council*—W. J. Spencer, S. Locke, F. W. C. Sturm, H. Hill, N. Heath, H. S. Tiffin ; *Honorary Seeretary*—A. Hamilton ; *Honorary Treasurer*—J. N. Bowerman ; *Auditor*—T. K. Newton ; *Curator of Museum*—A. Hamilton.

SOUTHLAND INSTITUTE.

First Meeting. *13th May*, 1884.

T. Denniston, Vice-president, in the chair.

New Members.—Dr. Young, John Kingsland.

Owing to the ill-health of the President, Mr. J. T. Thomson, the opening address was given by the Vice-president.

1. "Notes on the Occurrence and Habits of some of our New Zealand Plants," by W. S. Hamilton. (*Transactions*, p. 290.)

Second Meeting. *10th June*, 1884.

T. Denniston, Vice-president, in the chair.

New Members.—Dr. Whitton, Dr. Hocter, Dr. Macpherson, C. Bastion, sen., T. L. Wood, J. Kingsland, P. F. Daniel.

1. "On Development," by Dr. Galbraith.

Third Meeting. *8th July*, 1884.

Mr. Webber in the chair.

New Members.—John McPherson, William Young.

1. "On the Records of an Old English Borough," by the Rev. H. Stocker.

2. "On the Lignine Origin of the Quartz-pebble Beds of Southland," by W. S. Hamilton.

Fourth Meeting. *12th August*, 1884.

T. Denniston, Vice-president, in the chair.

1. "On the Settlement of the People on the Lands," by Mr. Morgan.

Fifth Meeting. *9th September*. 1884.

T. Denniston, Vice-president, in the chair.

1. "On the Senses and the Intellect," by Dr. Closs.

Sixth Meeting. *7th October*, 1884.

T. Denniston, Vice-president, in the chair.

1. "On Gravitational Experiments," by T. Wakelin. (*Transactio*ⁿ p. 407.)

2. "Alcohol," by Dr. Macpherson.
3. "Chemistry of Explosives," by P. F. Daniel.

SEVENTH MEETING (SPECIAL). *9th December*, 1884.

T. Denniston, Vice-president, in the chair.

1. "On the Flowering Plants of Stewart Island," by T. Kirk, F.L.S. (*Transactions*, p. 213.)

ABSTRACT OF ANNUAL REPORT.

During the year 11 new members have been elected. Seven meetings have been held, at which several papers were read. At a special meeting held on 9th December, it was resolved to reduce the annual subscription to half a guinea. The number of members on the roll is now 69. The receipts, including a balance carried forward, were £99 8s. 8d., and the expenditure £42 0s 3d.

ELECTION OF OFFICERS FOR 1885.—*President*—T. Denniston; *Vice-president*—Dr. Galbraith; *Council*—G. Bailey, Dr. Closs, Dr. Wardale, W. Mchaffey; *Secretary*—W. S. Hamilton; *Treasurer*—W. R. Robertson.

NELSON PHILOSOPHICAL SOCIETY.

First Meeting. *7th April*, 1884.

New Members.—Dr. Leggatt, Charles Green, Hugh Martin.

1. "The History of the English Alphabet," by the Rev. St. Clair Tisdale.

2. Dr. Boor exhibited some specimens of the Mason Bee found at Belgrove.

Second Meeting. *5th May*, 1884.

New Members.—D. Winton, F. H. Blundell, A. Greenfield, W. C. Ancell, J. Snodgrass, W. J. Glasgow, E. W. Honeywill, — Littlejohn, Captain Webb, Rev. J. Russell, Henry Cock, E. H. Deck, Mrs. Macartney.

1. "The Ascent of Mount Franklin," by W. S. Curtis.

Third Meeting. *2nd June*, 1884.

New Member.—Hamilton.

1. "Some Observations on the *Protozoa*," by J. Gully, jun.

2. "Objections to the Introduction of Beasts of Prey to destroy the Rabbit," by H. B. Martin. (*Transactions*, p. 179.)

3. Mr. J. Holloway exhibited and described a working Microscope manufactured by Field, of Birmingham.

Fourth Meeting. *7th July*, 1884.

New Member.—Miss Edgar.

1. "Agricultural Chemistry," by T. Hackett.

2. "On the Protection of Native Birds," by Hugh Martin.

3. The following resolution was passed:—"That, in the opinion of this Society, lists of native birds that are now protected by law should be printed, and that the Education Board be requested to give facilities for making them known to boys attending the public schools."

Fifth Meeting. *18th August*, 1884.

The Bishop of Nelson, President, in the chair.

1. "Nelson, A.D. 2000," by the Rev. Dr. Taylor.

SIXTH MEETING. *1st September*, 1884.

The Bishop of Nelson, President, in the chair.

1. "On the recent Sun-glows and the Theories that have been advanced to account for them," by John Meeson, B.A. (*Transactions*, p. 357.)

ANNUAL MEETING. *21st October*, 1884.

The Bishop of Nelson, President, in the chair.

New Members.—Henry Dodson, Gustave Dillberg.

Annual Address by the President.

ABSTRACT OF ANNUAL REPORT.

The Secretary's report showed that during the year 11 ordinary and 23 Council meetings had been held, and that 15 original papers had been read before the Society; and that the total number of members stood at 100. The Treasurer's report showed that the income of the Society for the year amounted to £95 0s. 6d., the expenditure having been £51 19s. 3d., leaving a balance of £48 1s. 3d.

ELECTION OF OFFICERS FOR 1884–85:—*President*—The Bishop of Nelson; *Vice-presidents*—A. S. Atkinson, Dr. L. Boor; *Secretary*—Dr. J. Hudson; *Treasurer*—J. Gully, jun.; *Council*—J. Meeson, B.A., J. Park, J. G. Holloway, J. Blackett, A. Greenfield.

ORDINARY MEETING. *4th November*, 1884.

The Bishop of Nelson, President, in the chair.

New Members.—A. W. Bain, F. A. Thompson, A. Richmond, T. Field, jun., H. Field, Rev. H. J. Lewis.

1. A communication from the Otago Institute was considered, and it was resolved, "That this branch of the New Zealand Institute (to wit the Philosophical Society of Nelson) having considered the proposal from Otago to alter the constitution of the Institute, does not desire at present to join in the movement.

2. "A short Description of a few Experiments bearing on the question of Spontaneous Generation," by Dr. J. Hudson. (*Transactions*, p. 182.)

3. The Secretary called attention to the great number of rats that were at present infesting the district.

COUNCIL MEETING. *11th November*, 1884.

The Bishop of Nelson, President, in the chair.

1. The Hon. J. C. Richmond, M.L.C., was nominated to vote at the election of a Governor of the New Zealand Institute.

2. The Rev. W. H. Dallinger was nominated for election as an honorary member.

ORDINARY MEETING. *6th December*, 1884.

A. S. Atkinson, Vice-president, in the chair.

New Member.—W. Bethwaite.

1. "The Plague of Rats in Nelson and Marlborough," by John Meeson, B.A. (*Transactions*, p. 199.)

ADJOURNED MEETING. *15th December*, 1884.

The Bishop of Nelson, President, in the chair.

New Member.—G. W. Lightband.

1. "Sanitary Law and its Influence on the Health and Well-being of the Community," by W. Wells.

ORDINARY MEETING. *2nd March*, 1884.

Dr. Boor, Vice-president, in the chair.

New Members.— Dr. Coleman, George Gillon, Robert Kingsley, Israel Johns.

1. "The Protection of Native Birds," by Hugh Martin.

ABSTRACT.

The author advocated certain islands around the coast of New Zealand being stocked with native birds and closely preserved.

APPENDIX

Meteorology.

Comparative Abstract for 1884 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	30·094	1·380	57·5	11·6	40·5	149·0	27·0	·341	71	38·070	203	—	—	6·2
Previous 20 years	29·958	—	59·3	—	—	—	—	·401	75	43·753	189	—	—	—
Wellington	29·905	1·551	53·6	12·3	47·0	145·0	29·0	·319	77	62·335	168	190	630— 7 Nov.	4·5
Previous 20 years	29·919	—	54·8	—	—	—	—	·337	72	51·994	158	—	—	—
Dunedin	30·045	1·547	49·6	13·6	54·0	148·0	26·0	·269	75	33·881	180	115	650—31 July	6·1
Previous 20 years	29·855	—	50·4	—	—	—	—	·279	74	35·209	163	—	—	—

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.	
	1883.	1884.	1883.	1884.	1883.	1884.	1883.	1884.
Auckland	56·2	56·4	67·0	62·3	61·3	58·7	52·2	52·6
Wellington	52·1	52·6	62·5	58·8	56·5	54·3	48·6	48·8
Dunedin	48·6	49·4	57·7	54·7	51·3	50·3	44·9	43·7

NOTES ON THE WEATHER DURING 1884.

January.—Squally wet weather generally with heavy rain, especially during middle of month; wind S.W.; temperature below average. Earthquake reported on 30th at Wellington, at 1 a.m., slight.

February.—On the whole fine weather prevailed, with moderate wind and small rainfall, except in south; temperature below average. Slight earthquake reported in north on 1st, after midnight. Meteors seen on 22nd and 23rd.

March.—Fine weather, with moderate rainfall and winds; temperature below average. Earthquake in north on 19th, at 4.30 p.m., slight.

April.—Fine weather during this period, rainfall below average, temperature less than average and high pressure. Earthquakes at Wellington on 11th, 6.49 p.m., sharp; 16th, 6.28 a.m., smart; 25th, 11.55 a.m., slight: at Lincoln on 11th, at 6.50 p.m.

May.—Excess of rain generally; temperature below average; continued high pressure at times; strong winds. Earthquakes at Wellington on 1st, 8.40 p.m., slight; 8th, at 8.30 p.m., very slight.

June.—Rainfall less than average during this month; temperature about average; generally fine weather. Earthquakes at Wellington on 5th, at 3 a.m., slight, and at 12.10 p.m., slight.

July.—Rather unpleasant weather, showery and changeable, though rain below average.

August.—Showery squally weather generally during this period; temperature rather above the average.

September.—Generally fair weather for the time of year, average temperature, rain rather in excess. Meteor observed at Wellington on 9th.

October.—Rainfall generally in excess of average, and on the whole showery, squally, unpleasant month.

November.—Rainfall about average, temperature under the average, weather on the whole unsettled.

December.—A very wet month, rainfall at all stations in excess of average; temperature below average; squally weather.

EARTHQUAKES reported in NEW ZEALAND during 1884.

Place.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
Woodville ..	..	..	..	..	..	..	..	..	..	..	..	31*	1
Palm'ston N.	..	..	..	..	..	..	..	..	..	..	..	31*	1
Hawera ..	..	..	..	11*	..	..	..	..	..	..	..	..	1
Greytown ..	..	..	..	..	..	5*	..	..	..	..	..	..	1
Napier ..	..	..	..	..	..	..	..	..	24	..	..	..	1
Taupo ..	7*	..	19*20*21*	..	..	..	..	..	..	..	..	..	4
Gisborne ..	..	8	..	..	..	..	..	..	..	..	..	..	1
Feilding ..	..	..	..	11*	..	..	..	..	..	..	..	..	1
Patea ..	..	..	..	11*	..	..	..	..	..	..	..	..	1
Masterton ..	..	..	..	11*	..	..	..	..	..	..	..	..	1
Wanganui	7*	..	..	..	..	..	..	..	..	6*	..	..	2
Wellington	30	6	..	11*16*25	1, 8	5	..	..	22	..	..	31	10
Blenheim ..	..	..	..	11,*16,25	..	2	..	..	..	..	..	..	4
Kaikoura ..	..	..	..	..	..	..	..	..	..	8*	..	24	2
Nelson ..	..	..	..	11*	..	..	..	..	..	..	..	..	1
Christch'rch	19	2	..	11*	..	..	..	..	..	8,* 10*	..	..	5
Lincoln ..	..	..	..	11*	..	..	..	..	..	..	..	..	1
Westport ..	..	..	..	11*	..	..	..	..	..	..	..	..	1
Greymouth	..	..	..	11*	..	..	31*	..	..	..	..	..	2
Lyall ..	..	..	..	11*	..	..	..	..	..	..	..	..	1
Invercargill	..	..	..	..	..	..	..	20*	..	..	..	..	1
Bluff ..	..	..	..	..	..	..	..	20*	..	..	..	..	1

The figures denote the days 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.

NEW ZEALAND INSTITUTE.

HONORARY MEMBERS.

1870.

Drury, Rear-Admiral Byron, R.N.
Finsch, Otto, Ph.D., of Bremen
Flower, W. H., F.R.S., F.R.C.S.
Hooker, Sir J. D., K.C.S.I., C.B., M.D., F.R.S.
Müeller, Baron Sir Ferdinand von, K.C.M.G., M.D., F.R.S.
Owen, Sir Richard, K.C.B., D.C.L., F.R.S.
Richards, Vice-Admiral Sir G. H., C.B., F.R.S.

1872.

Grey, Sir George, K.C.B., D.C.L.
Huxley, Thomas H., LL.D., F.R.S.
Stokes, Vice-Admiral J. L.

1873.

Bowen, Sir Geo. Ferguson, G.C.M.G.
Cambridge, The Rev. O. Pickard, M.A., C.M.Z.S.
Günther, A., M.D., M.A., Ph.D., F.R.S.

1874.

McLachlan, Robert, F.L.S.
Newton, Alfred, F.R.S.

1875.

Sclater, Philip Lutley, M.A., Ph.D., F.R.S.

1876.

Etheridge, Prof. Robert, F.R.S.
Berggren, Dr. S.

1877.

Weld, Sir Frederick A., K.C.M.G.
Baird, Prof. Spencer F.
Sharp, Dr. D.

1878.

Müller, Prof. Max, F.R.S.
Tenison-Woods, Rev. J. E., F.L.S.

1880.

The Most Noble the Marquis of Normanby, G.C.M.G.

1883.

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