PAPERS AND PROCEEDINGS

OF THE

ROYAL SOCIETY

OF

TASMANIA,

FOR

1887.

TASMANIA:

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ROYAL SOCIETY.

APRIL, 1887.

The opening meeting of the Royal Society for the Session 1887 took place on April 19th, when His Excellency Sir Robert G. Crookshank Hamilton, K.C.B., took the chair, as President, at 7·30. There was a large attendance, over 60 Fellows being present, and several visitors. Among the Fellows present were the Bishop of Tasmania, Sir Lambert Dobson, the Hons. P. O. Fysh, A. I. Clark, and Alfred Dobson. His Excellency, who was accompanied by Lady Hamilton, and Mr. H. W. B. Robinson, the private secretary, was met at the outer door by the council, and Lady Hamilton was conducted to her seat by the Hon. J. W. Agnew, the hon. secretary.

His EXCELLENCY said : Gentlemen, it has given me great pleasure to be present to-night at the opening of the Session of the Royal Society of Tasmania. Among the many surprises I have experienced since I came here, I do not know of any more striking or pleasant to me than to find a society of this sort in such full operation and vigour—a society devoted to the progress of science, and investigations of a physical character throughout the island. I have been looking at the volumes of your papers and proceedings which show how extremely wide has been the area of operations and investigations of the Society, including such diverse subjects as the occultation of Jupiter and the drainge of Hobart. It often seems to me that the public generally do not quite know how much they owe to societies of this kind. The investigation of science not only adds to the stock of general knowledge, and in that way adds to the stock of human happiness ; but both directly and indirectly it leads to opening up new industries, to the advancement and development of existing ones, and also tends to add very much to the comfort of existence and to the extension of the duration of that existence. It is not given to all of us to take part in this investigation, but we all benefit by them, and I think it is very important that every one should show their sympathy, and by their material aid, if necessary, sympathise with such societies as this. Both from an educational and a practical point of view, it is very desirable that the operations of this Society should be encouraged and extended. There is one thing more I should like to say. I had heard, and was pleased to hear it, that ladies sometimes attended your meetings, but I find that this evening there is no other lady present except Lady Hamilton. (Cheers.) There are some subjects upon which, I think, it is very important that the interest of women should be aroused. Everything that tends to the health of the community and subjects connected with sanitation are matters of the greatest importance, in which it is desirable that women should be interested. I will not now detain you any longer, but will ask you to proceed with the first business, which is the election of new members. (Applause.)

The following gentlemen were declared elected as Fellows of the Society :—Revs. Canon Geo. Fred. Archer, A. Martin, P. E. Raynor, Warden of Christ's College; Colonel Cruickshank, R.E., Messrs. W. Sleeman, C.E., Edward David Dobbie, Solicitor-General, George Wilson Waterhouse, B.A., barrister-at-law, C. J. Parkinson, M.D., House-Surgeon Hobart Hospital, and Wm. Benson.

List of additions to the library during the months of January, February, and March :—

American Agriculturist. (Cur. Nos.)

Annals and Magazines of Natural History. (Cur. Nos.)

Anuario del Observatorio Astronómico Nacional de Tacubaya Mexico. —From the Department.

Anzeizer der Kaiserlichen Akademie der Wissenschaften. Nos. 24 to 28, 1885; Nos. 1 to 21, 1886.—From the Society.

Bollettino della Societá Geografica Italiana, Anno XX., Fasc. 11, 12; Anno XXI., Fasc. 1.—From the Society.

Bolletino dei Musef di Zoologia ed Anatomia comparata, della Royal Universita di Torino. Vol. 1, 1886. Nos. 1—18.—From the Society.

Bulletin du Musée Royal D'Historie Naturelle de Belgique, tome IV., No 4.—From the Society.

Bulletin of the Museum of Comparative Zoology at Harvard College, Vol. XIII., No. 1. Reports on the results of dredging under the supervision of Alexander Agassiz in the Gulf of Mexico, 1877-8, XXX. Report on the Holothuridæ, by H. Jalmar Thiel.—From Agassiz.

Bulletin of the Brookville Society of Natural History, No. 2.—From the Society.

Catalogue of the remains of Siwalik vertebrata contained in the Geological Department of the Indian Museum, Calcutta, parts 1 and 2. Mammalia catalogue of the remains of pleistocene and prehistoric vertebrata contained in the Geological Department of the Indian Museum, Calcutta, by R. Lydekker, B.A.—From the Department.

Description of some new species of South Australian marine and fresh water mollusca, also a revision of the recent Lamellibranch and Palliobranch Mollusca of South Australia. Diagnosis of a new species of Caladenia, by Professor Tate.—From the Author.

Descriptive list of Australian aboriginal weapons, implements, etc., from the Darling and Lachlan Rivers in the Australian Museum.—From the Trustees.

Den Norske Nordhavs—Expedition, 1876-8. "Zoologi." Mollusca II.—From the Department.

Geological Magazine, (Cur. Nos).

Hourly Readings, Meteorological office, London. — From the Department.

Journal of the Royal Microscopical Society, Part 1, February 1887.—From the Society.

Journal of the Society of Arts. (Cur. Nos.)

Lamellibranchs of the older Tertiary of Australia, Part II, by Professor Tate.—From the Author.

Memoires de la Societe Royale des Sciences de Liege, Tome XIII, Brussels.—From the Society.

Memoirs of the Literature College, Imperial University of Japan, No. 1. The language, mythology, and geographical nomenclature of Japan viewed in the light of Aino studies, by B. H. Chamberlain, including an Ainu Grammar, by John Batchelor, and a catalogue of books relating to Gizo and the Ainos.—From the Imperial University.

Memoirs of the Geological Survey of India. Palœontologia Indica, Ser. XII. The fossil flora of the Gondwana system, Vol. IV., pt. 2. The fossil flora of some of the coalfields in Western Bengal, by C. Feistmantel, M.D., Ser. XIII. Saltwater Range Fossils, by W. Wangen, Ph. D. I. Productus Limestone Fossils, 6 Cœlenterata, Plates XCVI., VII.—From the Survey Office, Calcutta, Medical Press and Circular, December 8, 1886.—From the Editor.

Morphologia Floridearum, Till Algernes Systematik, VII. Florideæ, Ceramieæ, I. Callithamnion, by J. G. Agardh.—From Mrs. L. Meredith.

Monthly Notices of the Royal Astrcnomical Society, Vol. XLVII., No. 3.—From the Society.

Naturhistorisches Museum for Hamburg, 1886.—From the Department.

Records of the Geological Survey of India, Vol. XX., 1887.—From the Department.

Report of the Sydney Free Public Library for 1885-6.—From the Department.

Report of the Mining Registrar for the quarter ending 31st December, 1886. The Goldfields of Victoria.—From the Mines Department.

Results of a Census of the Colony of New Zealand, taken for the night of 28th March, 1886. Pt.—Population and Dwellings. Pt. II.—Ages of the People.—From the Government.

Report of the Superintendent of the U.S. Coast and Geodetic Survey, showing the progress of the work done during the year ending with June, 1885. Pt.—Text. Pt. II.—Sketches.—From the Department.

Sixth annual report of the State Mineralogist, p.p. 1 and 2, for the year ending June, 1886.—From W. Lulan.

Transactions of the Asiatic Society of Japan, Vol. XIV., pt. 1, Nov., 1886.—From the Society.

Transactions and Proceedings of the Royal Society of Victoria, Vol. XXII.—From the Society.

Transactions of the Royal Astronomical Society. New series, vol. III., pt. III. and IX.—From the Society.

Victorian Year Book for 1885-6, by H. H. Hayter, C.M.G.—From the Author.

Verdhandlungen der Gesellschaft. Für Erdkunde zu Berlin. Band XIV., No. 1, 1887.—From the Society.

Victorian Naturalist. (Cur. Nos.)—From the Society.

PAPERS.

A paper entitled "How far can the general death-rate for all ages be relied upon as a comparative index of the health or sanitary condition of any community," by Mr. R. M. Johnston, F.L.S.

Mr. Johnston in opening stated that the question as to the state of health or sanitary condition of a community is of the utmost importance to all, and especially so to those who are responsible for local sanitary provision, and hence it is often asked, how far is the general death-rate of any year to be relied upon as a test of either the health or sanitary condition of any place or country. Mr. Johnston stated that it was his intention to demonstrate that nevertheless the general death-rate of any one place, though in itself due to a combination of many complex causes, may be used as a fairly reliable local index to health and sanitary condition, although a most faulty index as regards the comparative health or the condition of different localities. The dominant influences which determine the total death-rate he placed as follows:—1st. The proportions living at various age groups; climate, migration, birth-rate, cosmical or obscure influences, etc.; density of population, sanitary condition, health, etc. Now, of these important influences, which together combine to make up the total death-rate, the first three, though chiefly affecting it, are not in the slightest degree connected with either health or sanitary conditions. It is also obvious, he went on to say, that, so far as any one locality is concerned, many of the conditions enumerated are more or less constant; while as regards different localities, and especially countries widely apart, nearly all the conditions came into play as disturbers, and hence it is that the general death-rate of any one locality may be a fairly reliable comparative index of its health and sanitary condition from year to year; while as regards longer periods, or widely separated localities, comparisons by the indication of a general death-rate are often fallacious or misleading. Much prejudice, he stated, existed in some minds against the use of figures. "Figures can prove anything" is a current popular phrase. Mr. Johnston pointed out that even words and phrases are more easily twisted to wrong uses than figures, yet, we do not despair of arriving at correct conclusions by the aid of facts and figures where due care, thorough investigation, and logical methods are employed. As a rule, the writer said, it is not so much that the results of computed figures are false, as that careless and false interpretations are put upon them. Lord Derby while presiding over the statistical section in 1865 happily illustrated some of the mistakes of this kind by the statement that erroneous interpretations of death-rate totals where abnormal causes are not taken into account; for example a year of pestilence, not only by its effect on the mortality of the year of its occurrence, but by its clearing away feeble lives and so lightening the death-rate in years immediately consequent. But, as observed by the President of section F. of the British Association at Birmingham, in September 1886, "there is less to be feared from errors arising out of this source if we lay to heart the warning uttered by Mr. Goschen on a recent occasion. 'Beware of totals,' and if we recognise more fully than we are usually apt to do, that if a table of figures, even if it be absolutely correct as a statement of facts, is merely raw material, not a finished product. The misfortune is, that it is only too frequently treated as the latter." Mr. Johnston continuing, pointed out that tables indicating the death-rates per year of different countries are too commonly treated as finished products, whereas he stated he should endeavour to demonstrate that they are raw materials so far as deductions relating to comparative health and sanitary condition are concerned. Mr. Johnston then, in a most able manner, with the aid of some very excellent diagrams, dealt with the subject under the several headings, which were admirably set forth by a few figures on a black board. Dividing the age groups into three—under 5 years, between 5 and 60, and over 60—he showed that the normal proportions living at these ages would be nearly as 3, 16, 1 in a division of 20, giving a mean death-rate in the three divisions of 50, 7, and 70 respectively. This gives a total death-rate of 16·6. Then supposing an alteration of the division of the persons living in each of these three classes to 3, 14, and 3, with even an improved state of the general health, the total death-rate would be increased to 19·20. Mr. Hayter had tried to get rid of this difficulty by creating an absolute death-rate by assigning an arbitrary value to each class, and establishing 15 classes, but this only increased the difficulty, the real solution of which was to eliminate the deaths over 60. Tasmania's advantage in the large proportion of deaths of persons over 60 was placed to her disadvantage by increasing her total death-rate, whereas it was the strongest proof of her healthy position. In concluding this very exhaustive paper, the author said he trusted that the subject had been made tolerably clear by the observations he had introduced, and that while the total death-rate for all ages might be used locally as a fairly reliable index of the healthy sanitary condition of the same place from year to year, to the meeting it had been proved a most fallacious index as regards the comparative health and sanitary condition of different localities, owing mainly to the extreme variability in the proportions living in different places under the principal age groups. The elimination of old ages, as in the health standard, has been shown to be a more reliable index between different countries. As regards variations from year to year, it is to be hoped, he said, that the observations made may be helpful to others in making proper deductions therefrom. (Hear, hear.)

Dr. E. O. Giblin, Health Officer of Hobart, who was called upon, desired to congratulate Mr. Johnston upon the paper he had just read, and to congratulate the Society upon having for one of its members a gentleman like Mr. Johnston, who took such an active and energetic interest in its proceedings. He was very glad this subject had been brought so prominently before them. For several years he had taken up some work relating to the general health of the town, following in the steps of Dr. Hall, a gentleman who was well known as the officer of health in Hobart, and he had been considerably alarmed the first year he made up his returns to find the death-rate of Hobart was no less than 23 or 24 per thousand of the population. He had sought to find out if there was any fallacy to swell this large death-rate, as Hobart, and Tasmania, had always been looked upon as a very healthy place. Afterwards he discovered that a large proportion of the paupers and invalids were aggregated at Hobart, and that the steamers calling at Hobart registered these, the deaths occurring on the voyage. Added to this there were the lunatic hospital and general hospital in which were collected numbers of cases from the country districts, which tended to increase the death-rate considerably. Still, after eliminating all these, the death-rate of Hobart was only reduced to about 18 per 1,000, a very high rate, because the death-rate of the country districts of the whole island was only 15 per 1,000. He thought Mr. Johnston had pointed out the cause, when a few years ago he drew attention to the large proportion of deaths over the age of 60, and had shown how fallacious it was to attempt any comparison of the total death-rate of Tasmania with the other colonies. He did not intend to allude to the great question of the cosmical influences which Mr. Johnston had referred to, which was a matter out of his depth, though probably there were others who would deal with this portion of the paper.

The Hon. Dr. Agnew said they had been listening to a very important paper, and one of those papers which required a considerable amount of thought before it was discussed, so it appeared to him that the better way by far would be to postpone its discussion till next meeting. (Hear, hear.) They would be much more likely to get a ripe expression of opinion upon the various points in the paper if it were quietly read and considered previous to discussion. There was a great deal in what Mr. Johnston had said about the origin of typhoid fever, which he at the first blush accorded with. It was common to consider it a filth fever, or dirt fever, but he believed it was due to something not yet fathomed. It was certainly a curious matter for consideration that at certain seasons of the year, and over large areas of country, and in different colonies, these simultaneous waves should take place. Whether they were due to the suns spots was a point that could only be ascertained by observations carried out over a long period of time. The Fellows were to be congratulated upon living in a colony where there was the greatest possibility of living to reach the age of 100 years. (Laughter.) It would also be a matter of considerable satisfaction to His Excellency and his friends that his first Governorship should be in such a colony, and if he only remained here long enough he might hope to arrive at the good old age of 100 years.

The suggestion was adopted, and the further discussion of the paper adjourned.

In the absence of the authors, a paper entitled "Description of new species of Tasmanian Hepaticæ," by B. Carrington, M.D., and W. H. Pearson, of England, corresponding members of the society, was read by the secretary, Mr. A. Morton. The paper, which was accompanied by eight plates, described eight new species of the Hepaticæ, collected by Mr. R. A. Bastow, F.L.S., and forwarded to England for examination by the above gentlemen.

A third paper entitled "Description of two new species of Tasmanian fresh water shells," by Mr. W. F. Petterd. One of the species *Ancylus Irvinæ*, n.sp., the author states was found at the Great Lake, and is a wonderfully fine, and interesting addition to our molluscan fauna. It was found attached to the rocks in the shallow margin of the lake, and although apparently numerous at this particular locality, only a limited number of examples were collected. Mr. Petterd in his paper said that this species is not only the finest form of the genus discovered in this island, but is also by far the finest in the world. The second form was a new shell belonging to the genus Gundlachia, which the author had named in honour of its discoverer, *G. Beddomei*, having been found by Lieut. Beddome in a fresh water pool off the Brown's River-road. Mr. Petterd states that this species differs in shape, colour, and is of a much larger size than the only other form known here, *G. Petterdi*, Johnston. The papers were accompanied with drawings of both the shells.

Some notes on the Tasmanian "Butter Fish" (*Chilodactylus Mulhalli*, Macleay) was read by Mr. SavilleKent, Inspector of Fisheries. The paper was accompanied with a stuffed specimen and a plaster cast of the fish. Mr. Kent, in his notes, stated that, in communicating this note upon the butter fish (*C. Mulhalli*), he would take the opportunity of recording his opinion that the fish figured and described by Macleay in the proceedings of the Linnæan Society of New South Wales, p. 440., Pt. XXII., under the title of *Psilocranium Coxii*, must be regarded as identical with this species. With the form given in the illustration quoted, and in all more important details of its diagnosis it essentially agrees. The only feature upon which he had, as far as he could perceive its claims to a separate generic, and specific titles have been found in the somewhat smoother surface of the head as compared with the ordinary members of *Chilodactylus*. Mr. Kent went on to say that the more cylindrical contour of the body, which is quoted by Macleay as substantially its claim to separate generic distinction, could scarcely be invested with so important a significance, more especially as admitted by Macleay in his original description of this type. Mr. Kent said that he might add that Mr. Morton, who is personally familiar with the typical examples of *C. Mulhalli* and *Psilocranium Coxii* preserved in the Sydney Museum, had experienced equal difficulty with himself in detecting any essential points of distinction between these respective types.

Mr. R. M. Johnston quite agreed with Mr. Kent as to the Butter Fish being the same as that described by Macleay. He had since had the pleasure of capturing several, and it was not so rare as was supposed, for the fishermen frequently caught it though they did not bring it to market, regarding it as what they called "mullock." The fish being very sensitive to light changed its colour in different localities, the colours being deeper in deep water. This was the case with the trumpeter, from the colour of which it was possible to affirm what part of the coast it had come from. In the boat's well the fish frequently change their colour in a trip from Maria Island to Hobart. He desired to compliment Mr. Kent upon the accurate and perfect manner in which he had produced his cast.

Mr. A. Morton said he felt convinced after a personal examination of the Sydney specimens, that Macleay's *Psilocranium Coxii and Chilodactylus Mulhalli* were the same and thought that both would prove to be synonyms of Richardson's *C. nigricans*.

The Curator of the Museum, Mr. A. Morton, contributed a few notes on three specimens of fish hitherto unrecorded as being found in Tasmanian waters, belonging to the family *Kurtidæ Genus Pempheris*. The specimens before the meeting had been sent to the Museum from George's Bay, by Mr. W. L. Boyes, and proved to be *Pempheris macrolepis*, Macleay.

AUSTRALIAN ANTARCTIC EXPLORATION COMMITTEE.

The Secretary read the following letter received from the Royal Society of Victoria, also the recommendations from the Antarctic Committee appointed by the Royal Society of Victoria, and the Royal Geographical Society of Australia (Victoria Branch), to the Hon. the Premier :—

Royal Society of Victoria, Victoria-street, Melbourne, 8th April, 1887. Australian Antarctic Exploration Committee. To the President of the Royal Society of Tasmania, Hobart.—Sir,—I have the honour to enclose herewith a copy of the progress report of this committee, and of its recommendations to the Government on the subject of Antarctic research, and to inform you that our Premier, Mr. Gillies, has replied to our application for a grant-in-aid to the effect that he is prepared to provide funds in the next estimates, provided that the Colonies contribute, and that he has just written to their Governments to ask their co-operation From the cordial manner in which the first proposal to renew Antarctic research was met in Tasmania, we feel sanguine of an affirmative response from its Government; but as it is desirable to lose no time in obtaining an early assurance to that effect, I am instrncted to ask for your powerful influence to secure it as promptly as possible. It will be seen by the progress report that this committee formed a deputation in August last to wait upon our Premier, and was fortunate enough to receive his approval and active assistance. May I suggest that probably a similar movement on the part of your society would largely tend to affect the decision of your Government, and moreover to expedite it, and a notification of it also. Feeling confident that you will concur that there could be no more worthy and appropriate method of signalising the centenary of the foundation of Australian settlement than that proposed, and that you will endeavour to assist it in the manner suggested. I have the honour to be sir, your most obedient servant,

H.K. RUSDEN,

Hon. Sec. Royal Society of Victoria, and of Australian Antarctic Exploration Committee.

Recommendations from the Antarctic Committee, appointed by the Royal Society of Victoria and the Royal Geographical Society of Australia (Victorian Branch), to the Hon. the Premier :—

1. The Antarctic Committee begs respectfully to recommend to the Hon. the Premier the propriety of stimulating antarctic research by the offer of bonuses.
2. That a sum of £10,000 be placed upon the estimates, to provide for the amount of the bonuses, and for the expenses of the equipment and of the staff.
3. The amount of the bonuses to be paid to the shipowners for the hereinafter mentioned services is to be decided by tender, and the same, together with the cost of equipment and the staff, not to exceed the sum of £10,000.
4. That the Government invite tenders from shipowners willing to perform the services required.
5. That the tenders be sent to the Treasury direct, or through the Agent-General, not later than the 1st June.
6. That tenderers must provide two fortified steam ships, each of not less than 175 tons register, 60 horse power nominal, and A1 at Lloyds, or of an equivalent class.
7. That tenderers must supply full descriptions of the ships and their equipments.
8. That the master and chief mate of both ships shall have held similar positions in Arctic steamships.

9. That the tenderer shall provide, free of charge, cabin accommodation in each ship for two gentlemen, who will sail as the scientific staff; also a separate cabin, of a size to be specified, as instrument room and office.

10. The scientific staff will have the status of cabin passengers, and be subordinate to the master, but the master must afford them every facility that does not interfere with the work or safety of the ship, for noting natural phenomena.

11. The chartered ships will earn a special bonus (to come out of the £10,000 appropriated) upon their entering at the Custom House a cargo of 100 tons of oil, being the produce of fish caught south of 60deg., S. The special bonus to be paid as follows, viz.:—To ships owned and registered in Australia, £1,000; to ships owned and registered elsewhere, £800.

12. The services desired are as follows, viz.:—A flying survey of any coast-lines lying within the Antarctic circle, and not now laid down upon the Admiralty charts. The discovery of new waterways leading towards the South Pole, and of harbours suitable for wintering in. Opportunities to be afforded to the scientific staff to add to our knowledge of the meteorology, oceanography, terrestrial magnetism, natural history, and geology of the region. The discovery of commercial products.

13. The tenderer must specify the bonus he demands for passing 70deg. S. with either one or two ships; also the bonus he demands for each degree attained beyond 70deg. S. by one ship; also the bonus he demands for every occasion upon which he succeeds in establishing on the shore a temporary observing camp.

14. That the Government should pay for only one such station for each 120 miles of latitude or longitude, unless the master shall have established more at the written request of both members of the staff.

15. The staff to have the right to refuse to accept the site of any camp selected by the master, and such refusal shall be logged by the master, and read over to the staff in the presence of the mate and the surgeon; and the staff shall hand to the master their objections thereto in writing, and the same must be signed by both of them.

16. The tenderer will not receive any more bonus for two ships than for one after passing the 70th parallel. The committee would prefer that one of the ships should remain fishing in the neighbourhood of North Cape, Victoria Land, whilst the other pushed into higher latitudes. In case of accident to the latter, the former would serve as a depôt and relief for the shipwrecked crew to fall back upon.

17. Should the master of either ship despatch an exploring party from his vessel, the contractor will be entitled to a bonus for each 60 miles of latitude or longitude traversed by such party, but the tenderer must specify what sum he will require for each 60 miles so traversed.

18. That the ships should proceed direct to the bight situated on the meridian of 180deg., with a view of one of them getting beyond Ross' furthest, and especially of observing the conditions of the volcanoes at the head of the bight.

19. The contractor will be liable to no penalty should he fail to reach to any latitude tendered for.

20. The contractor will have the right to employ his ships in whaling or sealing, and in loading guano or other cargo.

21. Should the masters be unable to get right (black) or sperm whales to enable them to compete for the bonus offered under the 12th proviso, they will nevertheless be entitled to the bonus should they return with a cargo of any merchantable commodity obtained within the Antarctic circle, and having a value equivalent to that of 100 tons of whale oil.

22. Both ships must be in Port Philip Bay and ready to start on the 15th of October.

23. That in case of any difficulty arising in England between the Agent-General and contractor, it shall be referred to the British Antarctic Committee for decision.

Mr. SPRENT said the Royal Society of Victoria and the Royal Geographical Society of Australia had written about this matter, and he had read a paper on the subject in September, when the Fellows passed a resolution to urge upon the Government the desirableness of Tasmania co-operating with the other Colonies in the proposed Antarctic expedition. He suggested that the papers be laid upon the table and discussed at the next meeting of the Society.

The Hon. Dr. AGNEW said this was a very important matter, and one the Colonies were bound to take up. The expense would not be very great, for should all the colonies combine, and if the contributions were put on the ratio of population, the sum required from Tasmania would not be a very large one for the Premier to put on the estimates. Certainly this Colony should take an active part in the matter, and he hoped that by next October they would see the ships of the expedition in their harbour. (Hear, hear.)

The Hon. P. O. FYSH expressed his entire sympathy with the objects of the proposed expedition. The monument they had erected in their public square to the memory of Sir John Franklin should indicate the spirit in which the colony would deal with this question. That which was most noble in his life, and formed the great object for which his life was given, the people here should sympathise with and support. (Hear, hear.) The scientific aspect of this question would undoubtedly commend itself largely to the gentlemen present, but to those who were utilitarian in their views they would have to speak of the commercial value of enterprises of this kind. They should hope that if this colony undertook to pay a portion of the expense, a specific commercial benefit would result, so far as Hobart was concerned. The probability was that the last starting point of the expedition would be from their own bay. In that case the people of Tasmania would take a very lively interest in it. The small amount of expenditure they would undertake in the matter would result in an advantage to Tasmania as much as to the other colonies, while it would also help to cultivate that federal spirit which they were so anxious to see developing. (Applause.) The expense to Tasmania would only be about £500, and without committing himself in any way as to what the Government might be disposed to do, he did not think it was necessary on an occasion of that kind to hide his own opinion under a bushel. (Applause).

The BISHOP OF TASMANIA deprecated the matter being put off as suggested by Mr. Sprent. The subject was not one that needed a great deal of thrashing out, but it did need prompt action, or they might be left in the lurch. He hoped the Society would entrust to the council the authority to represent it in approaching the Government, and in keeping this question very closely pressed home on their attention. (Applause.) He would move,—"That the council be authorised to approach the Government on behalf of the Royal Society in connection with the Antarctic Exploration Fund."

Mr. SPRENT seconded, and pointed out that unless they were prompt in their action they were liable to be forestalled. He said that Baron Nordenskjold was organising an expedition to the Antarctic circle, under the patronage of the King of Sweden. It would be rather hurtful to their Imperial notions to have a small power like Sweden preceding them in the exploration of their seas. After the encouraging remarks of the Premier it was very desirable to strike while the iron was hot.

The motion was then put and carried.

Mr. J. Barnard said: I rise, Your Excellency, to express my sincere gratification (which I am sure is shared in by the Council and all the Fellows present) at seeing Your Excellency in the exercise of your functions as President of the Royal Society; and on their behalf, as well as on my own, I tender to you a cordial welcome and hearty congratulations on the auspicious occasion of your assuming the position of our President, which indeed by our constitution is inherent in your Excellency's exalted office as Governor of the Colony. Speaking for myself as one of the vice-presidents, I feel peculiar satisfaction, as I am led to believe that my office in the Society will henceforth become a "sinecure;" and that the interest which your Excellency has shown in the Society by your presence this evening will continue unabated, and will rather increase than diminish with your Excellency's more full acquaintance with the work doing by the Royal Society. We have all listened with deep interest to the highly interesting address with which you have favoured us this evening on the opening of the Session; and I trust that its weighty and eloquent words will be duly recorded in our volume of Papers and Proceedings. Some of your Excellency's distinguished predecessors—notably Sir William Denison, Sir Frederick Weld, and Sir Henry Lefroy—did not content themselves with simply occupying the President's chair, but have also enriched our Transactions by their various contributions to science; and I presume to express the hope that, in due time, your Excellency may also be disposed to aid the Royal Society by reading papers at its meetings not less valuable and instructive. (Applause.) I beg to move,—"That the Council and Fellows of the Royal Society desire to congratulate His Excellency Sir Robert G. C. Hamilton, K.C.B., upon his assuming the office of President, and have much pleasure in tendering him a cordial welcome upon the occasion."

Dr. Agnew seconded the motion, which was put to the meeting by the Chief Justice, Sir Lambert Dobson, and carried with enthusiasm.

His Excellency: I thank you very much. I can only regret it if my attendance at these meetings should have the effect of putting Mr. Barnard out of the seat he has occupied so worthily. I do mean to attend all the meetings I can. (Applause). I think it almost too much to hope that every meeting will be as interesting as this one. I desire before sitting down, to move a vote of thanks to the authors of the papers, and I cannot pass over this occasion without saying how very deeply I was struck with Mr. Johnston's paper. I think it showed marked ability and was extremely suggestive, and it was wise to defer its consideration to a future day. There were one or two points in connection with it that occurred to me, and which might be discussed at next meeting. One was as to the making of an analysis of those curious waves of disease which occasionally rise and fall, and seem to come across large portions of country. It would be very interesting, if material existed, to have an analysis of that sort. Then there is another point that struck me. Of course with the Colonies, where there has been so large an immigration in recent years, that point which Mr. Johnston made about the number of people of different ages is very striking. I fancy that in an old and more settled country Mr. Johnston would hardly say the point was of such great importance. You might there, with tolerable certainty, assume that the proportions of people of different ages would approach to much about the same, especially in the case of a large population. There is one other point, and that is the difference between urban and rural conditions. I should be sorry if anything Mr. Johnston said—and I don't think it will—should have the effect of in any way lessening the exertions made in the way of looking carefully after our sanitation. Mr. Johnston pointed out that there are other causes which may make an apparently high death-rate beyond those that man has power to deal with. But I think the very fact that there is such a large difference between the urban and rural death-rate, enforces on us this: that the efforts of science ought to be to make life in towns as healthy as life in the country. (Applause.) I shall ask you to join me in a vote of thanks to the authors of these interesting papers. (Loud applause.)

Mr. G. S. PERRIN, Conservator of Forests, drew attention to the following specimens of Tasmanian trees, which he had laid on the table : — Arthrotaxis cupressoides, do. selaginoides, Dacrydium Franklini, and Microcachrys. Flowering branchlets of these were affixed to a card, and along with them were shown specimens of the wood of the different varieties. They all belonged to the class of Tasmanian conifers, and were collected from various parts of the island. One specimen, the Arthrotaxis cupressoides, had been obtained from the back of the La Perouse range, one of the most difficult places of access in Tasmania, where probably no one but Mr. Perrin has penetrated. One of the pieces of wood shown—a bit of celery-top pine—had been 11 years under water, and formed a portion of the first water-wheel erected at Mount Bischoff. It was in perfect preservation, as was also a piece of Huon pine, which had for 40 years been part of a plank in a jetty at Macquarie Harbour that was originally cut for that purpose by order of Sir William Denison. Mr. Perrin's specimens will remain for a short period in the Museum, where they may be inspected.

The meeting, after Mr. Perrin had given his account of his specimens, closed.

MAY, 1887.

The monthly evening meeting of the Royal Society took place on Tuesday evening, the 10th May, the President, His Excellency Sir Robt. G. C. Hamilton, K.C.B., in the chair. There was a large attendance of Fellows and several ladies present.

The following gentlemen were declared elected as Fellows of the society :—The Hon. the Minister of Lands (E. N. C. Braddon, M.H.A.), Messrs. F. J. Young, B.A., Cambridge, H. H. Gill, M.H.A., W. J. Jones, David Barclay, C. A. Payne, M.R.C.S., A. J. Taylor, J. W. Toplis.

List of additions to the Library :—

Bibliothìque Gèologique de la Russie redigeè par S. Nikitin.

Bolletino della Societá Geografica Italiàna, Serie II., Vol. XII., Feb., 1887. Anno XXI., Fasc 2.

Bulletins du Comité Geologique. Nos. 1 to 11. St. Petersburg, 1886. —From the Society.

Bulletin de la Société Royale de Botanique de Belgique, Tome-Vingt-cinqueieme, 1886.—From the Society.

Imperial Federation, March 1, 1887.—From the Editor.

Memoires du Comité Geologique. Vol. 2, No. 2. Les Ammonites de la zone à Les Ammonites de la Zone â Aspidoceras Acanthicum, de lest de la Russie par A. Pavlow. Vol. 3, No. 2. Carté Gèôlogique Générale de la Russie D'Europe, Feuille 139. Description Orographique par A Karpinsky et Th. Tehermycheff.—From the Society.

Monthly Notices of the Royal Astronomical Society Annual Report of the Council, No. XLVII., No, 4, February, 1887.—From the Society.

Nature. Current Nos.

Plants Poisonous and Injurious to Stock. By F. M. Bailey and P. R. Gordon (bound). Brisbane, 1867.—From the Authors.

Report of the Surveyor-General of the Army to the Secretary of War for the fiscal year ending June 30, 1886.—From the Department.

ADDRESS TO THE QUEEN.

His Excellency said that, before proceeding with the business of the evening, he would read to them an address which had been prepared for presentation to Her Majesty the Queen. He then read the following address :—

To Her Most Gracious Majesty the Queen—

May it please Your Majesty—We, the President and Fellows of the Royal Society of Tasmania, desire to offer our warmest and most respectful congratulations on the auspicious completion of the 50th year of Your Majesty's illustrious and beneficent reign.

Hitherto Your Majesty's reign has been unparalleled in English annals for discoveries in arts and sciences of priceless importance to the State, for enlightened legislation on matters more intimately connected with the social interests and well-being of the community, but still more, perhaps, for the marvellous expansion of the colonies of the Empire in everything which can foreshadow for them a great and glorious future.

That a reign so pure, so prosperous, so fraught with everything which can contribute to the power, progress, and prosperity of the nation should have been so prolonged is a matter for the deepest thankfulness; and with earnest prayers that the succeeding years of Your Majesty's reign may bear even a favourable comparison with those that are past, we humbly subscribe ourselves, Your Majesty's most faithful and most loyal subjects,

On behalf of the Fellows,

R. G. C. Hamilton, President.

J. W. Agnew, Hon. Sec.

The text of the address, which was engrossed on parchment, had been executed by Mr. Albert Reid, and a very handsome border of flowers, consisting of native fuschias, clematis, and maiden-hair fern, was painted on it by Miss V. Hall.

PAPER.

A paper, entitled "The Comets of February, 1880, and January, 1887," by Mr. A. Biggs, was, in the absence of the author, read by the secretary, Mr. A. Morton. The paper was accompanied by a star-chart of the comets of February, 1886, and January, 1887. The writer drew attention to the strong resemblance between the two comets in general appearance, length of tail, absence of any visible nucleus, and, as exhibited by the chart, the close similarity of their apparent paths in the sky. The author expressed an opinion, founded upon a rough heliocentric projection of their orbits from the uncertain data available, that these orbits were nearly, if not quite, identical, but differing from that of the great comet of 1882-3 with which the orbit of 1880 had been supposed to coincide.

Commenting upon the apparent absence of head in the case of the two later comets, the author suggested from the fact that the tail of a comet is not amenable to the laws of gravitation that the bodies in question were possibly not comets at all, but the main body of a meteoric stream, not far from the position the earth occupies at the end of January.

MR. JOHNSTON'S PAPER.

The discussion, adjourned from last meeting, was resumed on the paper by Mr. R. M. Johnston, F.L.S., on "How far the general death-rate for all ages can be relied upon as a comparative index of the health or sanitary condition of any community."

Mr. Johnston said before the discussion was commenced he wished to correct an error that had occurred in his paper. On page 8 they would find the statement, "Where, as in Tasmania, 36·74 per cent. of the deaths exceed the allotted span," etc. The words, "the mean age of," should have preceded the figures 36·74. Several other errors of a less important character had occurred in the paper.

Dr. C. J. Parkinson then opened the discussion, and said:—In the few remarks I have to make on the very interesting and instructive paper of Mr. Johnston, I am sorry I have not had the material or the time to go into the question so thoroughly as I should like to have done. The two points I wish to deal with are the age limits of his health standard, and the conclusion he draws on pp. 10 and 11, with regard to the health of Hobart. Speaking of the influence of migration on the total death-rate on p. 11, what Mr. Johnston points out constitutes an argument against including the deaths between 0 and 5 in the health standard. The reason is manifest: the bulk of immigrants consists of persons between 5 and 50. The proportion of children under 5 is thus reduced in a colony, and, therefore, for comparison with England or any old country, deaths at this age should be omitted. Also, on p. 12, Mr. Johnston points out the effect of the birth-rate disturbance, showing that an increase in the marriage and birth rates arising from a general improvement in the material welfare of a country may considerably increase the total death-rate without implying a deterioration in the general health and sanitary condition. This further suggests the desirability of omitting deaths at this age. To illustrate this, let us assume that the births in Tasmania in 1885 had been 20 per cent. larger, while the death-rate for all ages remained the same. The effect would have been to add 927 to the population and 104 to the deaths, and the general effect on the health standard used by Mr. Johnston would be to raise the death-rate from 10·5 to 11·2; thus, in Mr. Johnston's words, increasing the total death-rate without any disturbance of matters affecting the local health and sanitary condition. With regard, now, to the upper limit of the health standard, I venture to think that 60 is too low an age to take. We are not in the habit of considering deaths at that time of life as due to "extreme old age," and since Mr. Johnston, on p. 8, speaks merely of the desirability of excluding deaths from "extreme old age" in his health standard, I think he ought to have fixed the upper limit rather higher—perhaps 65 or 68 would be a better limit. (Hear, hear.) In England about 25 per cent. of the population die between the ages of 0—5, and 25 per cent. at 69 and upwards, the middle 50 per cent., that is those from 5—68 would probably afford a more desirable index for the purpose in view. It would also be desirable for greater accuracy to omit deaths from violence. This may seem an unnecessary refinement, but, bearing in mind the frightful losses of life in adjoining colonies from the recent shipping and colliery disasters, the result of including such deaths may occasionally be very great on the general death-rate; though suggesting these alterations in Mr. Johnston's present health standard I still think it a far more reliable test than any other in use. The next point I should like to touch upon is that of the health of Hobart compared with other towns. See pp. 10 and 11. As indicating the great utility of the health standard, the comparision made is most useful, but as proving the superior "health and sanitary condition" of Hobart, it is hardly so satisfactory, and for this reason—the other towns selected for comparison are so much more populous, and have such very inferior climates. As far as England is concerned, instead of London with a population larger than that of all Australasia, it would be much fairer to institute a comparison with health resorts such as Cheltenham, Hastings, and Eastbourne, and notwithstanding the presence of numerous invalids and elderly inhabitants, the result will be found the reverse of consolatory. In the places mentioned, including their suburbs, the total death-rates are 17·89, 17·49, and 14·19, as compared with 24·70 in Hobart. Taking the average percentage of deaths over 60 years to total deaths in England these towns will show a health standard death-rate of 13·06, 12·77, and 10·56 respectively, or in other words, a considerable improvement on Hobart. I am aware that the returns for these towns include a certain amount of rural district round each, but in the three cases I have taken, this outside population is very insignificant compared with the towns themselves, and further, the death-rate in towns of this size in England approximates very closely to that of rural districts. As far as regards the colonies themselves, it would be manifestly fairer to compare our capital with towns enjoying climatic conditions more like ours than the comparatively tropical cities of Queensland and New South Wales. This means, of course, with such places as Christchurch, Wellington, and Dunedin; but I have been unable to obtain the necessary statistics to do this. To show still more forcibly the immense influence of density of population, of which Mr. Johnston is well aware, and that absolutely nothing is learnt of their relative sanitary condition by comparing small and large towns, I need only mention that while the death-rate of towns in England of about the same size as Hobart varies from 12 to 18 per 1,000, that of the 20 largest towns varies from 18 to 34 per 1,000, and these are towns with the same climate and similar sanitary arrangements. We now come to the important question of the seasonal variation in the typhoid curve, to which Mr. Johnston pays so much attention in his paper, and which he considers such a difficult problem. I am unable to see any necessity for invoking a hidden cosmical influence to account for its periodical rise and fall. (Hear, hear.) Local hygiene and a seasonal influence are quite sufficient to explain it. As Mr. Johnston shows in his diagram, the months of highest temperature are January and February, and the diarrhœa curve shows a maximum mortality at exactly the same point, showing conclusively the direct influence which heat has on this disease. When we turn to the typhoid fever curve, which I will try to show is also directly influenced by excessive heat of weather, we find the maximum death-rate to be a month or six weeks later, that is in the month of March, and in accounting for this, I hope you will pardon me if I digress for a few moments to explain the causation of this disease. It has been proved beyond all cavil that typhoid fever is above all fevers the fever of fæcal decomposition ; that it occurs only amongst those who are exposed to the influence of defective drains or foul overflowing cesspools, especially when these are so situated as to pour their fetid gases into the interior of houses, or to contaminate by their emanations, their soakage and their leakage, water and other articles of food. Now, it has been observed over and over again, that these excreta, which are probably at first wholly ineffective, become in the course of putrefaction, through great heat, virulent in a high degree. This process of fermentation or putrefaction of the germs has been observed to take about a fortnight, and adding to this the incubative period of the germs after they have been received in some way into the human body, which is also about a fortnight, and as death in the majority of fatal cases occurs about the end of the second week from the onset of the disease, this makes altogether a period of six weeks, which brings us exactly from the maximum point of temperature at the end of January to the middle of March. (Applause.) Even if the specific virus of the fever may be generated *de novo*, the same process has to be gone through, showing most conclusively the direct effect of excessive heat, in causing the disease to pass from an endemic condition in the winter to an epidemic form in the summer. And if this is so apparent in the months of one year, surely it is only reasonable to expect that a similar increase in the disease will take place in cities where sanitary arrangements are grossly neglected in years with an unusually high temperature such as this year, when we had several days in succession in January with a temperature, ranging from 90deg. to 103½deg., the highest recorded temperature since 1849. (Applause). The periodical variation in the temperature curve corresponds roughly, I believe, with the sunspot periodicity, but what influence Jupiter can have, of course, we are unable to imagine. Surely to prove this influence Mr. Johnston should have shown corresponding waves in the typhoid death-rate in England, but there we find a very different picture. From 1871 or 1872 a most marked but gradual diminution has taken place, totally irrespective of the position of Jupiter, or even the number of spots on the sun, but it is certainly a noteworthy coincidence that this great diminution should begin to take place immediately after the passing of the Public Health Act of 1872, and the further Act of 1875. From 1871 to 1880 the typhoid death-rate had declined from 89 per 100,000 in the previous decade to 49 per 100,000, and it has since gradually diminished to 18 per 100,000 in 1885. To further illustrate this important point, I may mention that the eminent authority on sanitation, Dr. Buchanan, found that in 25 English towns in which sanitary improvements had been properly carried out, the typhoid death-rate diminished largely in the five years succeeding the completion of the works—to an extent varying from 33 to 75 per cent. In startling contrast to this satisfactory state of things, due entirely, be it observed, to human efforts, consider for one moment the present condition of Hobart where there have been already 34 deaths in the last four months, equal to an annual rate of 115 per 100,000. I would venture to suggest that the one great test of the relative sanitary conditions of towns as regards sewerage, drainage, and the purity and abundance of its water supply, is the typhoid death-rate—and here Tasmania and Australia compare most unfavourably with England, for the simple reason that sanitation in these matters is practically *nil*. It is in this disease that human action has been conclusively proved in England to be the all-important factor all other causes, with the exception of phthisis, contributing to the death-rate, have been apparently undiminished by man's efforts. Therefore, when Mr. Johnston suggests the probability of cosmical causes adding to or varying the intensity of disease, he should have made a special exception in the case of typhoid. When here in Hobart the foul water from a stagnant pool like the Cascade reservoir is allowed to pollute the general town supply; when we have filth lying exposed to an almost tropical sun, and then carried in leaking and open pans, in some cases through the very rooms of the houses; when we have the house slops trickling all day along slimy channels in front of our very doors; and when acting on all this mass of filth and foul water there comes great heat, such as that of the past summer, is it any wonder we have this fearful epidemic of a filth disease among us? (Applause.) With this epidemic in full activity every summer and autumn, is it not quite within the limits of possibility that some person of note, or a near relative of such, may fall a victim to it? Would not such an event be an almost irreparable injury to the city from a monetary point of view by ruining its present high reputation in the other colonies as a health resort? And does it not as a simple matter of business behove us to apply all possible remedies at once, to preserve that reputation rather than suffer its loss, and then have to struggle for many years to come to regain it; when, it may be, other towns have gained the fame that was ours and occupy the proud position we now hold of being the sanatorium of the Southern Hemisphere. (Loud applause.)

Mr. MAULT said that, taking Mr. Johnston's paper as a whole, he had been disappointed with it, because the consideration of such a subject gave Mr. Johnston a chance of aiding sanitary work in our midst, and he was afraid that, on the other hand the paper had had rather the effect of retarding that good work. He did not see from one end of the paper to the other any thing like an attempted proof of the value of comparative statistics in regard to the sanitary condition of Hobart itself. It was the Hobart of to-day only that he had spoken about, not the Hobart of to-day compared with any other time. If he had taken advantage of some of the statistics that Dr. Parkinson had advanced in regard to England he would have seen that while Jupiter was approaching the earth, while the sunspots were diminishing or increasing in number, there was one continual march in the way of diminution in the death-rate generally, amounting in the decade between 1870 and 1880, as compared with the decade between 1860 and 1870 to 1 per cent., and of that 1 per cent. at least three-quarters was due to a diminution in deaths from what are called preventible diseases. That would show most clearly that sanitary science and the inculcation of the duty of cleanliness can override such cosmical influences as were at work. He could not help thinking that Mr. Johnston had been led wrong by his love of comparative statistics. He (the speaker) did not like them. Their duty was with positive statistics. In his opinion they should look at a death from preventible disease as a homicide chargeable to something or somebody. There was one detail on which they ought to have information. He alluded to the manner in which deaths were registered here. He found that in the register of deaths in the City of Hobart it was apparently quite sufficient if at the time of registration the name of the deceased person was given, with his occupation, and the street in which he lived. It would be of infinitely more importance—in fact, it would make all the difference between usefulness and uselessness to give not only the street, but the number in the street. Parliament, by a vote it had passed last session, had given him a little leisure, and he thought to employ that leisure by preparing a mortality map of Hobart. But he found himself debarred from making this map because he could not get anything like precise information as to the locality of disease. He knew that a person had died in Argyle-street, but he could not tell whether it was at this end or a mile away. In most cases it appeared the deaths were registered by undertakers. He thought, perhaps, they could give him some assistance, and he had gone to an undertaker who had the largest business in the town. He gave all the information in his power, but even that was almost useless for the special purpose required. For the future they should know exactly where every death occurred. Mr. Mault explained the system adopted by Dr. Russell in Glasgow by which every case of disease was localised and registered. A death occurring at a certain house in a certain street was registered, and if other deaths followed at short intervals in the same house the fact was at once known, and the sanitary condition of the house was looked into. The same principle was followed in regard to localities. Some system of this kind in Hobart would enable them to reach at once the original source of disease or contagion, and stamp out epidemics before they reach serious proportions. (Applause.)

Mr. W. F. Ward, Government Analyst, said: I was so entirely convinced by Mr. Johnston's argument and figures of the superiority of his "health standard" for comparative purposes, and of the absolute necessity for taking into account the difference expressed in the saying, "The young man may die, but the old man must," that I was the more forcibly struck by the unduly favourable figures assigned to Hobart by the table on page 11. For this table all deaths over 60 are eliminated, but all persons living over 60 are calculated in. Now this would be fair enough if the "old age groups" in each case were tolerably equal in number, but on page seven we find that Tasmania has more than 80, and Queensland fewer than 19 persons per 1,000 in this group, yielding 36·74 and 6·38 per cent. respectively of the total deaths, but the capitals of the two colonies give decidedly higher percentages than those of the total deaths, which fact I have assumed (subject to correction) to mean correspondingly higher proportions of old people. On this assumption, which, whether correct or not, is applied all round, I have ventured to recalculate the table for each 1,000 living under 60, and not for each 1,000 living of all ages.

	I. (Actual). Deaths under 60 per 1000 of all ages living.	II. (Calculated). Deaths under 60 per 1000 living under 60.	(Calculated). Living under 60. per 1000 of all ages.
Hobart	13·97	15·44	905
Adelaide	15·42	16·14	956
Sydney	19·52	20·16	968
Brisbane	19·79	20·30	975

Taking the two extremes, Mr. Johnston's table may be taken as comparing the death-rate of 905 persons under 60 in Hobart with that of 975 in Brisbane, or 1,000 with 1,077, or taking the figures for the whole colony in each case, and not my calculated figures for the towns they would be 920 Hobart, and 981 Brisbane, or 1,000 or 1,066. The effect is to place Hobart in a much less favourable light with an increase of 1·47, nearly three times the increase of Brisbane; while the *difference* between Hobart and Adelaide in favour of the former is diminished from 1·45 to 0·7, or by more than 50 per cent. The order of merit, however, remains unchanged, but I must admit that my figures must give a very much closer "approximation to *relative* value of conditions affecting health" than those of Mr. Johnston. The death-rate shown on Mr. Johnston's diagrams, which illustrate so well that rhythm of action which Herbert Spencer teaches us to look for throughout Nature, we are all agreed are too high, and the aim of sanitary science is to lower them until they represent gentle undulations instead of billows. The crests represent mainly excess of zymotic diseases, and it is on these that we must pour the oil of sanitation until, if we cannot obtain a perfect calm, we may have only gentle ripples, such as those which in many places now represent the enfeebled action of small-pox. Let us compare for a moment visible with invisible vegetation. The seeds of thistle and dandelion in a good year are produced more abundantly and start on their travels. Some fall on stony ground, and perhaps get no start in life, while others get into good pasture, increase and multiply. So the invisible fungoid germs of zymotic disease have their good years (doubtless regulated by the sun if not by his spots), but they find no rest in clean, dry places; but in dirty water, foul yards, and gutters, they multiply exceedingly after their kind, or perhaps produce a more fatal progeny. To check, and ultimately even to stop this multiplication, is what we all wish, and the only way to do this is to sterilise our surroundings—in the country as well as in town—by keeping our water supply clean and unmixed with our sewage or surface drainage, our air unpolluted by accumulation of filth, animal or vegetable, which should be removed by proper sewers—in the former case at once, and in the latter by a regular system of carts at frequent intervals, as recommended by Mr. Johnston. The isolation and registration of all cases of infectious or contagious disease, and not of deaths merely, should also be rigidly carried out, and the plague spots in the town being known, they should be severely cauterised until the sore was healed. The opponents of a system of underground drainage for Hobart make a great outcry about the formation of sewer gas, but ignore the more or less close resemblance of that made on the premises for home consumption. Parkes, in his "Hygiene," says: "There are several cases on record in which typhoid has constantly prevailed in houses exposed to sewage emanations, either from bad sewers or from the want of them, and in which proper sewerage has completely removed the fever." Referring to a town in Devonshire, he says: "It used to be always liable to outbreaks of typhoid fever, but after the drainage of the place the fever disappeared." Without multiplying instances, here, surely, is a sufficient encouragement for us set to work with a will, taking care to keep our sewers, when we get them, well ventilated, but wholly unconnected with the inside of our houses, lest a worse thing befall us. Mr. Ward went on to say that in *The Mercury* he was was reported to have said that the mixing of good water with bad water had diminished its power of doing harm. That was true enough under certain conditions, but supposing typhoid germs to be present in the bad water, the statement amounted to saying that 50 of them in a pint were bad, whereas 50 in a gallon were good. Of course they would understand that he had no intention of saying anything of that sort. (Applause).

Mr. E. C. Nowell pointed out that when in estimating a death-rate they took the people of all ages together, they mixed two things which were utterly antagonistic. They had a measure of disease, and at the same time a measure of health. In the younger ages deaths, no doubt, were a criterion of disease, while those which occurred at greater ages were, of course, a measure of health, because if they had not been healthy persons they would not have lived to such a period. Dr. Parkinson had suggested that a greater age than 60 should be taken. He (Mr. Nowell) would submit whether the age might not be taken at 65. According to the life tables showing the average expectation of life, a person might expect to live till 65. Then as to the deaths under one year; they stood out as quite peculiar. The most dangerous time of life was the first year. It was just worth consideration whether in giving the general death rate of the whole country, not only the ages over 65 should be excluded or placed by themselves, but also whether the same should not be done with the deaths under one year. That, no doubt, would be favourable to Tasmania, because deaths of children under one year were very much less here than in the other colonies. As to the influence of cosmical and other causes, he thought that did modify the death-rate. When they saw the fact before them that this outbreak of typhoid fever extended over all the group of Australian colonies, they could have very little doubt but that it was influenced by a certain condition of the atmosphere. If they could analyse the air it would be an immense assistance to investigation in this matter. He did not see why that should not be done. At the same time it was to be remembered that while the condition of the atmosphere might influence diseases, there was no doubt they were not caused by it. It could not be too strongly impressed on the public mind, that even though diseases were exaggerated by causes such as he had indicated, that was no reason for relaxing one's efforts to stamp out disease. Indeed, it was rather an increased reason for bringing to bear everything that sanitary science could suggest to preserve the public health, for the better the sanitary state the less harmful would be any baneful condition of the atmosphere. He was glad to see the chairman of the Board of Health present, and he would suggest to him that the attention of the board should not be exclusively given to towns, but also to the country and especially to some of the country inns. In conclusion, he said that those who read Mr. Johnston's paper carefully must feel that there was no sufficient ground for the impression that it discouraged sanitary work. (Applause.)

Captain SHORTT contributed the following on the relation of the weather and typhoid during the last six months:—1st. Temperature.—Sudden changes frequently occurred during the summer. In January the mean temperature 66deg. was 2·5deg. above the average of previous 43 years' record. The 9th was an exceptionally hot day, registering 103·5deg. in the shade. The two previous days were also warm, 92deg. and 92·5deg. In February highest temperature 95; lowest 39deg. 2nd. Rainfall.—The precipitation of moisture was abnormal, as only ¾in. of rain fell in the months of December, February and April, though in November it was 2·88in.; January, 3·43in.; and March, 2·57in. Total amount about equal to former averages. 3rd. Wind.—There was an absence, excepting in January, of southerly winds and cooling rains; northerly winds predominating. To assist the epidemic, when the rainfall was slight the winds were light; generally strong winds act greatly in purifying cities, scattering the dust, which has already absorbed foul matter in drains, etc. The direction and velocity of the wind, rainfall, and temperature during the epidemic will, I think, justify the probability of an insufficiency of ozone. Ozone is a good disinfectant of the atmosphere, inasmuch as it hastens the oxidation of decomposing animal and vegetable matter, hence it is important to life and health, and it improves the health in respect to diseases of a zymotic character, such as typhoid. In Melbourne, Sydney, and Hobart the mortality from typhoid fever has been unusually large. These cities in the summer season generally experience S. and S.E. winds, which bring considerable quantities of ozone from the sea, and these winds having been much less frequent this season than usual, I think the virulence of the disease may be in some degree owing to the lack of the purifying ozone. (Applause.)

Dr. PERKINS President of the Health Board said he would not rely upon the general death-rate of the community as a guide to its sanitary condition. He was rather inclined to take up the position of those who say the general average death-rate is no test of the health of a community, but rather the amount of sickness among the population. (Applause.) The qualifying conditions of old age had been familiar to medical officers of health for many years. Speaking of qualifying influences, Mr. Johnston might very fairly have introduced that of the occupations of the people. The occupations of many persons were unfavourable to length of life. Mr. Johnston had mentioned only one qualifying influence, and that was one most favourable to Tasmania. Density of population was a very important qualifying influence. Mr. Johnston himself pointed out that there was a difference of 70 per cent. in the death-rate between town and country districts, and that was a proof of the importance of density of population. If they were to take in qualifying influences at all they must include them all. There was another test also they might apply; that was, the qualifying test of the birth-rate. Mr. Johnston told them that the birth-rate of Tasmania was less than of the other colonies. But they must not forget that a large birth-rate would mean a larger death-rate owing to the number of deaths that occurred among children. He could not attach the same importance as Mr. Johnston to cosmical influences. There were always atmospheric influences at work, but these operated as much towards health as disease. If they could bring their sanitary arrangements up to a proper degree of efficiency they could afford to disregard cosmical influences. They had never yet obtained the active and hearty co-operation of the people in the carrying out of sanitary measures, but when they did it would be possible to reduce the number of cases of zymotic disease even in summer to a minimum and keep it there. If they had sanitary measures carried out with knowledge and spirit, the number of cases of typhoid fever might be counted on the fingers of one hand. (Applause.)

Mr. Morton, the secretary, also read the following communication received from Dr. Agnew:—I much regret being unable to be present at the discussion on Mr. Johnston's valuable and highly interesting paper. It is satisfactory to note that it more than confirms the general impression as to the salubrity of the Tasmanian climate, and proves by the inexorable logic of recorded facts, that in no part of the world from which we have statistics, is the prospect of a long life so good as in this colony. Some of Mr. Johnston's observations on the present epidemic of typhoid are worthy of careful consideration, and will, no doubt, insure discussion. My own impression is that the cause and origin of this disease are not yet clearly determined. No doubt the commonly assigned causes, filth or dirt, and certain foul gases, generally play a very considerable part in forming or fostering the disease, and therefore these noxious agents should unquestionably, in all cases, be done away with. But the question still remains, would the disease ever arise were these agents absent? Information, I venture to think, is still wanting before a conclusive answer can be given. From my own experience, however, and from the recorded experience of others, I think the disease may arise at any time without any hitherto recognised cause, but that its diffusion is generally influenced to a large extent by insanitary conditions. As these conditions, however, are frequently present, even in an intense degree, without producing fever they cannot be the sole cause, although they may constitute a great and palpable factor. But something more subtle appears to lie beyond. In the course of at least 25 years of my practice I do not think I saw six cases of typhoid, yet Wapping and other parts of the city were probably in a worse sanitary condition than they are at present. The few cases I saw, too, were quite solitary, and never acted as *foci* for the spread of the disease. Why was the city not scourged, at least occasionally, during all this time with fever if the real cause was persistently present? Again, like other epidemics, the present one has had its rise and fall over vast areas of town and country, the insanitary conditions still remaining a constant quantity. Weather, I am told, exerts little or no influence. Now, speaking of a locality under our immediate observation, if well-known noxious agents were (as frequently alleged) the sole causes of the fever, why should a healthy person, if exposed to their evil influence in Hobart to-day, be less liable to take the disease than he was a month ago, and why, if he took it, should it be of a milder type? The sanitary conditions remain virtually as they were. It cannot be said that the weak and puny alone succumbed at the onset, and that the robust who are left are better able to resist the poison. The disease, in fact, as far as age, health, and physical condition are concerned, has been very impartial as to its victims, nor does locality itself seem altogether to confer immunity. If the usually assigned agencies too, were the sole cause of this disease, why should persons employed in cleansing sewers be so healthy as they are said to be, how, indeed, could any of them escape? These men in stirring up the foul deposits, inhale continuously the nascent sewer-gas in all intensity; for however well the sewer may be ventilated it is clear the gas must exist there in greater proportion than is possible in the upper air. It may be said these men have become acclimatised to their surrounding, but as this suggestion cannot apply to their first exposure to the gas before acclimatisation was possible, the argument falls to the ground. I fear to trespass on the time of the meeting by going more fully into this very wide subject, and will therefore only add that although I do not agree with those who think the ultimate cause of typhoid has been discovered, many a report as to the beneficial effect upon it of sanitation leaves no room for doubt as to our proper mode of procedure. Our clear course is to do that duty which lies nearest to us, *i e.*, to thoroughly cleanse and purify all our surroundings. When this is accomplished, although I think occasional cases will still occur, the disease will probably be robbed of all, or most of all, its terrors.

His Excellency: Before calling on Mr. Johnston to reply I would like to say a few words. In the observations I made at the last meeting of this society I pointed out that I scarcely thought the public realised how much they owed to societies of this sort. Nothing could better exemplify this obligation than the paper we are discussing. (Applause.) The duration of human existence, and the influences determining it, are of the intensest interest to all, and men like Mr. Johnston, who, by patient labour in their study, tabulate and intelligibly state the results of observations, carefully recorded, as to the duration of life, are real benefactors to their country — nay more, to humanity at large. (Applause.) The science of statistics is a very difficult one—it requires so much measuring and weighing of facts in their relation to each other. But the common saying referred to by Mr. Johnston that "figures prove anything," is only correct when they are not properly used. Now, Mr. Johnston has conclusively proved to us that in certain conditions you cannot rely upon the death-rate by itself as an index of the health of a community. Does this prove that all statistics so based and accepted hitherto have been wrong? Certainly not. It only proves that this index may be misleading where, from accidental causes, you have an abnormal number of people of certain ages living in any particular locality. In a perfectly normal state of society the number of persons living at each year of age will depend entirely upon the rate of mortality among them, and when this is so the general death-rate is the readiest and most comprehensive test we can have of the health of the community. But in the colonies we are not in a normal state, nor shall we be for many a year to come, and migration, as Mr. Johnston has shown, in their case clearly vitiates any general conclusions as to the health of localities based upon the death-rate alone. Now, he has shown us a very simple way of testing the health of the community. He says, discard all deaths over 60 and you then get a trustworthy test of the comparative health of the community. I agree with him in a large measure, although there is much to be said for somewhat raising the limit, and for the purposes of this test I should also eliminate deaths of children under five years of age, as Dr. Parkinson proposes, respecting which period I shall have something to say presently. But even so, you must take the results with some qualification. People who emigrate to the colonies are generally more healthy and strong than those of similar ages who stay at home, and whether the death-rate among them in their new home is greater or less than that of the colony is yet to be proved. Now, as regards children under five, the death-rate at present everywhere is simply appalling. At the last meeting I said that the influence of women in matters of health and sanitation was of great importance, and in this group I may say it is paramount. I would commend to Mr. Johnston a careful analysis of the causes of death at this period, and would ask our medical friends to consider this subject most carefully. (Hear, hear). I now come to the question of typhoid, and about this I speak with sadness, not only because of its general prevalence at the present time, but also because my dear son is now suffering from it. Whatever obscurity may prevail regarding this disease all must admit that it is largely preventible by sanitary arrangements. As I pointed out in one of my first public utterances in this island, one of the imperative duties of the State, whether central or local, is to safeguard the health of the community. This society, in its corporate capacity, can force upon the proper authorities the paramount importance disclosed by statistics for energetic action in the matter, and I hope it will do so. But, individually, they can do much to urge on action on the part of those directly charged with the duty. In a self-governing community no one is relieved of his responsibility in such a matter. The representatives of the rate and taxpayers are bound to carry out the views of their constituencies on such matters, and the constituencies are bound to let them be known. No one is justified in sitting with his hands folded and saying, "It is not my business." (Applause.) As I said at the last meeting, so far from relaxing our efforts in the direction of prevention of disease, all Mr. Johnston's figures point to further and energetic action, and so long as the country is more healthy than towns we are bound to go on doing everything in our power to improve the sanitary conditions of life in cities. (Applause.) As regards the very curious and highly interesting waves of disease which appear to pass over countries often far apart, with something approaching to regularity, there is much to learn. They require to be most carefully analysed, with the view of determining how far they are general throughout the world, what the nature of the deaths is, and at what ages they mainly occur. We know but little of this at present, but I think everything points to these waves being due to climatic influence, although their causes are obscure. It is undoubtedly man's business to counteract as far as possible climatic influences which are painful to human existence, whether these may be local, as is possibly the case to some extent with typhoid, or general, as would appear to be the case with these waves of disease. Before calling upon Mr. Johnston to reply upon the whole subject, I would again desire to impress upon you how much we owe, first to the persons who carefully record the facts on which vital statistics are based; and secondly, to able statisticians like Mr. Johnston, who tell us what these records disclose. It is interesting and useful for us of the general public to discuss these matters, and sometimes at discussions of this sort persons who are not in themselves accustomed to scientific investigations, may hit upon great truths, or find out blots in statistics, but it is to the men who spend their lives in scientific investigation that we have to look for any real and sound progress in the knowledge of such subjects; men who with conscience pursue their laborious investigations for the sake of science itself, and who seldom receive the credit and honour which the benefits they confer upon humanity merit. (Applause.) It may be interesting to this Society to know that the two gentlemen Mr. Johnston refers to in this paper as authorities on vital statistics, viz., Mr. N. A. Humphries and Mr. T. A. Welton, are personal friends of mine, and that I have written to each of them, sending copies of Mr. Johnston's paper. (Loud applause.)

Mr. Johnston, in the course of his reply, said some of Mr. Mault's criticisms were not justified. The subjects he had been charged with omitting or insufficiently dealing with did not come legitimately within the scope of his paper. Mr. Mault in extolling human effort in matters of health seemed to be under the impression that he (Mr. Johnston) differed from him on that point, and yet he had devoted more space to extolling the value of human effort in mitigating disease than most other causes except one. In his paper he had said :—"Let me not be understood, however, to assert the valuelessness of human effort by ascribing the periodical death-rate, rise, and fall, mainly to far reaching superterrestrial causes, among which the sun's varying energy plays a large part. On the contrary, I desire to affirm that human effort, directed to selection of sites for dwellings; supplies of pure food and water; to provision against poisonous food and drinks; to improvements in sanitary matters, and to facilities for healthful recreation; to improvements in workshops and factories; to the multiplication of acknowledged health safeguards and of convenient centres for the proper treatment of disease, as well as to improvements in treatments of injuries and diseases. In all such matter human effort does much, and can do more, to mitigate the intensities of attacks of disease, from whatever source they come, even if it cannot wholly subdue them. That sanitation and improved treatment has done much in England during the last 20 years to lower the death-rate of the younger lives cannot be reasonably doubted, and this of itself should encourage local effort to strive for further improvement." He had been entirely misunderstood by those who assumed that he under-valued human effort. Indeed, there had been some preconceptions with regard to the paper which were not entirely justified. At the same time he was thankful for the generous way in which the paper had been criticised, for it was necessarily open to many misconceptions, and some errors on the part of the statistician would naturally creep in. He agreed that greater information should be given in their public registers for localising any kind of infectious disease, so as to control it as far as they could. With respect to this efforts had been made by the registrar and by the Government, and he had no doubt the Government would take measures to give the registrar power to get information as to locality. At the present time the registrar could not compel any person to give more information than was now recorded, which was all that could be demanded under the Act. He quite sympathised with those who wished to see the limits of age separating the old age group from the younger, raised from 60 to 65. But the reason he adopted 60 was that in examining statistics for other countries it was one of the limits that could be generally found. Those who had to toil through immense masses of figures would know the difference it made in the labour to adopt a figure which was easily and generally accessible. Besides, his researches had satisfied him that the advancing of the age to 65 would make no material difference in the result as regards Tasmania. To eliminate the ages under five in a general health standard as suggested by Dr. Parkinson and others would not be a wise course, as this group affords the most sensitive index to local health conditions. Besides it would be unfair to such a colony as New Zealand, where deaths under 5 are relatively very few; while the reasons advanced for excluding the group, owing to the small variation in proportion living in different colonies, are not of much force. Mr. Johnston further pointed out that the general health standard was only supplementary to the indices for each specific age group given separately in page 21 of his paper, and he showed that for age group 5-60 Tasmania stood first of all the colonies, New Zealand not excepted; thus the deaths 5-60 per each 1,000 living are—Tasmania, 5·60; South Australia, 5·67; New Zealand, 6·17; New South Wales, 7·37; Victoria, 7·72; Queensland, 12·66. He did not agree with those who would not allow Tasmania credit for her climatic conditions in their effect upon death-rate. Nature had done a great deal for this country, and it would be an absurd thing if in announcing their position to the world they could not credit themselves with the advantages that had thus been conferred on them. Coming again to the question of sanitary work, he stated that in his paper he had shown that in death-rate we were 70 per cent. worse in Hobart than in the country districts of Tasmania. With that standard before them there was no need to travel further to show how far human effort might reach in dealing with preventible diseases. It had been said that sickness was more reliable than death in showing the health of a community. He thought there was not much in that, and he had formed his opinion by studying the comparative number of deaths to cases in the public hospitals. In the Tasmanian hospitals in 1883 the proportion of deaths to cases treated was 8·05 per cent; in 1884 9·17; in 1885, 9·84. There was scarcely more than 1 per cent. of difference in the different years. Mr. Johnston concluded by explaining a series of charts he had drawn on the suggestion of His Excellency, showing the undulation of waves of disease in different years. These dealt for the most part with England, and showed that, notwithstanding the undoubted advance in sanitary science and the improved condition of towns, the occurrence and virulence of disease had been marked by an irregularity in different years, which plainly indicated to Mr. Johnston's mind that they were not entirely controllable by human effort, and that other influences must have been at work. The diseases thus shown on his diagrams were cholera, measles, small-pox, typhoid, and diarrhœa. (Loud applause.)

The Hon. P. O. Fysh moved a vote of thanks to those who had taken part in the discussion of the paper. He said it must be argeeable to find that in the diversity of opinion that had been expressed all were working towards the same goal, and that in thinking that Mr. Johnston did not attach sufficient importance to sanitary work they were under a misconception. It must be exceedingly satisfactory to know that there had evolved out of the discussion on this paper a deep feeling in the mind of every gentleman present that the work which had been commenced with respect to sanitation was not a work which they could afford to lose sight of, but were more deeply impressed with the necessity of all those efforts which man could make to keep down preventible diseases. (Applause.) They were indebted to Mr. Johnston for having initiated the discussion, which had been a most valuable as well as a most interesting one. He would be wrong if he did not thank their President for the very interesting manner in which he also had dealt with the subject. (Applause.) It was agreeable for them to know that they had a President who would take something more than a perfunctionary interest in their proceedings. As President they would like to see him frequently among them. (Applause.) There was one point he would like to mention that had been omitted in the discussion. He would like to call Mr. Johnston's attention to the frightful state of affairs that existed in the colony in the years 1851-2-3. In 1851 they had a population of 59,000 people, with a normal death-rate of 1,000. That was very nearly what their statistics for 1885 showed them to be now—about 15·40. But there came some disturbing cause in 1852 and 1853, which those who then resided in this colony were never likely to forget. With a declining population they had a death-rate which immediately doubled. They had a population of 64,000 in 1852, with a death-rate of 2,000, and in 1853 a population of 63,000, with a death-rate exceeding 1,900. This had been due to some disturbing cause that had never been satisfactorily explained. He had no doubt if Mr. Johnston would look into the subject he would be able to supply them with some valuable information about it. (Applause.)

Mr. JUSTIN BROWNE seconded the motion, which was carried with acclamation.

Owing to the lateness of the hour, the reading of a paper by Mr. R. A. Bastow, "On the Riccia natans (water plants)," was postponed till next meeting.

The proceedings then closed.

ANTARCTIC EXPLORATION.

A deputation from the Council of the Royal Society, consisting of the Bishop of Tasmania, The Hon. J.W. Agnew, M.D.,M.E.C., Messrs. James Barnard, R. M. Johnston, T. Stephens, and Alex. Morton (secretary), waited upon the Premier at his office on Monday afternoon, April 25th, with reference to the above subject.

DR. AGNEW stated that they had waited as a deputation from the Royal Society to ask for the sympathy of the Government on a matter in which the society had taken a great deal of interest—that was the exploration of the Antarctic Seas, with a view to any discovery that might be made towards the South Pole. It was a subject that many other bodies had taken a deep interest in, and he believed the Government of Victoria had expressed its readiness to do a good deal towards the object of such an undertaking. As Tasmania was the most southern colony it was fitting that she should take a deep interest in the proposal, and the colony had already been linked with discoveries in the South Seas by Hobart having been the port from which the ships Erebus and Terror, with Crozier and others, sailed on their memorable voyage. The port has been very largely interested in the whaling industry, and he thought it behoved them to take part in the undertaking. About £10,000 would be required to fit out vessels in a thorough manner, and it was estimated that some of the other colonies, besides Victoria, would join, and, if so, the pecuniary share Tasmania would have to take in the undertaking would not in the least degree be beyond her means. Under these circumstances they were anxious to enlist the sympathy and support of the Government, and any information the Society might obtain from time to time would be promptly placed before the Government. They hoped in the course of another year to have one or two ships arrive in Hobart fitted out for a voyage of discovery to the Antarctic Seas. He could not say what the results might be to some people if any land were discovered not dreamt of hitherto, but possibly a new flora and a new fauna might be there discovered. They knew that in all probability those seas would be found the haunts of whales, probably only the black kind of whale, but that furnished in its bone an article of increasing value to commerce. He did not think the sperm whale was likely to be met with so far south in the colder waters, but those who were engaged in commerce, like the Premier, would probably know more about this subject. It was thought that probably a sum of about £500 would be sufficient to furnish Tasmania's quota towards the expense of the undertaking, and he hoped the matter would be favourably considered by the Government.

Mr. BARNARD thoroughly agreed with Dr. Agnew in what had been suggested as to the advantages and benefits that might be supposed to accrue, and the scientific results that might be made elements in the consideration now being bestowed upon the question of raising the requisite ways and means. It had now become a practical question. They wanted to see what could be done in Tasmania in comparison to what would be done by the adjacent colonies. All colonies, no doubt, were interested more or less in the success of such an expedition, but Tasmania was specially interested, and the Royal Society had taken the matter up, as would be seen by the resolutions that the secretary would read. He felt peculiarly interested in the question, inasmuch as he had lived in the time, and had witnessed the advent into our waters of the Erebus and Terror when they returned from their exploration, and had the gratification of meeting their distinguished commanders at Government House at the time of Sir John Franklin's Governorship. The project had been initiated in Victoria, and he did not yet know what New South Wales intended to do, but it would never do for Tasmania, which had the greatest interest in such a project from its position, to fail to engage in an expedition in the essential success of which it would share very fully in. He did not know either whether the Home Government would share in the expense, but the leading scientific men in Great Britain, including those who had ventured towards the North Pole, had taken a very great interest in the matter. In conclusion, he expressed an earnest hope that Government would give the proposal a favourable consideration.

The BISHOP, and Mr. R. M. JOHNSTON did not think it necessary to occupy further time, as the matter had been very fully placed before the Premier.

Mr. ALEX. MORTON said the society had passed the following resolution in September, 1886, upon which occasion Mr. C. P. Sprent read a paper on "The Proposed Antarctic Exploration":—"That in the opinion of this society it is desirable, in the interest of science and commerce, that the exploration of the Antarctic regions should be continued, and that Tasmania should co-operate with the other Australian colonies in the despatch of an expedition for that purpose, and that the council communicate this resolution to the Premier." This was done, and at the last monthly meeting of the Society the subject was again considered on the reception of a communication from the Royal Society of Victoria and a progress report of the Antarctic Exploration Committee. It was then resolved that the council be authorised to approach the Government on behalf of the Royal Society, in connection with the Antarctic Exploration Fund.

The PREMIER, in reply, said they would be well aware of the multifarious matters brought under the notice of Ministers, including many that were far out of the ordinary routine of official duty. This was one of these, but it was a matter in which the Government desired to co-operate in any possible way it could, and they had to thank the Royal Society for having taken the initiative. The Government would still have to look to them to give direction to any practical support it might feel disposed to accord. But before Parliament was asked to vote any assistance there should be something to demonstrate that it was the wish of the people, and he would suggest that Parliament should be asked to grant £1 or £2 for every £1 subscribed. He did not know whether Victoria proposed that the £10,000, which it was estimated the expedition would cost, should be divided over the Australian communities *pro rata,* or whether Victoria and New South Wales proposed to bear the larger share of the burden. If it were federally divided, Tasmania's share would be a comparatively light one, and he would not at all fear that Parliament would not vote it. Still it would very much strengthen the case if the Society would collect from the commercial, scientific, and other portions of the community, sufficient to show that the public took an interest in it. Personally, he hoped to see the colony carrying out the traditions of its fathers. The Anglo-Saxon race were a discovering people, and many of them regretted that Christopher Columbus was not one of the race. They were all sorry he did not obtain from England the assistance he asked for. England had identified herself with Antarctic exploration, for Captain Cook had sailed as far south as 71deg. a century ago, and it would be derogatory to our credit to let Sweden or any other nationality take the work to a more successful issue. In Tasmania we occupied a vantage ground in respect to this exploration, and the colony would most probably form the base of operations. In this colony we lived in an atmosphere of discovery, and we should possess in vain the statue standing in Franklin-square if we did not feel the deepest interest in any future Antarctic discovery. As an offshoot of Great Britain we should be wanting in the national characteristics if we did not take the responsibilities as well as the advantages of the origin. Such responsibilities, in this part of the world, could not be better exercised than in voyaging over that unexplored portion of the earth nearest to us. If Ministers thought as he did, and if the Fellows of the Royal Society thought as he did, a public subscription should be initiated, and then the Government would be able to see what support they could ask Parliament to vote. At present Parliament was in recess, and any promise the Government could give would be subject to the reservation that Parliament would have to sanction it. He promised to submit their views to the Government, and thanked them for having taken the matter up.

Dr. AGNEW thanked the Premier for his reception of the deputation, and the tenor of his reply.

JUNE, 1887.

The monthly meeting of the Royal Society was held on June 14, the President, Sir Robert Hamilton, occupying the chair, and about 30 Fellows and several ladies being present. His Excellency was accompanied by Miss Hamilton, Miss Hervey, and Mr. H. W. B. Robinson, the Private Secretary.

NEW MEMBERS.

Messrs. N. E. Lewis, M.A., B.C.L., and Samuel Clemes, proposed as members of the society were balloted for, and declared elected.

ADDITIONS TO THE LIBRARY.

The secretary read the following list of additions made to the library during the month of May:—

Analele Institutulum Meteorological Romaniei. Tom. 1, 1885.—From the Institution.

Annals and Magazines of Natural History, 5th ser. No. 112.

Bollettino della Societa Geographica Italiana. Fasc. 3, 1887.—From the Society.

Bulletin of the Museum of Comparative Zoology, Harvard College, February, 1887.—From Professor A. Agassiz.

Bulletin de la Société Imperiale des Naturalistes de Moscow, 1886.—From the Society.

Chemist and Druggist of Australasia, June, 1887.—From the Editor.

Die Scen der Dutschen Alpen line Geographische Monographie. Von Dr. Alois Geistbeck.

Acht Tafelu, Mit 128 Figuren, Geologischen und Geographisehen.

Profilen Tiefenschichtenkarten und Dia grammen. Leipzic, 1885.—From the Society.

Draft of Prospectus of Selden Society.—From the Society.

Geological Magazine, April, 1887.

Hourly Readings, 1884. Meteor. Office, London. Part 1, January-March.—From the Department.

Imperial Federation, London, May, 1887.—From the Editor.

Journal of the Royal Microscopical Society, current Nos.—From the Society.

Journal of the Society of Arts, current Nos.

List of Members and Catalogue of Library of Geological Society of Australasia, 1886-7.—From the Society.

Machinery Market and Machinery Exported, London, 1887.—From the Editor.

Magnetical and Meteorological Observations, Bombay, 1885.—From the Department.

Meteorological Observations at six stations in India, 1886.—From the Department.

Mitterlungen des Vereins für Erdkünde Zu Leipzic, 1883-5.—From the Department.

Monthly Weather of the Meteorol Office, London, June and November, 1886.—From the Department.

Monthly Notices of the Royal Microscopical Society, London, March, 1887.—From the Society.

Nature, March, 1887.

Observations and Researches made at the Hong Kong Observatory Bombay, 1885.—From the Department.

ICELAND.

The Rev. J. B. WOOLLNOUGH read a long and interesting paper entitled, "Notes on Iceland." Mr. Woollnough prefaced his paper by calling attention to three books he had placed upon the table—two published by Icelanders in their own country, and the third published by an Englishman, containing a collection of the national songs, including a national anthem set to the same air as our own National Anthem, of which he gave a metrical translation. The paper opened by a reference to the eminence obtained in Iceland in literature, science, and art in comparatively early days, and the manner in which the people had solved, with no little success, the social and political problems, thereby influencing in no small degree their fellow-men in other parts of the world. Its literature, after 300 years of natural life, was one of the best in Europe, and formed one of the brightest gleams of light in the darkness of the middle ages. To Englishmen this country could not fail to be interesting. It had founded a colony in Greenland in the tenth and another in America in the eleventh century, which led to the later discovery of America by Columbus, who desired to test the Icelandic accounts of the lands towards the west. England was now testing a national system of education, about 50 years old, but Iceland with no schools at all had the best educated people in the world. With all this to be said about it the population was only half as great as Tasmania—a little over 60,000 people who lived and struggled against the most adverse circumstances. It appeared to have been first visited by Irish monks A.D. 800, but about the year 900 the change introduced in Norway by Harald Fairhair caused many nobles and others to emigrate to Iceland. These sea rovers when they landed on Iceland took up a definite area of land, prescribed by custom, and no more, allotting portions to their retainers by a rough sort of feudal tenure. In 929 the whole seaboard, the only habitable part of the island, was taken possession of, and in that year the general Legislative Assembly or Althing met for the first time, and adopted shortly afterwards a general code of laws. This national Parliament was composed of 144 members, being the chiefs of the various districts, and two other members nominated by each. They were lawyers by nature, and the whole of their early history is composed of suits between chiefs, which frequently led to the final arbitrament of the sword. The young Icelanders of the early days, in the spirit of the sagas travelled to other parts of the world in the combined characters of traders, soldiers, lawyers, and, not unfrequently, poets. The closest parallel to the Icelanders of the tenth and twelfth centuries were the English adventurers of the sixteenth century, who were the terror of the Spanish main, and were warmly appreciated by Elizabeth. In the year 1,000 the Christian religion was first introduced into Iceland, and the Roman alphabet took the place of the old characters. After a warm debate in the Althing, the Christian religion was established as the national religion. It soon took root, and piracy disappeared, while the young Icelanders began to leave home for the purpose of visiting European universities. The national literature was then soon born, and the chief literary glory of the country was that it is the only European country that could boast of a prose literature dating from the twelfth century. The commerce of the country extended to many southern lands, and one of their ships returning from Dublin was driven over the western seas till a country was touched which they called Vinland. This was North America, where a colony was founded in 1007. A colony was also established by Eric the Red in Greenland, but it died out in 1418. In discovery and colonisation the Icelanders were before all other nations, and might be said to have been 300 years before their time. In 1262-4, after a series of warm political debates the Althing determined to unite with Norway, and bitter opposition was afterwards raised to this course. The reader of the paper knew that there were people in this colony who thought they should do as Iceland did by a union with Victoria. Victoria would gain by this, and the loss would be ours, and we would find, as the Icelanders had found, that without local self-government there would be nothing to foster local energy and interest in public affairs. From the date of this union Iceland fell into obscurity compared with the brilliancy of its past history. In the 14th century Iceland was transferred with Norway to Denmark, under which Government it remained. The Lutheran form of faith was adopted in 1578, and the first printing press set up. In the 16th century the people suffered much from the Algerine pirates, and subsequently was visited by smallpox, which carried off no less than 16,000 of the inhabitants. Since then it had suffered much from nature and from man, and the highest testimony of the great qualities of this people was that, though one-fourth, and afterwards one-third, of their numbers were suddenly carried off, and immense areas of pasture land burned under streams of lava, their indomitable perseverance kept them there. Towards the end of the last century the Althing considered the question of abandoning the colony, but patriotism and hope, and energy kept the people there. The writer advocated inducing the people of this interesting country to emigrate to Tasmania, as we would find in them people with some money, good education and a native power of struggling against difficulty which would make them admirable colonists. In 1874 Christian IX. visited his subjects in Iceland, and granted them a constitution, under which a Governor was appointed who received his orders from a Ministry for Iceland. The Parliament established was composed of two chambers elected for six years, and meeting for six weeks every second year. During the last few years the country had been passing through a political crisis, for a great meeting of all the male inhabitants over 21 years had commanded the Althing to sit and demand Home Rule. This was done, but the King would not consent, and it had again been demanded. The Danes were contemptuously kind to Iceland. They had set aside their wishes, crippled their trade, and established a national bank which had many evil results. There was practically no crime in Iceland, sheep stealing and petty theft being the only offences known. The last murderer dated a long time back, and was carried to Norway for execution, while the prison had been turned into a museum. In the writer's opinion the sources of wealth in Iceland were not yet developed or not sufficiently developed. The land was not fully stocked, the fisheries were not attended to, and, until recently, when a Leith merchant paid in coin, the commerce had been carried on by barter. Since then money had been accumulating in Iceland. With a good banking institution, good boats for harvesting the fisheries, and taxation, a new development would ensue. Up to the present there was not any system of taxation, and, consequently, roads and bridges did not exist, while immense marshes were waiting to be drained. There were no very rich people, and no poor people, a greater equality existing than in any republic. Out of a population of 64,000 it was curious to observe that there were 57,000 freehold farmers, 523 labourers, 11 doctors, 27 dealers, 230 carpenters and joiners, 80 blacksmiths, 80 goldsmiths, two prisoners, and no record of any lawyers. There were only 63 surnames in the whole country, many people not having any. A very interesting description of the Valley of Kingvalla where the Althing met—a plain five miles wide depressed by sudden volcanic action—was given, and the paper concluded with some facts relating to the social nature of the people and their hospitality. As a proof of their courtesy and disinterestedness, he related that he had dropped a diamond ring and could not discover it again. Upon his return to Edinburgh he received a letter from his host enclosing the ring, which had been found by a farmer who refused to take any money for it, saying that he had already more than received his reward in the satisfaction he had in having been able to restore his ring to the "Walking Priest."

TASMANIAN FISHES.

Notes on the identity of certain Tasmanian fish by Mr. SAVILLE-KENT:— Two species were referred to in Mr. Saville-Kent's notes, the first being the large species of parrot fish, commonly taken in Tasmanian waters, and known to the fishermen by the name of the "blue-head." Mr. Saville-Kent stated that he had failed hitherto in his endeavour to establish its identity with either of the several species of parrot fishes included in Mr. Johnston's catalogue. While recently in Sydney he submitted a coloured drawing of the fish to Mr. Douglas Ogilvy, of the Australian Museum, who recognised it as a previously unrecorded species which he had described in the proceedings of the Linnæan Society of New South Wales, under the title of *Labrichthys cerulœus*. The second form referred to was the so-called "magpie perch" of the Hobart fish market, and which is included in Mr. Johnston's catalogue under the title of *Chilodactylus gibbosus*. At the Manly Aquarium in Sydney Mr. Saville-Kent had observed this technical name placarded against an entirely distinct fish, and on searching out the original figures a description of it given by Richardson ascertained that the Tasmanian type was a new and hitherto undescribed species, and for which he now proposed the technical title of *Chilodactylus vizonarius*. With reference to the two broad black bands that incirle the fishes body, coloured drawings, from life, of the two species in question were exhibited by Mr. Saville-Kent. Mr. Saville-Kent also exhibited to the meeting examples of oyster-brood recently reared by him on the Government reserve at Spring Bay, and referred to them as an earnest of yet more substantial results that might be anticipated by a perseverance with the operations recently inaugurated. The specimens in question were the pine branches covered with oyster brood described in these columns a few weeks since. Mr. Saville-Kent regretted that Mr. Johnston was not present, as he believed that gentleman would give an opinion, but probably Mr. Morton would have something to say on the subject.

Mr. A. MORTON stated that, owing to a previous engagement, Mr. Johnston was unable to be present, but that he (Mr. Morton) might say that the drawing of the fish submitted to the meeting by Mr. Kent was not identical with the one referred to in Mr. Johnston's catalogue as *Cossyphus Gouldii*, although *C. Gouldii* was enumerated in Mr. Johnston's catalogue. Mr. Johnston had stated that he had not seen a specimen himself, but that the late Mr. Morton Allport had recorded it as having been found in Tasmanian waters. With regard to the other drawing, *Chilodactylus vittatus*, Mr. Morton said that Mr. Johnston had informed him to-day that a fish answering the description of *C. vittatus* had been reported to him (Mr. Johnston) as having been captured in our waters.

Mr. SAVILLE-KENT also presented a specimen of the *Leipodus caudatus*, or frost fish, which he had secured after it had been found floating about in the Fisherman's Dock. He had frequently seen it caught in the North Atlantic, especially off the coast of Spain where it was caught like the fishermen caught barracoota. It had a beautiful silver flash as it was thrown up through the air. It took a bait similar to the barracoota, to which species it was allied, as would be seen by looking at its canine teeth.

Mr. A. MORTON said it was a strange coincidence that a fish of the same species was found floating in the water at the same time last year by Mr. Whitehouse, and as far as he had been able to discover it had never been found in a living state in New Zealand, but was there found washed up after a severe frost on the beaches, particularly between Wanganui and Wellington. It grew to 5ft. or 6ft. in length, and was highly prized for food, realising from 2s. 6d. to 3s. per lb.

Mr. MORTON read the following account of two rare fish by Mr. R. M. Johnston :—*Histiophorus Herschelli* (Gray). — A fine specimen 13ft. 6in. total length, was recently discovered by me stranded and half buried in the sand bank communicating with a large lagoon, immediately to the north of Cape Fredrick Henrick on Forestier Peninsula. It answers in all characteristic points to the above species so far as could be observed. Unfortunately it was much decomposed internally, and the ventral and anterior portions of anal fin were destroyed. The anterior part of spinous dorsal was elevated into a crest composed of about 11 spines, curving between the occiput and a line passing through posterior of præoperculum ; somewhat truncated at its point of junction with the rest of dorsal spines, which were uniformly only about 2in. high to junction with soft rays near peduncle, which are slightly higher than the posterior portion of spinous dorsal rays. The longest rays of first dorsal were about 12in. to 14in. The soft anal is developed similarly to the soft dorsal, each composed of seven rays. The characters and dimensions as observed were :—Length of head to extremity of upper jaw, 4ft.; broad expanse of tail forks, 4ft. 4in.; to greatest depth about 2ft.; D. 11·31/7, A.-/7, V.P. 14 falcate. Dermal productions, bifurcate or lozenge shaped ; skin thick, hard, and bony. As Dr. Gunther states that specimens of this genus are few and imperfect in museums, and as it is desirable to make further observations on large individuals, it is of the greatest importance that this noble specimen should be secured for our Museum. The specimen was too large for me to carry to town, as I was at the time travelling on foot, but I have urged Mr. Frank Rush, to whom I have explained its nature and position, to bring it to town as perfectly as possible on his next trip to that locality. It would be desirable for the Museum authorities to assist in defraying the expense of its removal to Hobart. It would prove a most interesting as well as valuable addition to their collection. The addition of the above species of swordfish to our catalogue of Tasmanian fishes will be of much interest to ichthyologists generally. I had heard of a swordfish having been seen prior to the publication of my catalogue and observations on Tasmanian fishes in 1880, but being in doubt, I omitted it from the list of fishes then given. *Lamma cornubica.* Gm. (Porbeagle shark.) Præoral portion of the snout longer than the longitudinal axis of the cleft of the mouth, conical pointed; angle of the mouth nearly midway between the gill opening and nostril; teeth 13-16—12·14 on each side, lanceolate with a small basal cusp on each side in adult specimens; in young specimens these cusps are absent; the third tooth on each side of the upper jaw is very small; the width of the first gill opening is nearly equal to its distance from the last; origin of the dorsal fin above the root of the pectorals, which are somewhat falciform, the length of their lower margin being nearly one-fourth of that of the upper. A fine specimen, about 3ft. long, was recently captured by Mr. Frank Rush in a graball net, and to him I am indebted for the opportunity of making these observations and for enabling me on his behalf to present to the Museum collection the valuable addition of so rare a species in our waters. Mr. Morton since has most skilfully stuffed the example, which may be seen in the Museum.

Mr. Morton said he had tried to make arrangements to secure the specimen of the swordfish, but had failed up to the present, though he hoped to succeed eventually. So far as he could make out from the description it corresponded very closely with the specimen contained in the Sydney Museum, which had been secured in a rather curious manner. Two fishermen were off the coast there fishing for schnapper, and every second or third fish caught was taken off by a large fish swimming around the boat. The boat was anchored by a chain, and the large fish, which was found to be a swordfish, inserted his sword in a link of the chain, and made away with the boat. The fishermen, who fortunately had harpoons, secured the fish and sold it to the Museum for £10.

A NEW WATER PLANT.

Mr. R. A. Bastow read a paper on a specimen of the *Riccia natans* (water plant). Mr. Bastow stated that this plant was new to Tasmania, and he had failed to find that it had been discovered anywhere in Australasia except in one locality in New Zealand. The specimen under review had been obtained by Miss Oakden, of Launceston, in a lagoon near the Tamar, and was much larger than the English plant. He also submitted a specimen *Nitella* of obtained from the pond in the Royal Society Gardens. Both specimens were exhibited under the microscope.

MISCELLANEOUS.

Mr. Morton drew attention to specimen numbers of the Picturesque Atlas of Australasia lying on the table, and referred to it as the most elaborate and artistic work ever published in Australia. He had brought back from Sydney with him a few of the sketches contained in the work, eleven parts of which had been already published in that city by an American company. He also drew attention to a portfolio containing about 50 sketches of Tasmanian scenery by Mr. J. S. Prout—an artist who was probably well known to some of the older members—which had been very generously presented to the society by the Hon. William Robertson, of Colac, Victoria.

THANKS FOR THE PAPERS.

The President, at the conclusion of the meeting, invited the Fellows to join with him in a hearty vote of thanks to the gentlemen who had read the papers there that night, and thereby contributed to a very interesting and instructive evening. As regarded Mr. Woollnough's paper, he had listened to it himself with the greatest interest, for his home, the place where he was born, was only two day's sail from Iceland—the Shetland Islands. He had been accustomed to hear of Iceland in all his early days. Vessels going to Iceland very often called at the Shetland's on their way, and one from there came with a cargo of Iceland ponies, one of which was purchased for him and ridden by him when a boy. To him, therefore, it had been truly interesting to listen to Mr. Woollnough's paper, for although he had never been to Iceland himself, the members of his family used to go there constantly, and he became very familiar with what might be called the social matters as opposed to the historical affairs of that place. As far as his judgment went it entirely accorded with all Mr. Woollnough had said. To the other gentlemen—Messrs. Saville-Kent, Johnston, and Bastow—he thought they would certainly have great pleasure in giving them their hearty thanks for the papers they had read. (Cheers.)

The meeting then terminated, and the microscopes on an adjoining table were visited.

JULY, 1887.

The usual monthly meeting of the Royal Society was held on Monday, July 11th, when there was a good attendance of Fellows and visitors.

Mr. JAMES BARNARD said the President (His Excellency Sir Robert Hamilton, K.C.B.) would not be able to be present, as he was detained elsewhere by important business, so it devolved upon him as the senior vice-president to take the chair.

List of additions to the library during the month :—

American Museum of Natural History, Annual report of the Trustees, and list of members for the year 1886-7. From the Department.

Annual Report, Vol. I., 1885, Geological and Natural History, Survey of Canada, and maps to accompany report. From the Department.

Bollettino della Societá Geographica Italiana, Serie II., Vol. XII. Fasc. 5. From the Society.

Bulletin de la Sociéte Imperiale des Naturalistes de Moscow, No. 3. Moscow 1886. From the Society.

Catalogue of the Lizards in the British Museum, 2nd Edition, by Albert Boulenger, Vol. III.; Lacertidæ Gerrhosauridæ, Scincidæ, Anelytropidæ, Dibamidæ, Chamœlontidæ Catalogue of the Fossil Memmalia in the British Museum, Part IV., containing the order Ungulata sub-order Proboscidæ, by R. Lydekker, B.A., F.G.S. From the Trustees.

Den Norske Nordhavs—Expedition 1876-8, XVII., Zoologi, Alcyonida, ved. D.C. Danielssen. From the Department.

Guide to the Galleries of Reptiles and Fishes of the Department of Zoology of the British Museum, General Guide to the British Museum. From the Trustees.

Monthly notices of the Royal Astronomical Society, Vol. XLV., No. 6, April 1887, from the Society.

Monthly weather review, M.S. of America, January and February, 1887. From the Department.

Proceedings and transactions of the Queensland branch of the Geographical Society of Australasia, second session, 1886-7. From the Society.

Photograph of nest and eggs of the mountain thrush of Victoria. From Mr. E. D. Swan.

Records of the Geographical Survey of India, Vol. XX., Part II., 1887. From the Society.

Results of a Census of the colony of New Zealand taken for the night of March 20, 1886. Education. From the Department.

Statistics of the colony of New Zealand for the year 1887, Part III. Trade and Interchange.

Verhandlungen der Gesellschaft Für Erdkunde Zu Berlin, Band XIX., No. 1, 1887. From the Society.

Victorian Naturalist. July. From the Society.

THE PROPOSED ANTARCTIC EXPEDITION.

The secretary (Mr. A. Morton), stated that during the past two or three months the council had corresponded with the Royal Society of Victoria in regard to the Antarctic exploration. A meeting of this Society had appointed a deputation to wait upon the Premier, and since that deputation had waited upon the Premier, the following telegram had been received :—"Admiral Sir Erasmus Ommaney, secretary to the Antarctic Committee of the British Association, writes, urging all learned and scientific societies throughout Australia, to send a united appeal to promote Antarctic exploration. Is your Society willing to join in such an appeal? Please reply without delay. Probably you will not find it necessary to call a special meeting to justify you in replying generally. (Signed), A. C. MACDONALD, hon. secretary Antarctic Committee, Melbourne." His Excellency the President then called a special meeting of the Council, and a reply was forwarded, stating that the Council had decided to follow up the action already taken, and to join in the appeal, and enclosing papers to show what had already been done.

SPECIAL SCIENTIFIC MEETINGS AT ADELAIDE.

The secretary read the following letter from the secretary of Royal Society of South Australia :—

"Parkside, South Australia :—To the Hon. Sec. Royal Society, Tasmania.—Sir,—An effort is being made by the council of the Royal Society of South Australia to arrange for special meetings of scientific men, and for excursions in which would be of special interest to naturalists and geologists, partly in conjunction with, and partly in addition to the meetings of the Studical Congress, which are to take place in Adelaide at the end of August of this year. These meetings are not intended to in any way anticipate the proposed Australasian Association for the advancement of science, but are to be informal. The council think that the meetings of the congress and the Jubilee Exhibition will afford specially good opportunities for such meetings. As an additional attraction the council have arranged with the South Australian Government to permit members of your society to travel over the South Australian railways at that time at half rates on production of a member's ticket. Negotiations are in progress with the Governments of New South Wales, Victoria, and Tasmania, with the view of obtaining a similar concession, and my council have very little doubt but that they will be granted. Although the arrangements have not yet been completed, it has been thought advisable to draw your attention to what has been done, with a view to bringing the proposal before your members at as early a date as possible. I shall be glad to hear from you whether any of your members are likely to avail themselves of the opportunity. On receipt of your reply, stating, if possible, the probable number, I will forward to you blank cards to be filled up for presentation at the railway stations when booking for the journey.—Yours truly, W. L. CLELAND, M.B., Hon. Sec."

A reply was sent, stating that the letter had been laid before the Council, and would be laid before the next meeting of the Society.

SCIENTIFIC FEDERATION.

A letter was read from the Premier, forwarding a letter from the Agent-General, covering a communication received by him from the High Commissioner for Canada, forwarding a letter written by Sir Wm. Dawson, of Montreal, to Professor G. G. Stokes, President of the Royal Society. The last document contained a proposal for a union of British and English speaking geologists to lay a broad foundation of geological fact, classification, nomenclature, and representation, which would ultimately be adopted by other countries as far as local diversities and differences of language might permit.

Mr. T. STEPHENS looked upon the communication as one of special interest directly to geological investigation, and, indirectly, to all interested in scientific matters. An International Congress on the subject had been held two or three years ago at Bologna, under the presidency of the King of Italy, and an endeavour was made to arrive at a common basis upon which geological maps and geological terms might in future be employed. At present almost every country had its own way of distinguishing different periods and different geological formations on maps, a bright carmine in some countries representing granitic formation, while in other countries it might represent some sedimentary formation. The object of the proposal he imagined was to establish some common agreement among geologists all over the world to distinguish different formations. Tasmania could not expect to contribute any important help or advice in such a matter; but he thought it desirable to assure Professor Dawson of the hearty sympathy of Tasmania.

THE BISHOP of Tasmania said he thought some tangible resolution should be placed on the records, as he agreed with Mr. Stephens that it was a very important communication. He looked upon it as tending towards the millennium, for geology in the past had been the science of choosing the best stones to throw at one another, and disputed theories had been contended for with marked animosity.

Mr. R. M. JOHNSTON was very glad to find the importance of the communication so readily recognised, seeing how very desirable it was that some common plan should be adopted if it did not interfere with practical work in regions where the systematic sub-divisions of one country did not exactly agree with those of the other. Some parts of the world had gone into details with such elaboration that it was practically impossible for other parts to follow. In the greater divisions a common plan of colouring might be advantageously adopted, but he felt that as with Professors Hutton and Tait, Mr. Jack and others, difficulty and confusion would arise if Australasia adopted the colours of other parts of the world, so far as the minor divisions of systems were concerned. Those who learned geology from books would not know of the difficulty in the field if Australian geologists followed too closely the sub-divisions of Europe. Still they might present their difficulties and ask guidance and assistance how to come into greater harmony with them, and in that respect effect a great deal of good. He did not agree with those who said "Do away with colours," simply because they could not particularise; for pioneer work must at first be content with generic groupings, and finer lines of demarcation would come afterwards.

Mr. T. STEPHENS moved,—"That the Royal Society of Tasmania cordially welcomes the proposal embodied in Sir Wm. Dawson's letter, and requests the council to communicate to the proper quarter the desire of the Society to further the important object of the federation of British and American geologists.

Mr. R. M. JOHNSTON seconded the motion, which was agreed to.

A RARE MOSS.

Mr. BASTOW submitted a specimen of *Dawsonia superba*, one of the most magnificent of known mosses, collected by Miss S. Gerard, near Ulverstone, on the North-West Coast of Tasmania, and gave a few descriptive particulars of the plant, only one species of which had yet been discovered and that only once by Mr. Gunn in Tasmania. The genus was confined to Australasia.

TASMANIAN HEPATICÆ.

Mr. R. A. BASTOW, read a paper giving a full list and description of the Tasmanian *Hepaticæ.* Accompanying the paper were 35 plates illustrating about 140 species. This very valuable paper will be a great acquisition to the Journal of the Society, covering, as it does, 228 pages of manuscript. Mr. Bastow said as much of his paper was of a technical character he would merely read a part of the introduction thereto, stating that in popularly-written botanical hand books the *Hepaticæ* are usually not described, the authors chiefly confining their attention to plants of larger growth ; the phanerogamous plants receive full notice the ferns and lycopods may also be described, but here the line is usually drawn. The *Mosses*, *Hepaticæ*, *Lichens*, and *Fungi*, are dismissed with some such remark as, "that they are distributed throughout the world, and are of no economical importance," "or that they form beautiful transition from low to high organisation," and "that they are evascular." Few persons ever dreamed that earthworms were of any importance until Darwin observed and described their habits; and probably quite as few are aware of the aid lent by the *Mosses* and *Hepaticæ* to the economy of nature in the formation of peat ; it is not at all unlikely that the *Hepaticæ* cushioned the swampy ground ages ago, and contributed their share in the structure of coal for the use of man at the present day. It may, therefore, not be wasted time if we bestow a little attention to the Natural Orders of Australasian Cryptogams containing as they do, the more minute forms of plant life. He essayed during the last session of this Society to describe to the best of his ability the Tasmanian *Mosses*, and now ventured upon a description of the *Hepaticæ.* Doubtless many errors may be found that a more experienced and abler pen would have avoided, but as the reference to descriptions is the first necessity in the study of *Hepaticæ*, even if that reference be but a poor one, and as the subject has not yet been taken in hand since the publication of "Hooker's Flora Tasmaniæ," with the exception of the valuable supplement in Vol. XI. of Baron von Mueller's "Fragmenta Phytographiæ Australiæ," and as those who reside far away from the city, and are desirous to know something about the *Hepaticæ* that grow in such profusion in the moist gullies and by the banks of streams, and yet have no hand-book on the subject that they can consult, he ventures to hope that the following compilation may to some extent be useful, its many shortcomings notwithstanding. The entire structure of some of the *Hepaticæ* so resemble the *Mosses* as to render them popularly regarded as identical, but they may be distinguished therefrom by their soft, spongey lax texture; by their leaves being destitute of nerves ; by their frequently less vivid colours ; and by their affecting moister situations. They vary in size as do the *Mosses*, from 6in. long or more, and remarkable for their beauty as well as their size, to very minute capillary forms scarcely distinguishable as plants without the aid of the microscope. The fruiting specimens are not so easily detected as they are in *Moss* plants, but that apparent deficiency is more than counter-balanced by the numerous and exquisite forms of leaves affording excellent characteristic points for the determination of genera and species. Perhaps the *Hepaticæ* grow in greater profusion and variety, and attain greater size and beauty in the densely ferned and matted dingles on the moist slopes of the mountains of Tasmania than in any other part of the world. A little rough scrambling through the tangled masses of vegetation, and a little climbing over fallen forest giants, yet keeping near to the stream, and we are certain soon to discover the old decaying logs completely covered with *Hepaticæ,* so much so as to effectually conceal the decaying wood that supports them. Some of the cavities in the logs are matted with an abundance of long, stringy, whitish plants; these are soft and yielding *Lepidozia,* and charming objects for the stage of the microscope, the leaves being scarcely visible to the naked eye. Other logs will be found covered with that giant amongst *Hepaticæ, Gottschea Lehmaniana;* it is of light green colour, and is suspended in masses over the stream. The large size of this plant, 6in. or more, makes it a prominent object, yet its leaves are so curiously laminated and folded that it is very difficult to dissect for the purpose of absolute certainty in determination of species. Some of the rocks are covered with a dark green moss-like coating, rough-velvety both in appearance and touch, the genus *Lejeunia.* Although the leaves are minute, each leaf is furnished with a sac, the water in the sac swarming with moving bodies, probably *antherozoids.* Others are covered with a light brown and beautifully pinnate plant, *Polyotus Magellanicus,* each leaf bearing a club-shaped lobule, so curious an appendage that when once observed it will not be readily forgotten. All the foregoing belong to that section of *Hepaticæ* known as *Foliosæ.* They are plants with distinct stems, bearing distinct leaves. But there are other *Hepaticæ* that bear no distinct stems or leaves, these organs being fused into one flat leaf-like frond, hence the name of the section *Frondosæ.* To this section belong the *Blyttia, Metzgeria,* and other genera. The latter may be observed forming a perfectly flat net-work around the bark of the living trees. It is almost impossible to secure a perfect specimen without taking the bark as well, but the collector will be amply repaid when he settles down to its examination with the microscope. The under side of the frond is particularly interesting. The third section of the order is called *Carnosæ.* In this the fronds are broad and fleshy, of a vivid green colour, having oblique scales on their under sides. They cover moist rocks or stumps, and sometimes grow on earth. By the aid of a pocket lens small receptacles will be observed on the upper surfaces, surrounded by a beautiful pellucid fringe, the receptacles contain *gemmæ.* Seen for the first time they are sure to remind the observer of a miniature bird's nest with eggs inside. The remaining section is *Anthocerotæ.* These also have fleshy fronds, but differ from the preceding section in being without scales on the under sides, and in the manner of fruiting. The plants of this Natural Order are nearly always procumbent, the *dorsal* side of the stem being the upper side as it grows, and the under side the *ventral.* For the purposes of identification botanists have divided the *Foliaceous Hepaticæ* according to the manner in which the leaves are set on the stem; they are either *succubous, vertical,* or *incubous,* and it is not easy for beginners in the study to determine in which manner the leaves are actually set; it is, therefore, important to make the differences very clear. If the lowest part of the base of the leaf is on the *dorsal* side of the stem, the leaf is *succubous.* If the base of the leaf crosses the stem *transversely,* it is *vertical.* If the lowest part of the base of the leaf is on the *ventral* side of the stem, it is then *incubous.* The *stipules* are the third rank of leaves, and are generally comparatively small; they are, however, of great use in identifying the genus and species of the plant. The fruit, as in mosses, is generally terminal or lateral. If terminal, the pedicel of the capsule will proceed from the apex of the stem ; if lateral, the pedicel will proceed from the side of the stem. In some of the genera the fruit is embedded in the frond. Usually the fruit of *Hepaticæ* may be known by the pellucid cellular fruit-stalk, with four brown radiating arms at the tip of the stalk. It generally consists of an *involucre*, a *perianth*, a *calyptra*, and a *capsule*. The *involucre* is a few elongated and sometimes lobed leaves, and in most cases the *perianth* may be observed within these. The *perianth* is an erect, tubular, or inflated sheath ; is sometimes compressed, and is frequently angled or keeled. The mouth of the *perianth* may be contracted, dilated, entire, or lobed, these distinctions being in many cases specific characters. Within the *perianth* the transparent oblong or globose *calyptra* will be seen if the fruiting is sufficiently advanced, and here at the base of the fruit stalk it remains, not ascending with the capsule as in *Mosses*. Of all the fruiting organs in *Hepaticæ*, this alone is never absent. As the *capsule* ripens, it bursts the *calyptra*, and is carried through it and upwards as a small blackish ball at the tip of the pellucid stem, and when ripe it bursts into four valves in most species. The *capsule* then appears as a small brown cross. The capsule contains innumerable spores, mixed up with long spiral threads called *elaters* ; when the capsule bursts, these elaters twist about and throws the spores to some distance. Elaters are never found in the fruit o *Mosses*. The female inflorescence or *archegonia* consist of minute and slender flagon shaped bodies with long tubular necks, within each there is one solitary loose cell. One of these becoming fertilised, it eventually ripens into the *calyptra* above described, the loose cell becoming the *capsule*. The male inflorescence or *antheridia* are very minute pedicelled sacs on the same or on different plants from those containing the *archegonia* they are usually solitary on the axils of modified *(perigonial)* leaves, which sometimes occupy proper branchlets. The fruit of the *Frondose Hepaticæ* is somewhat different. In the *Marchantia* for instance, the *involucre*, *perianth*, and *capsule* are contained on the surface. These will be familiar to most persons as small green stalked knobs growing from leafy expansions on wet rocks or stumps. The *gemmæ* contained in the frondose expansions, and before alluded to, are themselves reproductive.

Mr. A. J. TAYLOR thought Mr. Bastow had followed up his valuable work on Tasmanian Mosses very well indeed in the paper just read, which would also be of great assistance to students. The drawings accompanying the paper were a credit both to Mr. Bastow and *The Mercury* office.

Mr. JOHNSTON considered the paper a very valuable continuation of the work Mr. Bastow placed before the Society last session. Those who knew nothing whatever of Hepatics must have gained something from the reading of such a valuable paper. With the plates and key a simple way was furnished by which even children could be led forward to understand and converse pleasantly upon that singular group of plants. Papers such as those written by Mr. Bastow would have been of great value to him when first he came to the colony, as he had, in a measure, to construct his own handbook as he went along.

Mr. A. MAULT praised the paper for its completeness and elaboration, and thanked the writer for the insight he had given to a very interesting branch of natural science. In these days, when the population of the country was constantly drawn to the town forming the danger of our cultivation, nothing would counterbalance it so much as the encouragement of such interesting studies as Mr. Bastow had undertaken.

Mr. A. MORTON placed a high value upon such papers, and thought it was due to Dr. Agnew that three or four very practical papers had been published by the Government in the proceedings of the Society during the present session, thus scattering the fact broadcast that the Royal Society of Tasmania was doing its best to encourage the development of natural science. He thought a handbook should be prepared on the Mosses and Hepaticæ of Tasmania for the use of its schools, and he hoped a sum of money would be voted, and Mr. Bastow asked to prepare such a work. It was not only in Tasmania that this work was appreciated, for he had heard people in Sydney and Melbourne speak very highly of the former paper, and when he told them that a paper on Hepaticæ was being prepared by Mr. Bastow, which would eclipse those on Tasmanian mosses, it was said that the Royal Society would be doing good work if the former paper could be eclipsed.

The CHAIRMAN thoroughly appreciated the liberality of Dr. Agnew, but thought the present Premier would be found doing the same work. He considered handbooks of the natural history of the colony would be valuable aids in education, and far better than the obsolete knowledge frequently taught.

KING'S ISLAND, MOUNT CYGNET, AND FINGAL.

Mr. R. M. JOHNSON read some notes with respect to the fishes, and the land and fresh-water molluscs of King's Island. He stated that he was indebted for the specimens on the table to the commendable interest taken by Mr. John Brown, surveyor, in the natural history of Tasmania. The collections embraced four species of fishes, and nine of molluscs. The fishes were common to the rivers of Tasmania, and the shells were also common to Tasmania, with the exception of *Helix Brunonia*, which though closely approaching *H bisulcata* and *H lamproides*, was easily distinguished by the partly closed perforation, very convex base, and peculiar shagreen surface-ornamentation. It had a closer alliance with *H atramentaria* of Victoria from which, however, it differed in many points.

Mr. JOHNSTON also read an interesting paper on the lower coal measures of Mount Cygnet, as an addenda to a preceding paper, giving sections characteristic of the formation, and adding some remarks upon the beautiful feldspar-porphyries found at Port Cygnet. Alluding to the alluvial gold discovered at Lymington in the same locality, and worked with more or less success in the valleys associated with the porphyritic rock, he said it was a question of much interest to ascertain by careful experiment whether the pyrites of the metamorphic rocks associated with the porphyry might not also be auriferous. Apparently no other rocks of an auriferous character were to be found in the vicinity. He had submitted some of the pyrites to Mr. Ward, who would shortly be able to give a report.

Mr. JOHNSTON also read some notes on the Fingal Basin from the operations of a trial bore, by means of a diamond-drill, sunk recently at Harefield, under the direction of Mr. Bateman, to a depth of 723ft. The paper gave an abstract of the principal rocks passed through in the bore, which the writer regarded as of the greatest interest, forming one of the best evidences yet obtained regarding the stategraphical relation of the rocks of the Fingal Basin. Beneath the Upper Palæozoic Marine Beds, carbonaceous shales and a very thin seam of coal was found. The fossils contained in them though meagre and imperfect, indicate that these lower beds belong to the lower coal measures, and are probably identical with those of the Mersey.

Mr. WARD said he had examined the rock mentioned by Mr. Johnston in the paper on Mount Cygnet, and found no gold in the small quantity of pyrites placed at his disposal, but had very little doubt that if a sufficiently large quantity were treated gold would be found, as it almost always had been in pyrites.

Mr. STEPHENS said that the three papers just read would each furnish materials for an interesting discussion, but it was not possible now to do more than touch upon one or two of the subjects mentioned.

The Mt. Cygnet coal beds, like nearly all similar formations in Tasmania, had been extensively affected by intrusive igneous rocks, and a noticeable feature was the common occurrence of a form of *slickensides*, as a polished and sometimes striated lining of joints, resulting from the slow and long continued friction of two surfaces in contact with each other. The movements of which this evidence remained were probably caused by the slow contraction of the huge dykes of trap in the vicinity during the process of cooling, rather than by the original intrusive action.

The felspar porphyry of Port Cygnet and the neighbourhood he (Mr. Stephens) had frequently brought under the notice of the Royal Society. He agreed with Mr. Johnston in connecting it with the occurrence of gold in many of the neighbouring gullies, and saw no reason to modify the opinions which he had expressed in a paper on the subject read before the Society as far back as 1869, except as to the age of certain rocks which he then suggested might be silurian. In 1869 or 1870 he had sent to Sydney for examination a quantity of pyrites from Port Cygnet, but on being very carefully tested at the Mint it was not found to contain any gold. The most probable source is to be looked for in the quartzose veinstones which occasionally traverse the porphyry both at Port Cygnet, and in the ranges lying west of Oyster Cove, where traces of gold are also met with under precisely similar conditions.

Dr. SANDFORD suggested that the Marine Board should carry out some dredging improvements off King's Island, when, he had no doubt, interesting collections could be made.

Mr. MORTON was glad the Bishop had referred to this matter. In Sydney, when supplies were sent to the lighthouses, notice was generally given to the Museum staff, so that they might send an officer if they wished. Though they had no Government steamer here, he hoped the Marine Board would assist the Museum in obtaining specimens, as Mr. Brown had told him many specimens were to be obtained at the different islands, and he intended to ask the trustees of the Museum to send supplies of spirits of wine to those in charge of the lighthouses for the purpose of preserving any specimens they may capture.

MISCELLANEOUS.

Mr. SWAN submitted a photograph of the nest of the mountain thrush of Australia, taken by Mr. A. J. Campbell.

Mr. PERRIN submitted several specimens of Eucalypts and other plants, including the deciduous Tasmanian Beech, the flower of which had not been seen, but he managed to obtain a specimen at La Perouse last December, and also a specimen in fruit at Mount Arrowsmith.

Mr. A. J. TAYLOR submitted a form of codlin moth trap from the garden of Mr. Maning, Sandy Bay, giving evidence of its successful working. Also the skins of a Tasmanian devil, rabbit, and house rat tanned and preserved by the following method :—Two quarts of bran in six quarts of boiling water, cooled and strained, and then mixed with an equal quantity of saturated salt solution. To each gallon of this mixture add 1oz. of sulphuric acid. Scrape all flesh and fat from the skin after thoroughly damping, and place it in the last mentioned mixture. Let it remain for 20 minutes if a small skin ; 30 minutes for medium (such as wallaby), and 60 minutes for large skin (as kangaroo).

Wash immediately on taking out in clear water and well work it with the hands occasionally when drying.

Mr. F. ABBOTT read a short paper on a specimen of Sporobolus virginicus, forwarded to Baron von Müeller, for the purpose of recording the fact of its being indigenous to Tasmania.

THE LATE MR. C. P. SPRENT.

The CHAIRMAN alluded to the fact that since last meeting a vacancy had been caused in the ranks of the Society, which had lost a very distinguished member in the late Mr. C. P. Sprent, Deputy Surveyor-General, who had been struck down by the prevailing epidemic. Testimony had been borne to his valuable services as a public officer in the *Gazette*, but Mr. Sprent had been a prominent member of the Society, and they would all retain in their minds the admirable paper read by him very recently on the subject of the proposed Antarctic expedition, which had already borne fruit in the steps being taken to give effect to it. He was sure they all sympathised deeply with the lamented gentleman's widow and her family, while the society had lost a valuable member, not only in the fact of the valued contributions he had made to its proceedings, but in the hopes given of future contributions had he been spared.

The Hon. N. J. BROWN said he was not aware until a few minutes previously that the matter which had just been so feelingly alluded to by the chairman would come before the meeting; but having been in a position to know the late Mr. Sprent thoroughly well, and to appreciate his high character in the public position he held, he did not think he would be right in missing the opportunity afforded him by the chairman of saying a few words such as had been indicated might be said on such an occasion. The occasions were rare when subjects other than those upon which their cold reasoning faculties were brought to bear came before the Society, and when subjects such as this came up in which emotions were stirred it was difficult to find expression in fitting terms. He might be permitted to say it had always been a matter of pride and satisfaction to him that he had been the means of placing the late Mr. Sprent in the important office he held at the time of his death. During his tenure of that office he (Mr. Brown had got to know and value him, and almost to regard him as a brother. Mr. Sprent's large and wide knowledge ; his high scientific acquirements—acquirements which were won by unflagging industry ; his kindly heart, high honourable character, and thorough honesty and integrity, formed a combination of excellence rarely met with. The name of the late Mr. C. P. Sprent was indelibly fixed in the records of this Society, whilst that of his honoured father was placed on the records of the colony, and his loss to this Society was very great indeed. His loss to his family and friends, and he thought he could say, to the country, would be well nigh irreparable, if not quite so. He thought he should meet the views of those present, and many who were not present, if he concluded his brief and imperfect remarks by moving, "That a letter of condolence be forwarded from the President and Council of this Society, to the late Mr. Sprent's widow and mother."

Mr. R. M. JOHNSTON, who rose to support the motion, said he could not trust himself to speak upon the matter, as he had lost one of his dearest friends.

Mr. PERRIN also supported the motion, to enable him to state that Baron Müeller had desired him to convey to the Fellows of this Society his condolence at the loss they had sustained.

The motion was carried, and the meeting then terminated.

AUGUST, 1887.

The usual monthly meeting of the Royal Society of Tasmania was held on August 15. There was a fair attendance of Fellows, and the chair was occupied by the President, His Excellency Sir Robert Hamilton, K.C.B., who came accompanied by Miss Hamilton, Miss Harvey, and Mr. H. W. B. Robinson, the private secretary.

List of additions to the library during the month of July last:—

Abhandlungen der Mathematisch Physikalischen Classe, der Koniglich Bayerishchen, Akademie der Wissenchaften Fünfzehnten Bandes.—From the Society.

Annual Report of the Board of Regents of the Smithsonian Institution for the year 1884.—From the Department.

Anales de la Oficina Meterologica, Tome V.—From the Department.

Boletim da Sociedada de Geographia di Lisbon 6A cerie Nof. 9, 10, and 11.—From the Society.

Bulletin of the Museum of Comparative Zoology at Harvard College, Vol. XIII., No. 4—Studies from the Newport Marine Laboratory, XVIII., on the Development of the Calcareous Plates of Amphiura, by J. W. Fewkes.—From A. Agassiz.

Bulletin of the Essex Institute, vol. 17, Nos. 1 to 12, January to December, 1885.—From the Society.

Bulletin of the California Academy of Sciences, vol. 2, No. 5, September, 1886.—From the Society.

Bulletin of the American Museum of Natural History, vol. 1, No. 8. —From the Society.

Bulletin of the United States Geological Survey, No. 27—Work done in the division of chemistry and physics, mainly during the fiscal year 1884-85. No. 28—The Gabbros and Hunblende Rocks occuring in the neighbourhood of Baltimore, M.D. No. 29—One, the freshwater invertebrates of the associated North American Jurassic. No. 30—Second contribution to the studies on the Cambrian Faunas of North America. No. 31—Systematic review of our present knowledge of fossil insects, including Myriapods and Arachnids. No. 32—Mineral springs of the United States.—From the Society.

Bulletin de la Société de Geographie, 7 serie, 1 to 4, 1886.—From the Society.

Catalogue general Argentino.—From the Society.

Essex Institute Historical Collection, Vol. XXI., January to December, 1884; Vol. XXII., January to December, 1885.—From the Society.

Field Naturalists' Club of Victoria, seventh Annual Report, 1886-7; list of members, etc.—From the Society.

Gedächtnissrede auf Carl Theodor V. Subold.—From the Society.

Gold Fields of Victoria, reports of the Mining Registrars for the quarter ended 31st March, 1887.—From the Department.

Homenagem a Luciano Cordeiro, 16 Maio, 1888.—From the Society.

Inhaltsverzenchniss der Litzungsberichte, 1871, 1885.—From the Society.

Journal of the Linnæan Society, vol. 19-21, Nos. 114, 116, 126-8, "Zoologi;" vols. 22, Nos. 146-8, "Botany."—From the Society.

Journal of the Society of Arts, vol. 34, 1885-6.—From the Society.

Journal of the Trenton Natural History Society, No. 2, January, 1887.—From the Society.

Journal of the Royal Historical and Archeological Association of Ireland, vol. VII., 4th series, October, 1885, No. 64; January, 1886. No 65; April, 1886, No. 66: July, 1886, No. 67; October, 1886, No. 68; January, 1887, No. 69.—From the Society.

Journal of the Statistical Society, vol. XLIX., pt. IV.; vol. L., pt. 1.—From the Society.

Journal of the Royal Asiatic Society of Great Britain and Ireland, N.S., vols. 18, 19, pts. 1, 2, IV., 1886-7.—From the Society.

Journal of the Royal Society of New South Wales, vol. XXI., part 1, August, 1887.—From the Society.

Journal of the Royal Microscopical Society, part 3, 1887, June.—From the Society.

Journal of the Chemical Society, containing the papers read before the Society, and abstracts of chemical papers pubilshed in other journals, No. CCXCIV., May, 1887.—From His Excellency Sir R. G. C. Hamilton, K.C.B.

List of surviving members of the American Philosophical Society of Philadelphia, presented to the Society at the stated meeting held March 5, 1886.—From the Society.

List of the members of the Linneon Society of London. Session 1886-7.—From the Society.

List of the members of the Geological Society of London, November 1, 1886.—From the Society.

List of the members, officers, and Professors, with the report of the visitors of the Royal Institution of Great Britain, 1886.—From the Society.

Memoirs of the Boston Society of Natural History, Vol. III., No. XII., "The life history of the Hydromidusæ: a discussion of the origin of the Medusæ and the significance of the Netagenesis," by W. K. Brooks, No. XIII. "The oldest known insect Larva *Monsolucoides Articulatus*, from the Connecticut River rocks;" "Note on the supposed Myriapodan, Genus *Trichiulus*;" "A review of Mesozoic Cockroaches," by S. H. Scudder.—From the Society.

Memoirs of the Geological Survey of India, Palæontologica Indica, Ser. X. Indian Tertiary, and Post-Tertiary Vertebrata, Vol. XLV., Pt. II. The fauna of the Karnul Caves (and addendum to Pt. I.) By R. Lydekker, B.A.—From the Society.

Meteorological Observations made at Hobart and other places in Tasmania during the year 1886.—From the Meteorological Observer.

Mineral resources of the United States calendar year 1885, Division of Mining Statistics and Technology.—From the Department.

Monthly Notices of the Royal Astronomical Society, vol. XLVII., No. 7, May, 1887.—From the Society.

Monthly Weather Review, U.S., January to June, 1885; January to June, 1886.—From the Department.

Notes on the Post Tertiary Strata in South-Western Victoria, by J. Dennant, F.G.S.—From the Author.

Proceedings of the Royal Geographical Society, and Monthly Record of Geography, vols. 8, 9, 1886-7.

Proceedings of the Zoological Society of London for the year 1886.—From the Society.

Proceedings of the Boston Society of Natural History, Vol. XXIII., Pt. II., March, 1884, February, 1886.—From the Society.

Proceedings of the Academy of Natural Sciences of Philadelphia, Pt. II-III., 1886.—From the Society.

Proceedings of the Davenport Academy of Natural Sciences, Vol. IX., 1882-4.—From the Society.

Proceedings of the American Philosophical Society, Vol. XXIII., Nos. 123-4.—From the Society.

Proceedings of the Royal Institution of Great Britain, Vol. XI., Pt. III., No. 80.—From the Society.

Publication der Norwegischen Commission der Europœischen Gradmessung, Heft. V.—From the Society.

Quarterly Journal of the Geological Society, London, vols. XLII.-III.-IV., No. 168, 1886 ; Nos. 169-70, 1887.—From the Society.

Report of the progress and condition of the Botanical Gardens of South Australia during the year 1886.—From the Department.

Report of Board of Trustees of the Queensland Museum for the year 1886.—From the Society.

Report of the Superintendent of the U.S. Naval Observatory for the year 1886.—From the Department.

Results of rain and river observations made in N.S.W. and part of Queensland during 1886, by H. C. Russell, B.A.—From the Government Astronomer.

Societe de Geographie, Nos. 16 to 19, 1886, Nos. 1 to 9, 1887.—From the Society.

Sitzungesberichte, Heft. IV., 1885, Heft. I-II., 1886.—From the Society.

Till Algernes Systematik, VII., "Siphoniæ."—From the Society.

Transactions of the Institution of Engineers and Shipbuilders in Scotland, Vol. XXIX., 1886.—From the Society.

Transactions of the Asiatic Society of Japan, Vol. XV., pt. 1.—From the Society.

Transactions and Proceedings of the Royal Geographical Society of Australasia, Victorian Branch, Vols. III. and IV., 1st January, 1885, to 31st December, 1886.—From the Society.

United States Geological Survey—"Geological History of Lake Lahontan, a quaternary lake of North-Western Nevada, by J. C. Russell.—From the Department.

Vandstandsobservationer, Heft. IV.—From the Society.

Victorian Naturalist, Vol. IV., No. 4, August, 1887.—From the Society.

THE VICTORIAN ROYAL SOCIETY.

The SECRETARY read copies of letters sent to the Royal Society of Victoria with reference to the proposed Antarctic exploration, and the following reply :—"Melbourne, 25th July, 1887. I beg leave, with many thanks, to acknowledge the receipt of your letter of the 10th inst., replying to mine of the 16th ult., and assuring our Antarctic Exploration Committee of the cordial support of the Royal Society of Tasmania in the proposed appeal to the British Association on behalf of renewed Antarctic exploration. My committee held a meeting on the 19th inst., when the appeal (which was sent to Admiral Ommanney on the 2nd inst.) and the replies to my circular of the 16th ult. were read, and I was desired to forward to you with a copy of the appeal, the grateful thanks of the committee for the readiness and cordiality of your response. I have just written to Admiral Ommanney again enumerating the Australian societies who have assured us of their concurrence in the appeal to the British association. A resolution was also moved by Baron von Müeller, and carried unanimously, expressive of the profound regret of the committee at the great loss sustained by, not only your Society and the cause of Antarctic exploration, but by colonial science generally in the untimely death of Mr. Sprent your Deputy Surveyor-General, and I am desired to request you to convey to your Society the tenor of the resolution. Having myself experienced Mr. Sprent's courtesy and valuable assistance in the matter of Antarctic exploration, I can very cordially sympathise with you and your society in our mutual loss. (signed) H. K. Rusden, hon. sec. Royal Society and Australian Antarctic Exploration Committee.

Accompanying the letter were some notes connected with the proceedings of the joint committee appointed by the Royal Society of

Victoria and the Royal Geographical Society of Australasia, Victorian branch, to promote an expedition to the South Pole at the earliest practical date, and embodying a letter from the committee to Sir Erasmus Ommanney, the secretary of the British Association Antarctic Committee, expressing the hope that the efforts of that association might speedily receive the reward they deserve, and giving details of the work done in Australia and the end in view.

The PRESIDENT said the matter would now rest very much with the British Association, and the next step would be the decision of that body.

PLANTS.

The Secretary submitted a paper by Baron von Müeller on some plants new to Tasmania, and others found in new localities. The plants referred to by the Baron were *Belendena montana*, *Richea pandanifolia*, *Prionotes cerinthoides*, *Richea Gunni*, *Donatia novæ-Zealandiæ*, *Milligania dentiflora*, *Potamogeton Cheesemanii*, *Sporobolus virginious*, *Diploderma glanoum*, *Castoreum raduaturn.*

Mr. PERRIN read the following notes on the plants referred to by the Baron :—

Notes on some new plants (*Sporobolus virginius*) not previously described as found in Tasmania, with notes on the distribution of *Richea*, *Pandanifolia*, *R. Gunnii*, *Bellendena*, *Montana*, and other plants described by Baron Von Müeller :—

Sporobolus Virginius, recently found near the entrance of the Tamar, by Miss Oakden.

This plant has been recorded by R. Brown in his Prodromus, but has been unaccountably missed from Australian and Tasmanian botanical publications.

R. Brown in his Prodromus describes this plant as being very closely allied to the species of the Natural Order, *Gramineæ* (herbs and grasses chiefly), *Agrostis*, and originally described as *Agrostis Virginicæ*, but which on further examination was subsequently referred to *Agrostis Diandra.*

Brown, however, describes three species (3) ;—

Sporobolus Indicus
„ *elongatus*
„ *pulchellus*

The information upon these plants is somewhat scant ; on referring, however, to Robert Brown's works, as published by the Royal Society, I find the following :—

In a list of Indian plants, extracted from a numbered list of dried specimens in the East India Company's Museum, which had been collected under the superintendence of Dr. Wallick, and numbered consecutively 3,764, 3,765 in the catalogue, appear as *Sporobolus coromandelianus.*

Sporobolus diander.

These are Indian specimens of the natural order *Gramineæ*, and may perhaps be identical with two of those mentioned in the Prodromus ; but not having any specimens to guide me I am unable to determine the species from the description given.

In a note attached to the catalogue on the two Indian species just given, Dr. Wallick says :—"Mr. Brown having undertaken the elaboration of the grasses, the specific names which are wanting will be supplied hereafter by that gentleman, who has in the meantime furnished this provisional list of the family."

To this is added the following editorial note.

[As this intention was never carried out those names only are quoted which have Mr. Brown's authority attached to them.—ED.]

From this it would appear that this species of plant had not received the full attention from the early botanists they deserved.

Mr. Bentham, however, in his "Flora Australiensis," says, page 450 :—

This order, *Gramineæ*, has been the object of special study of several of the most eminent botanists, among which the labours of Brown, Kunth, and of Trinius have been the most important.

But the only general enumeration they have left is that of Kunth, who had not at that time the materials, nor yet the leisure to investigate the synonymy which had already become exceedingly confused.

This confusion has been gradually increasing by the large number of species described in partial works, without that general comparison which is specially needed in an order in which a large proportion of the species have a very wide geographical distribution.

Three of this species are common to Australia and New Zealand, whilst 14 are endemic (mostly small) in Australia. Of these perhaps the species better known to outsiders is *Anthisteria ciliata*, common to all the colonies, viz.:—The well-known kangaroo grass, also *Spinifex hirsutus*.

The chief portion of our grasses are comprised in this order. In Mr. Spicer's work on Tasmanian Plants mention is made of eight species of Agrostis, viz. :—

Agrostis quadriseta	*Agrostis Venusta*
parviflora	,, *Solandri*
,, *aœquata*	,, *Scabra*
,, *montana*	,, *Vulgaris*

To these we must now add *Sporobolous virginius*.

Richea pandanifolia—Giant Grass-tree, lately received by Baron von Müeller from Chas. P. Bennett, and noted as growing on Alpine heights, N. W. Tasmania. Also *Richea Gunnii* (J. Hooker), Cradle Mountain, noted by Mr. W. R. Bell.

When on an exploration tour to the back of Mt. La Perouse in December last, I found a splendid grove of *Richea pandanifolia* about 500 feet below the top of the connecting range of hills between Adamson's Peak and Mt. La Perouse at an altitude of about 2,500 feet. They are also very numerous on the West Coast, and during an exploration which I made in July of last year on the east side of Mount Sorell, after rising some 1,500 feet from the bed of the King River, I found quite a number of these exceedingly handsome palm-like trees, which, when seen among the dark green myrtles give quite a tropical appearance to the surrounding vegetation, and they reminded me very much of the beautiful screw palms *(pandanus)* of tropical North Australia. I have also seen *Richea Pandanifolia* on the ranges and hills around Mount Lyell.

Bellendena Montana—Mount Bischoff, F. Kayser. Leaves wedge-shaped, smooth, toothed at end (Spicer); fruit, egg-shaped. "Mountain Rocket" (Spicer).

This genus is limited to a single exclusively Tasmanian species. A low glabrous shrub, sometimes under six inches high, bushy or tufted leaves, usually cuneate, broad or narrow, with three obtuse crenatures or short rounded terminal lobes, sometimes broadly crenate. The whole leaf ¾ to above an inch long, tapering into a short petiole, flat, but rather thick, and sometimes glaucous; flowers, white (Benth. Flor. Aus.), and is found on Mt. Wellington, R. Brown, and Ben Lomond, 3,000 to 5,000. Some specimens from the latter place have entire *narrow leaves*.

Mr. MORTON mentioned, with reference to two species of fungi referred to in the paper that Mr. Leonard Rodway was engaged in preparing descriptions and drawings of all the Tasmanian fungi, and had obtained a large number of specimens, many of which were new. He hoped Mr. Rodway would be able to submit a paper to the Society next year.

Mr. STEPHENS said it appeared that Baron von Müeller desired to place on record localities new to him for some of these plants, one of which, however, was common to the whole western side of the island.

NEW FISHES.

Mr. Morton, the secretary, submitted a specimen of a new fish to Tasmania, which was not only a new species, but, as he had been able to discover, proved to be a new genus. It had been found on the beach near Bridgewater in a rather bad state, as the crows had been at work on it and taken out one of the eyes, besides eating a part of the side. Upon reference to several works on ichthyology he could not place any to our genus, and during a recent visit to Sydney he submitted it to Mr. J. Douglas Ogilby, who has charge of the Icthiological department in the Sydney Museum. After consulting a number of works, the conclusion come to was that it was a new genus. It was apparently a deep water fish. At first sight it appeared like the Hapuka (*Oligorus gigas*) of New Zealand, found in our waters occasionally, but the scales and fins revealed a difference, the diameter of the eye being much larger. The dentition was also different. Owing to its prominent head he had given it the name of *Eurumetopos.* He was very glad to have the pleasure of giving as the specific name of this fish the name of one of the leading members of the Society who had done more work in connection with the Natural History and Geology of Tasmania than anyone else, Mr. R. M. Johnston. (Hear, hear.) He felt proud to have the honour of naming this remarkable specimen submitted, *Eurumetopos Johnstoni.* Mr. Morton also submitted a new species of the genus *Triptergium*, a genus hitherto unrecorded in Tasmania, although Mr. Johnston had a specimen, but of a different species, but had not described it. It was discovered at Clarke's Island by Mr. McLaine, and he proposed to give it the specific name of *Clarkei.* Several species of this fish were found in New Zealand and Australia.

A DECEASED SCIENTIST.

Some correspondence was read with reference to Mr. Augustus Oldfield, a brother of Mr. E. D. Oldfield who kept a commercial school in Hobart for many years. Mr. Augustus Oldfield, who was a botanist for many years in Tasmania, and possessed very high testimony of his scientific acquirements and disinterestedness from Sir J. Hooker, Baron von Müeller, and other authorities, died in comparative obscurity, and his friends desired that his name should at least be rescued from oblivion, considering his valuable work. The matter came recommended by Dr. Agnew, and the testimonials of the deceased gentleman were read.

Mr. Bastow said that he had frequently come across the name of Oldfield in his botanical researches, and felt certain that the deceased scientist had done a great deal of useful work, though he knew nothing of him.

Mr. Grant thought that in the case of a man whose work was so fully acknowledged by eminent authorities, the least the Society could do was to record his name as one who had done valuable work in Tasmania so as to encourage others to follow in his lines.

The President said he would assume, from the tone of the meeting, that it was the desire of the Fellows that some formal recognition of the labours of the deceased gentleman should be placed on the records.

MOUNT WELLINGTON.

Mr. Perrin read some statistics from a report by him on the destruction of the ferns and trees of the Mount Wellington reserve.

Mr. Grant pointed out that the whole of the frontage along the Huon-road was in private hands, and the destruction so justly denounced took place on this land. Nothing could be done without the Government could be persuaded to purchase back the alienated land.

Mr. Swan agreed with Mr. Perrin's desire to see the flora of the mountain preserved, but objected to the artificial improvements advocated.

Mr. Stephens corroborated what Mr. Grant had said, but thought the police might take the trouble to ascertain where the tree ferns taken came from.

Mr. Perrin said that the unalienated reserve comprised thousands of acres, and the destruction was going on there as well. He only wished to plant exotics around the proposed springs.

THE GEOLOGY OF THE SCOTTSDALE LINE.

Mr. T. Stephens drew attention to several specimens from the tunnel on the Scottsdale Railway, kindly furnished by the Engineer-in-Chief (Mr. Fincham.) The tunnel is to be carried through a ridge of that series of rocks striking more or less north and south which are to be found at intervals along the whole of the N. Coast, and may be generally described as silurian, the subdivision of the primary rocks of Tasmania being impracticable in the present condition of our knowledge of their several relations. The rocks at the tunnel comprise bands of clay slates, schists, and sandstones, among which are quartzose bands of intense hardness which have caused trouble. The tunnel is between 25 and 26 miles from Launceston and nearly half a mile long, somewhat more than half of which is now pierced, gradient 1 in 39. Proceeding towards Launceston the silurian rocks, Mr. Stephens said, become overlaid by those of upper palæozoic age with the common fossils of that formation, a few of which were exhibited. There is in places an impure limestone, which is closely allied to, but probably on a lower horizon than the interesting foraminiferous limestone associated with scattered remains of the coal measures of the Piper's River district, specimens of which he (Mr. Stephens) had brought under the notice of the Society several years ago. Mr. Stephens said, passing out of the region of sedimentary rocks, the line going towards Launceston traverses a very difficult country, both for engineering work and construction; as, indeed, is the case along the greater part of the route. The prevailing rock here is massive diabase. When within a few miles of Launceston the line passes over the tertiary formation overlying the lower hills to the N.E. of Launceston, which presents no novel features. In showing the various rock specimens, Mr. Stephens pointed out how the partial decomposition of sulphide of iron had bleached and destroyed the portions of a purple-tinted paper, which were in contact with it.

Mr. Grant said he knew the district well, though he did not know the country above the route of the railway, which was almost *a terra incognita*, and any information concerning it, especially with regard to the agricultural land, would be valuable. He believed the opening of the railway would be productive of much good, as there were rich districts there.

NOTES AND EXHIBITS.

The Secretary (Mr. A. Morton) drew attention to a large and valuable collection lately presented by the trustees of the Australian Museum, Sydney, to the Tasmanian Museum. The collection consisted of a series of valuable casts, chiefly from the cave Breccia, Wellington caves, New South Wales:—No. 1. A cast of the right lower jaw of the *Thylacoleo carnifex* or Pouched Lion of Australia, a carnivorous marsupial of the Australian tertiary period. No. 2. Casts of bones belonging to an emu found in the same caves. No. 3. Portion of incisor of large fossil wombat. No. 4. Cast of portion of leg bones, etc., of a large marsupial found also in the Wellington caves (*Diprotodon sp.*), and several fossil bones of the kangaroo, cast of a portion of a tail of a gigantic fossil lizard; this fossil was obtained at Lord Howe Island, some 420 miles from Sydney. It is allied to the present strange lizard found at Western Australia, known as *Moloch horridus.* Specimens of both were exhibited on the table.

A fine cob of Indian corn grown on Maria Island was submitted by the Secretary.

A very interesting collection of carved ethnological subjects from the Bouka Island, Solomon Group, from the Australian Museum, were also exhibited.

ENORMOUS EARTHWORMS.

Mr. MORTON exhibited some very large earthworms kindly obtained by Mr. Bernard Shaw, Inspector of Police. Some of these measured from 2ft. to 3ft. in length. Mr. Morton stated that Mr. J. J. Fletcher, Director of the Linnæan Society of New South Wales was busy writing a work on the earthworms of Australia, and on forwarding a few of the Tasmania worms for comparison, Mr. Fletcher writes :—" They are splendid specimens, and about the finest worm I have yet seen, for though one of ours is longer, it is not so robust, nor so altogether magnificent. My third paper is to be read on the 29th inst., but I am not able to include them in it, as I have not quite finished with those already in hand. But I will get to work at them as soon as possible. They are certainly a new species, and very likely a new genus, but I cannot decide this without dissection. Later on I shall be glad to send you for your museum specimens of as many named species of our worms as I can spare." Mr. Morton said he had some alive that he intended sending to Mr. Fletcher.

THANKS.

A vote of thanks was passed to the authors of the papers, and to those who had contributed interesting information.

LICHENS.

Mr. BASTOW at the conclusion of the meeting, submitted some well mounted specimens of Tasmanian lichens, including some of the most interesting species. Other specimens had been arranged for the microscopes which were inspected by the ladies and gentlemen present.

SEPTEMBER, 1887.

The monthly meeting of the Royal Society of Tasmania was held at the Museum on September 12.

His Excellency (the President) Sir Robert Hamilton in the chair, and there was a large attendance of Fellows and Ladies.

The Hon. B. S. Bird and Mr. C. E. Featherstone were admitted Fellows of the society.

List of additions to the library during the month of August :—

Annual Report of the Department of Mines, New South Wales, for the year 1886.—From the Department.

Bollettino dei Musei di Zoologia ed Ana tomia comparata, della R. Universita di Torino, Nos. 19 to 26, Vol. II.—From the Society.

Bulletin de la Sociètè D'Ethnographie, 2nd ser., No. 7.—From the Society.

Monthly weather reports, U.S. of America, 1886-7.—From the Department.

Norwegian North Atlantic Expedition, 1876-8, XVIII., A and B. "The North Ocean—its Depths, Temperature, and Circulation." By H. Mohn. With 48 plates and 3 woodcuts.—From the Department.

Proceedings of the Linnæan Society of New South Wales, second series, Vol. 2. Part 2.—From the Society.

Results of Meteorological Observations made in New South Wales during 1885.—From the Government Astronomer.

Scientific Transactions of the Royal Dublin Society, Vol. 3. Series 2.

XI.—On New Zealand Coleoptera. With descriptions of new genera and species.—By D. Sharp, M.B.

XII.—The Fossil Fishes of the chalk of Mount Lebanon, in Syria.—By James W. Davis, F.G.S.

XIII.—On the cause of Iridescence in Clouds.—By G. Johnstone Stoney, M.A., etc. Vol. 5. N.S. July, 1886. Part 3. October, Part 4. January, 1887. Part 5. April, Part 6.—From the Society.

Statistics of the colony of New Zealand for the year 1886. Results of the Census of the colony of New Zealand, taken for the night of the 28th March, 1886. Sickness and Infirmity, Land, Stock, etc., Industries, Land and Building Societies, Public Libraries, Mechanics Institutes, Places of Worship, Maori Census.—From the Department.

The Times, London, June 22, 1887, containing an account of the jubilee.—From Mr. Justin Browne.

Transactions of the Wagner Free Institute of Science of Philadelphia, Vol. 1.—From the Trustees.

Transactions of the Geological Society of Australasia, Vol. 1. Part 2.—From the Society.

Verhandlungen der Gesellschaft Für Erdkunde Zu Berlin. Band, XIV., No. 5, 6,—From the Society.

PAPERS.

Mr. SAVILLE-KENT, F.L.S., F.Z.S., read a paper on the acclimatisation of the true salmon (*Salmo salar*) in Tasmanian waters, and upon the reported salmon disease affecting the fish under cultivation at the breeding establishment on the river Plenty. He pointed out that the disease was more or less prevalent amongst the fish at every breeding season, and was caused by the growth upon some wounded or abraded surface of the fishes skin of a species of aquatic fungus, known technically by the name of *Saprolegnia ferax*. Continuing, he said—"The spores or germs of this fungus are almost constantly present in pond or river water and naturally germinate and flourish luxuriantly upon any submerged dead or putrifying animal matter. The mildew-like growth that develops upon dead flies immersed in water represents one phase of this fungus, and I exhibit this evening samples of it growing on pieces of dead fish and mussel that have been purposely cultivated for the occasion. Also fragments of the felt or paper like masses characteristic of the growth of this *Saprolegnia* upon diseased fish, and which have been detached from one of the salmon that recently died at the Salmon Ponds. Mounted specimens, illustrating the more minute structure of this fungus, are exhibited in the adjacent microscopes. This more minute structure as there shown, and which I have also delineated on the accompanying diagram, consists of an interlacing network of branching threads or hyphæ, commonly called the "mycelium" of the fungus, and from which arise erect subcylindrical or club-shaped seed capsules or "sporangia." Within each such sporangium may be developed several hundred microscopic seeds or zoospores, every one of which, should it alight upon congenial soil, such as a sore on a fish's back or any dead animal matter, is capable of developing into an extensive fungus colony. Millions of these minute seeds or zoospores may be developed from a single tuft of fungus not more than one quarter of an inch in diameter, and as these are provided with locomotive organs or cilia, wherewith they can traverse the water in every direction, it may be anticipated that in those waters where the fungus is abundant, a wounded fish has little or no chance of escape. There is yet another seed or spore known as the "oospore" by which this fungus may be developed, but which is of much rarer occurrence, and provides for the latent or resting phases of the species. As will be familiar to many present, a very destructive outbreak of this fungoid disease attacked the salmon in the English and Scotch rivers in the year 1878, and has been more or less prevalent in later years. Thus, in the annual report of the local Board of Conservators of the Tweed district for the year 1881, it is recorded that no less than 14,600 salmon had succumbed in that river to this disease, making with the two preceding years a total of 22,000. While up to the present time nothing is known absolutely or accurately concerning the immediate origin of these epidemic outbreaks, there is, I think, much evidence to show, in the case more especially of apparently healthy fish being attacked, that the absence of sufficient oxygen in the water for the healthy maintenance of the fish, either through overcrowding, abnormal temperature, or by direct pollution, represents a very if not the most important factor. Notwithstanding, however, the apparently exhaustive onslaughts of this formidable epidemic it is satisfactory to know that the returns of the fish captured in these previously affected rivers within later years has been in no way diminished, but even increased. It is indeed advocated by some authorities on fisheries matters that good is accomplished through the visitations of this epidemic, since it operates as a check by which the old male fish or kelts, which systematically lay in wait for and prey upon the young salmon smolts when descending to the sea, are periodically eliminated. . . . With the true salmon, *Salmo salar*, however, the case is different. The only breeding stock of these species that has been available this past winter for artificial propagation has been a series of 30 fish developed from the salmon ova brought out by the s.s. Abingdon in 1884, hatched out that same year, and since retained in the Ponds. These fish, or rather what remain of them up to the present time, not having migrated to salt water, are in a relative dwarfed or undeveloped condition. The largest of them scarcely exceeds a foot in length, and they still retain their immature or parr markings. The majority of them have nevertheless manifested a tendency to propagate, and from the entire series a number of ova little short of 4,000 have been artificially expressed and fertilised. I should rejoice to be able to congratulate the colony upon having in this most auspicious anniversary of Her Majesty's reign, and after many years of indefatigable and self-denying perseverance on the part of that very worthy body of gentlemen, the late Salmon Commissioners, succeeded in establishing in Tasmania a race of this noble fish that would propagate and grow to maturity in its lakes and rivers without requiring to migrate to salt water, and which race might be most appropriately distinguished by the title *par excellence* of the "jubilee salmon." I fear, however, that the prospects of the achievement are not altogether encouraging. With the view of assisting, as far as possible, towards the successful conduct of the experiments that might be continued, he submitted the following suggestions :—In the first place, it is desirable that more than ordinary care should be exercised in the manipulation of these valuable fish for artificial propagation. During the Conferences at the International Fisheries Exhibition, London, 1883, at which I had the privilege of being present, one of the most important papers contributed was that by Professor Huxley on "Fish Diseases." In this paper the fatal malady caused by, or associated with the fungus, *Saprolegnia ferax*, was specially dealt with, and in the discussion that followed many new and valuable data were elicited. In this direction, Mr. Wilmot, the Chief Commissioner of the Canadian Fisheries, bore testimony to the fact that at the hatching stations in Canada they formerly lost a very large number of the salmon manipulated through the fungus. "Round the tail, where the men had caught the fish, this fungoid growth appeared and spread until the fish was killed." Also, in handling the salmon "three or four finger marks might be left across the fish's back; a few days after they invariably found three or four stripes of fungoid growth, and the fish invariably died." In order to combat the mortality from this cause, india-rubber gloves were supplied to the hatcheries for the manipulation of the fish and have been used ever since with gratifying results, it being found that the salmon were much less liable to injury and to the attacks of the fungus when so treated. Similar simple mechanical appliances might undoubtedly be profitably introduced at the hatchery on the River Plenty for the future handling of the surviving fish. Mr. Saville-Kent proceeded to explain that, in his opinion, the failure to acclimatise the true salmon in Tasmanian waters was chiefly due to the considerably higher temperature of the sea on this coast as compared with that of the British seas. In conclusion, he remarked that every resource at the command of human skill had apparently been brought to bear upon the naturalisation of the salmon in Tasmania, and no more fitting opportunity than the present could be selected for placing on record the indebtedness of the colony to that body of gentlemen, the late Salmon Commissioners who have so perseveringly devoted their time and best energies for many years to these acclimatisation operations. And if, owing to an inflexible law of nature, this one species has proved intractable, they will have the satisfaction of knowing that through their accomplished establishment in Tasmania of many varieties of the allied and more plastic forms of *Salmo trutta* and *Salmo fario*, they have conferred on the community at large, if not an equal, yet a very substantial benefit.

Sir LAMBERT DOBSON said he had never seen anything at all approaching a salmon since he had come from the Old Country. He had heard Sir Frederick Weld say that he caught an 8lb. salmon, but the question was whether it was a true salmon. There was no doubt that the ova sent out from Home was sent by gentlemen who were good judges, and it was genuine salmon ova. Therefore they should assume beyond all possibility of doubt that the ova was really salmon ova. These had failed. There was something yet to be learned, and he did not think they should lose sight of the fact that the English herring, crab, and lobster might be introduced.

His EXCELLENCY said he had listened with very great pleasure indeed to this paper and discussion. This was a subject in which he took a very great interest, merely as a fisherman. He had often before he came here heard of the efforts made by Tasmania to acclimatise salmon. He thought it stood to reason that the ova sent out here must have been proper ova, but it was a pity that so few specimens were afloat. There appeared to have been only one real salmon ever caught, and if they were really sure that there was one 10lb. salmon caught, why should they not catch more? He thought it would be a great pity and misfortune if it was to be considered now that after the great many years they had tried this should turn out a failure. He expressed satisfaction at seeing so many ladies present, taking an interest in the proceedings of the Society, which was very gratifying. (Hear, hear).

In the absence of the author the SECRETARY (Mr. A. Morton) read a paper entitled "A First List of the Birds of Maria Island," by Col. W. V. Legge. In his paper the author pointed out that of late years much has been added to our knowledge of the local distribution of birds in Europe and Asia, by the publication of "Lists of Birds" in such journals as the "Ibis," "Stray Feathers," and the "Proceedings of the Geological Society," and the information afforded by such papers had proved of the greatest advantage to authors in the publication of recent works.

The paper dealt with some 64 species, and should prove of the tmost importance to ornithologists. Accompanying the paper was several interesting specimens of Terns and other sea birds.

NATURAL GRAFTING.

Note on a specimen of natural grafting, or inarching of the branches of the weeping ash (*Fraxinus excelsior pendula*), by F. Abbott, Superintendent Botanical Gardens. Mr. Abbott said the specimen laid on the table was one of natural grafting or inarching ; similar examples are occasionally met with, and it is most probable that the art of grafting itself originated with the ancients by cases of a like nature coming under notice. Several things are necessary to lead up to a union of this kind—1st. The branches must naturally be in the right position 2nd. A certain amount of friction is necessary to rub off the outer bark, and then some amount of quietude and repose is essential to allow the union to take place. As it is only occasionally that all these conditions can be fulfilled at the proper time good examples like the one under notice are not common, and on that account it may be of interest to those present.

The SECRETARY drew attention to a very valuable cast of a skull of an Australian herbiverous marsupial (*Nototherium Mitchellii*) an extinct animal, rather smaller in size than the *Diprotodon*. The fossil remains of this remarkable animal are found in New South Wales and the Darling Downs, Queensland. The secretary stated that this very valuable specimen had been presented by their very generous friends, the trustees of the Sydney Museum. Dr. Ramsay, the curator of the Sydney Museum, Mr. Morton stated, was always most willing to assist the Tasmanian Museum in making the Museum as complete as possible in their collections.

MAGNIFICENT SHELLS.

On the table were two magnificent specimens of *Pinna nobilis*, presented by Lieut. Beddome to the Museum.

VOTE OF THANKS.

The President proposed a vote of thanks to the authors of papers read, which was carried by acclamation.

OCTOBER, 1887.

The usual monthly meeting of the Royal Society of Tasmania was held on Monday evening, October 10th, 1887. The President, His Excellency Sir Robert Hamilton, occupied the chair at opening, and there was a moderate attendance of Fellows, and lady visitors.

List of additions to the library during the month of September :—

Bollettino della Societé Geografica Italiana, Ser. II., Vol. XII., Fasc, 6, 7, 8, 1887. From the Society

Bulletin de la Societé Royale de Botanique de Belgique, Fondée Le ler Juin, 1867. Tome Vingt, sixieme, Anner, 1887. From the Society.

Journal of the Royal Microscopical Society, Part 4 , August, 1887. From the Society.

Leeds Philosophical and Literary Society's annual report for 1886-7. From the Society.

Monthly Notices of the Royal Astronomical Society, Vol. XLVII., No. 8. From the Society.

New Zealand Medical Journal, No. 1, Vol. 1., September 1887. From the Society.

Reports of the Mining Registrar of Victoria for the quarter ended June 30, 1887. From the Society.

Summary and Review of International Meteorological Observations, April and May, 1886. From the War department, Washington.

Transactions and Proceedings of the New Zealand Institute, 1886, Vol. XIX. From the Society.

Victorian Field Naturalist, Vol. IV., No. 5.

ANOTHER EXPERIMENT FOR THE ACCLIMATISATION OF SALMON, PROVIDED FOR BY THE HON. J. W. AGNEW.

The PRESIDENT said :—" I regret that I am unable this evening to remain to hear the interesting paper on the diamond diggings which will be read to you, as I leave by the express to-morrow morning for the Longford show, and have some business to attend to to-night. But I have come specially down to make an announcement which I am sure will be heartily welcomed by all the members of this society, and by the Tasmanian public at large, through the instrumentality of the Press, of whom I see some members here to-night, and who generally make our proceedings known. Rather more than a week ago Mr. Morton, our secretary, received a letter from Dr. Agnew, from Melbourne, in which he announced that he placed £500 at the disposal of the Royal Society, if they would undertake the trust, to give one more trial under the most favourable conditions to the introduction of a fresh supply of salmon ova for Tasmania—(hear, hear)—and he expressed his wish that Sir Thomas Brady, who has already done so much in the selection of ova should be invited to select this batch in that stage of development, which experience has shown to be the most suitable for handling it, to superintend its shipment, to accompany it to Tasmania, and to see to its deposit in the Salmon Ponds here. I need hardly say that the council who met at once to consider this munificent offer, heartily accepted the trust, and passed a vote of warm thanks to Dr. Agnew. We then appointed a committee of Fellows consisting of Mr. Seal, Mr. Webster, Mr. Belstead, Mr. Johnston, and Mr. Morton, with the view first of consulting the Government and obtaining their co-operation, and then of making the necessary arrangements. I am happy to say that the Government, as we expected, deeply impressed by Dr. Agnew's magnificent gift, gave their hearty concurrence, and are most ready to co-operate in every way, both as regards placing all their appliances at our disposal, and giving us the invaluable assistance of Mr. Saville-Kent, so far as it is now available, and of Mr. Seager. By last mail I wrote to the Secretary of State for the Colonies and the Lord-Lieutenant of Ireland asking that Sir Thomas Brady, who is an officer of the Irish Government, might be granted the necessary leave of absence to enable him to undertake the task, and expressing my strong opinion that not only much benefit might be anticipated to arise to the colony from Sir Thomas' proposed visit, but also that I felt sure the granting of his services for the purpose by the Imperial Government would be regarded by the colony as a gracious act on their part. I also wrote to Sir Thomas Brady, who is a personal friend of mine, inviting him to Government House during his stay in Tasmania. The committee are now at work, and I would suggest that any Fellows of this Society who have news on the subject should communicate with them.

We cannot, of course, say that this experiment will succeed, but we mean to do our best that it shall, and with the accumulated experience now available I think we do well to be sanguine. I do not wish to be understood as giving my definite opinion that no salmon have ever been caught in Tasmania, for I do not hold that opinion; but undoubtedly the most ardent believer in the presence of salmon in our waters will admit that they do not flourish like the trout. Now, what we want to do is, by the aid of this magnificent offer of Dr. Agnew's, to set at rest all controversy on the subject, and to secure, as I am sanguine enough to hope, unless there is some insuperable climatic reason that we shall, before long, have the real *salmo salar* in Tasmanian waters. The most serious climatic consideration, no doubt, is the temperature of the sea surrounding Tasmania, but there is a great difference in the temperature of the sea in the north of Scotland and the south of England and south-west of Ireland, where the gulf stream infringes, and it might be well that some at least of the ova should be taken from these southern rivers. This, however, is more a matter for the committee than for the present meeting. They will be glad to receive any suggestions. In conclusion, gentlemen, on an occasion like this, with our minds full of Dr. Agnew's splendid liberality, we must not forget, and he would be the last, I am sure, to wish that we should forget or ignore the noble efforts which have already been made to introduce salmon into Tasmania. I regard this, and I am sure Dr. Agnew regards it, simply as one more effort under the most favourable conditions in the same direction. An effort which we all trust will be crowned with success, and, if it is crowned with success, such success will be largely due to the experience which has been gained from the previous efforts of Mr. Youl and other gentlemen, notably the late Salmon Commission, who have worked so hard for the colony in this matter." (Hear, hear.)

His Excellency then retired, and Sir Lambert Dobson took the chair.

The CHAIRMAN said he did not know whether any member would like to speak on the subject. No doubt they were all gratified with this liberality of Dr. Agnew, whose name was synonymous with liberality, and it was therefore like painting the rose to express any praise of it. (Hear, hear.)

DIAMOND DIGGING IN AFRICA.

Mr. JAMES ANDREW read a paper on "Diamond Digging in South Africa." He apologised for selecting a subject which did not possess a very scientific interest, though he thought it might prove of interest, as he found very little was known connected with it in this part of the world, and it was possible that diamond digging might become an industry in Australia as it had already been found in New South Wales. After giving an outline of the history of the discovery of diamonds at Griqualand, Mr. Andrew gave a very lucid description of the method of working, and some interesting particulars regarding the mines and the stones found.

The CHAIRMAN said the subject was not altogether new to him, as he had seen at South Kensington a large working model of the mines and the process of working. Even more interesting was an exhibition of the process of cutting the diamonds. Knowing how hard they were it was wonderful to see how simple the process was. There was a table with a number of rapidly revolving discs, over each of which an iron arm, about 18in. long, was arranged, and at the end of these arms there was a truncated cone on the end of which the diamond being operated upon was soldered. A workman by shifting the position of the arm, cut the facets with the nicest accuracy. What seemed a most difficult process was a very simple one indeed; but as a labour-saving process it was simply wonderful, and proved an interesting sight, around which a great number of people was always found. He was sure they were all very much indebted to Mr. Andrew for the paper, which gave a most interesting account of diamond mining.

Mr. R. M. Johnson thought Mr. Andrew had no need to make any apology for reading such a paper, which was most interesting, and contained many particulars of a highly scientific character, set forth in a very clear and lucid manner. The origin of the diamond was a question of scientific interest, and he thought the carbonaceous shales referred to had something to do with it. He pointed out that diamonds had been produced by an artificial process, of which Mr. Ward could probably give an account. Most minute granules of diamonds had been produced on the heated surface of a tube, but the chemists came to the conclusion that it was only by a process that they could not command that the diamond of commerce could be obtained.

Mr. W. F. Ward explained that diamonds had been artificially produced from hydro-carbon, by condensation in vessels heated for a long time, but they were very minute, as were also the artificially produced rubies and sapphires, and cost five to ten times more than natural stones. Regarding the trimming of diamonds into shape, the work was sometimes roughly performed by splitting. the diamond having lines of cleavage. As to the origin of diamonds he scarcely thought carbonaceous shales could be credited, as that was a water formation in which they were deposited. His brother had forwarded a package of the Kimberley stuff to his father, who examined it to see if the beginning of a diamond could be found by the microscope. Many of the diamonds were broken up, and had apparently been formed in another rock.

Mr. T. Stephens thought all the authorities were agreed in connecting the diamonds with the igneous rocks in which they were found, but, as Mr. Andrew had said, the more recent authorities differed as to the actual origin. He congratulated the Society upon the character of the paper, and hoped Mr. Andrew would be persuaded to write something about the West Coast of this island of which he had an extended experience.

THE BUILDING ROTIFER.

Mr. R. A. Bastow read the following paper on a Building Rotifer:—Until late on Saturday evening last I was under the impression that the rotifer now on the stage of the microscope was *Melicerta ringens*, or what is known commonly amongst microscopists in Great Britain as the building rotifer, but on further and closer examination I find that although it is of the same family of Floscularia, it is Limnias, and not Melicerta. Both animals are very beautiful, and have received much attention from Gosse, Slack, and other naturalists. The ciliatory wreaths projecting from their cases are of a singularly interesting appearance, and are continually at work, forming whirlpools to ensnare their prey. On the slightest alarm the creatures instantly rush into their homes, and when quiet is restored the flower-like wheelwork is again expanded therefrom. The Limnias possesses two large rotating discs, and a ringed case; the Melicerta, two large and two small discs, and a case made of pellets, which the little creature is continually adding to, as it were, brick by brick, these bricks and pellets being made by the animal itself. I have specimens under gradually increasing powers of magnification here on the table, each animalcula industriously working at its assigned task, and never resting, not even sleeping, until the work of its life is accomplished, and it ceases to exist. These were collected from the pond in front of the residence of Mr. Curzon Allport, Davey-street, and, being placed in a small aquarium, they have multiplied exceedingly." In connection with the paper were a number of highly interesting specimens shown at work under microscopes of different power.

The CHAIRMAN asked, as they never slept and never rested, whether Mr. Bastow knew how long they lived?

Mr. BASTOW said he had had them under a microscope for a month, but he did not know how long they lived.

Mr. R. M. JOHNSTON said he had seen two species of rotifer near St. Leonards with Mr. Harrap, of Launceston, who with one or two friends had made a valuable collection, and used formerly to write some interesting papers for the Society. He would like to commnnicate Mr. Bastow's observations to Mr. Harrap, and the secretary might ask that gentleman to again favour the Society with the result of some of his researches.

"ALPHA CENTAURI." BY A. B. BIGGS.

A paper on the double star Alpha Centauri, accompanied with a diagram showing a projection of its real orbit from its apparent curve was, in the absence of the author, read by the secretary (Mr. A. Morton.) The paper drew attention to the special interest attaching to this star, from its being, so far as known, the nearest fixed star to the solar system (225,000 times the earth's distance from the sun); that it is one of the finest objects of its class in the whole heavens; and, that being invisible to the observatories of the Northern Hemisphere, science is indebted to southern observers for all that can be known of it. A clear description was given of the method employed in the investigation, which included an enormous number of observations extending from 1818 to the present time, of which the author's measures extended from 1882.

The most interesting deductions from the investigation are as follows:—

The maximum apparent angular distance separating the pair is 23¼secs. of arc, which occurred in 1818, the next occurrence being in 1902. The actual mean distance of the comparison from its primary is a little over 20 times that of the earth from the sun. Its period of revolution is 84¾ years, both period and distance corresponding very closely with those of the solar planet Uranus. The nearest apparent approach of the stars to each other was in 1885, namely, 1 7-10th sec. of arc, they being then so close that high telescopic power was necessary to divide them at all. The actual orbit is inclined (or tilted) from the line of sight 79deg., hence its apparent curve is a very long, narrow ellipse.

From the actual mean distance of the companion from its primary, and its period of revolution, the author computes the mass of the principal star to be about 1 1-7th times that of the sun.

The author's observations of the star were given in a table, and also an ephemeris showing positions and distances for subsequent years up to 1901.

THE ECHIDNA.

Mr. A. MORTON submitted a paper entitled "On the egg of the echidna, or porcupine." He stated that till the year 1883 very great doubt existed in the minds, not only of naturalists but of all observers as to how the echidna brought forth its young, when Mr. Caldwell, a student of Cambridge, who took the Balfour Travelling Scholarship, left to travel in the Australian colonies to study the embryology of the marsupial, the monotremata, and the ceratodus. Mr. Caldwell, with most other scientists, states that he was under the impression that the echidna and platypus were born in the same way as the marsupials; but in Queensland, assisted by the blacks, he was enabled to procure many specimens which set at rest the question, and enabled him to decide that they were oviviparous. This important discovery was made known to

Professor Liversidge, of the Sydney University, who sent a telegram to the British Association then sitting at Montreal, and Mr. Caldwell, on his return to Sydney, shortly afterwards exhibited several examples in different stages of development, from the egg just hatched to the egg, found upon dissecting the animal, ready to be laid. A great number of people were still under the impression that these animals were viviparous. In a book by Arthur Nicholls, entitled "Zoological Notes," published in London in 1883, the writer refers to the ignorance of the natives of Australasia and their statements that both the porcupine and the platypus laid eggs. The writer of this book went on to say that he had found, in dissecting the animals, the young of the platypus in the uterus. Though the two animals existed in this colony he could not find any record placing officially before the scientific world and the general public the fact that the eggs had been found here. Last month he had received a letter from Mr. Fletcher, who lived in the Campbell Town district, stating that while riding in that district, his horse had put his foot into a hole. Upon putting his hand into the hole he found a porcupine, which he lifted out, and an egg dropped from the animal as he lifted it breaking in its fall, exhibiting an embryo animal. Mr. Fletcher had very generously presented this specimen, comprising the broken shell and the animal to the Museum, which he (Mr. Morton) was very proud to get as an interesting record, which further established the facts discovered by Mr. Caldwell. The paper was mostly a technical description of the egg and the anatomy of the animal, agreeing with Mr. Caldwell's description. The egg was about three-quarters of an inch long.

Mr. A. J. TAYLOR said he had listened with pleasure to the remarks which had fallen from Mr. Morton, as they were of the highest scientific interest. He pointed out that in 1849 Dr. Milligan had reported that the natives said echidna laid eggs, so it was clear that before accusing the natives of ignorance, writers should know more of the subject. The statement Mr. Morton had been enabled to make was one he ought to be very proud indeed of.

Mr. R. M. JOHNSTON congratulated the Soceity upon the paper and the specimen, which was of the highest value to the scientific world. It would corroborate the investigations of Mr. Caldwell, so ably carried out in these colonies, and Mr. Morton was to be congratulated on this important addition to the demonstration of the true mode in which the echidna brought forth its young. It was not a discovery on the part of Caldwell so much as a scientific demonstration, as statements had been made on both sides, but there was no evidence before the scientific world. Mr. Caldwell had solved, the doubt, and any addition to the proof would be a satisfaction to that gentleman, as well as to all others interested in science.

THE WHITE HAWK.

Mr. MORTON stated that Mr. Arthur Brent, an enthusiastic collector of birds eggs, had informed him of the discovery of a nest and eggs of the common white hawk, *Astur novæ-hollandiæ*, generally known as the Goshawk. The nest, formed of small twigs, lined with the leaves of the peppermint tree, was discovered in a stringybark tree, 60 or 70 feet from the ground, in a gully near Austin's Ferry. It contained two eggs of a blotchy colour, though they were of a bluish colour inside when blown, and something like the Allied Harrier. So far as he knew the eggs of this bird had not been found here before, and he promised to take the measurement and description and give the particulars at the next meeting.

Mr. SWAN said he had never heard of the eggs having been found before, but Mr. Bethune, of Dunrobin, had found a nest with the young birds in it.

ORCA CAPENSIS.

In reference to a specimen upon the table, Mr. STEPHENS said that some of the Fellows present might remember a rumour from Launceston a few months ago of the discovery in the neighbourhood of Piper's River of a fossil jawbone of a gigantic extinct animal. Inquiry having been made, Mr. W. P. Hales had kindly secured and forwarded the specimen, when it turned out to be a weather-beaten portion of the skull of an Orca, several species of which inhabit the Southern Ocean. There being no means at hand of identifying the species, the bone had been sent to Mr. E. P. Ramsay with a request that he would kindly compare it with the specimens in the Australian Museum. Mr. Ramsay promptly replied as follows :—" The bone, as you justly remarked, is the jaw of an Orca, the right upper portion of the maxilla ; it agrees best with O. capensis, but has a less number of teeth." Mr. Stephens went on to say that this was a very variable genus, and that Gray and Van Beneden differ as to the number of teeth in Orca capensis, the former giving 12-12 – 12-12, and the latter 13-13 – 13-13, as the formula. The Orcas, or killers, as they are popularly termed, are without exception the most ferocious inhabitants of the ocean, and even the largest sized whales are not safe from their attacks. There is a good skeleton of Orca pacifica in the Museum.

VOTE OF THANKS.

The CHAIRMAN proposed a vote of thanks to the authors of the very interesting papers that had been read, which was carried by acclamation.

The meeting then terminated.

NOVEMBER, 1887.

The final monthly meeting of the Royal Society of Tasmania for the 1887 session was held on November 21. The President, His Excellency Sir Robert Hamilton, K.C.B., occupied the chair, and there was a very large attendance of Fellows and visitors, including many ladies. His Excellency was accompanied by Miss Hamilton, Miss Hervey, and Mr. H. W. B. Robinson.

NEW MEMBERS.

Messrs. J. S. Laurie and J. F. Echlin were elected Fellows of the Society.

EXPLORATION OF MOUNT MUNRO.

The SECRETARY read the following letter from Baron Von Mueller :—

" November 19, 1887. To the Hon. Sec. Royal Society of Tasmania.—Allow me, honoured sir, to inquire whether possibly some arrangements can be made this summer by your amateur naturalists to explore Mount Munro, on Clarke Island, in the interest of geology, zoology, and physiology. So far as I am aware, this mountain has never yet been visited for the purposes of science beyond triangulation, and as it is nearly as high as Strzelecki Peak on Flinders Island, where Dr. Milligan made so many important observations on minerals, insects, and plants, any researches carried out on high elevations of Mt. Munro should also be replete with novel interest. Perhaps during the Christmas and New Year's holidays some of the Tasmanian scientists could unite for a tour to Mount Munro, which would not involve more expenditure and exertion than spending the holidays in other and less profitable excursions. The Field Naturalists' Club of Victoria, at my suggestion, will institute researches on King Island next month. If from Hobart and other places the Mount Munro region were searched for, Tasmanian science might be expected.—Respectfully yours, FERD VON MUELLER."

Dr. SANDFORD pointed out that Mount Munro was not on Clarke Island, but on Barren Island.

Mr. R. M. JOHNSTON said this mistake had probably caused Baron Müeller to forget that he had forwarded a list of plants found along the base of Mount Munro. But it was the Alpine plants that it was desirable to explore, and he thought if the Baron himself would come over next summer arrangements could be made for a picnic on a large scale.

PAPERS.

1. First "List of Birds observed at Tasman Peninsula." By J. R. McClymont, M.A. The list enumerated 70 species of birds observed by Mr. McClymont.

2. "The Highlands of Lake St. Clair." By Colonel W. V. Legge, R.A. The paper was more descriptive than scientific, and dealt with the magnificent scenery in the locality of Lake St. Clair, and the desirableness of making a road to the West Coast through that locality. Some interesting details of the topography of the less frequented parts were given, including descriptions of several unnoted lakes to which names were given by the writer. Colonel LEGGE strongly recommended an annual expenditure on this highroad to the West Coast.

3. "The nesting of certain Birds on the Acteon Island." By Col. W. V. Legge, R A.

4. "Observations with respect to the Nature and Classification of the rocks of the Tertiary Period, more particularly relating to Tasmania." By Mr. R. M. Johnston, F.L.S. He said he would not take up the time of the meeting by reading the paper which would be printed, and could then be better followed, but by an outline of the paper. He endeavoured to show some of the difficulties connected with the classification of the rocks of the Tertiary Period in Australia and Tasmania. Repeated elevations of the sea throughout the whole period as in England do not occur, and hence the local classifier is deprived of the aid of the *per centage* method as applied by Sir Chas. Lyell in the determination of the principal divisions of the European rocks of the Period *v. Eocene*, *Miocene*, and *Pliocene*. For these reasons Mr. Johnston proposes to divide the system into two simple groups, *Paleogene* and *Neogene*; the former embracing all marine and leaf-bed deposits, including the older basalts and tuffs; and the latter embracing the older raised terrace drifts. He also stated that during the *Neogene* age there is some evidence of a change of climate. The drifts evidently indicate greater plurial action, and although from our Alpine heights small glaciers may have descended towards the plains, the latter afford no evidence of "boulder drift" such as is found throughout the lower levels in Scotland. He therefore is of opinion that while the combined effects of the eccentricity of the earth's orbit in conjunction with recurrent periods of precession may have had some assisting influence, the direct effects of these of themselves were not so severe as in the Northern Hemisphere, owing to the impossibility of the smaller area of southern lands being entirely shut off from the warm equatorial ocean currents, as was the case in Europe during the glacial epoch which reached its greatest intensity there during the pleistocene period. The elevation of the land in the Southern Hemisphere is probably the chief cause of local glaciation. The paper included a list of fossils tabulated and arranged, showing 357 genera and 908 species.

5. "On the geological conditions of the site of the new storage reservoir near Hobart," by Mr. T. Stephens, F.G.S. The writer described the situation of the fault which he had mentioned in 1877 as likely to be found traversing the site of the dam of the new reservoir, and remarked that, though the site had not been wisely selected in the

first instance, there was fortunately an absence of the circumstances usually attending such disturbances of the bed rocks, and that under the present able management there need be no doubt as to the stability of the work.

6. "Common-sense in Education : being a brief survey of the Methods of Education and Instruction in their bearing on the Practical Requirements of Life." By Mr. J. S. Laurie. Mr. LAURIE contended that science and modern languages should form the instruction of at any rate five-sixths of the masses to be educated. He quoted several authorities as to the objects and method of education, and said it was hardly creditable to human nature that one generation bequeathed so little to succeeding generations from the instruction imparted to it. The one redeeming feature of the colossal system of instruction now being imparted throughout the world was that special instruction was now occasionally being given for specific purposes. He defined education to be 'To give harmonious and adequate development to all natural powers, with a view to the right discharge of the functions and duties of life,' and proceeded to cite the opinions of many eminent names in English literature condemnatory of the system of education adopted through several centuries. Going into the detailed work of ordinary grammar schools, he condemned the method of teaching each subject, and admitted that many of the masters had a clear appreciation of the duties of their honourable office, but were bound in one set system by the necessity of working in connection with recognised standards adopted by the accepted examination tests. The education of the North American Indians answered its purpose, and fitted the child for the duties it would have to discharge when it came to take its place in the organisation of the tribe, and the instruction of the ancient Greek was equally perfect, securing the *mens sana in corpore sano* which was the object desired. In our modern experience, on the testimony of a perfect galaxy of witnesses of the highest order, except, perhaps, in medicine and certain exact sciences fitting for a specific pursuit, we could not boast of even a reasonable measure of success. With the exception of certain holders of the higher positions, the masters as a body could not be blamed for this failure, as all thought of what might be done was crushed out by the necessity of what must be done. Too much was attempted, and nothing done well. He endorsed the opinion that nature should be rigidly followed, and considered that the Kindergarten system symbolised what would have to be adopted throughout all stages of education as the modern method. It was fortunate, as far as this colony was concerned, that object lessons were adopted in nearly all our schools that the Education Act included the application of the Kindergarten method in the earlier stages, and that the establishment of technical classes was contemplated. The expenditure upon technical instruction in England had now reached the respectable annual sum of £400,000, and instead of being looked upon as an expenditure, was now accepted as an economy. Australia was fortunate in having such an admirable model as that established in the Technical College at Sydney, which was not only elevating the taste of that community, but adding to the aggregate value of the work of the mechanics. (Cheers.)

Discussion on Mr. Laurie's paper was deferred until a future date.

At the invitation of the PRESIDENT, a vote of thanks was passed to the writers of the papers that had been read during the evening.

ADDRESS BY THE PRESIDENT.

His EXCELLENCY then delivered the following address in closing the present session of the Society:—

Gentlemen,—In winding up the session of the Royal Society of

Tasmania for 1887 it is desirable that I should, as your president, briefly review the operations of the Society in the period.

Our number of Fellows has considerably increased, 21 having been elected in the session. The attendance at the monthly meetings has been larger than in any previous session. I am glad to say also that we have been favoured by the presence of ladies to a greater extent than has hitherto been the case, and I am sure they will admit that at every meeting they have attended they have listened to much which has interested them. The additions to the library have been very satisfactory, and Dr. Agnew, our most liberal benefactor, has had bound for the Society at his own expense that very valuable work, "Gould's Humming Birds," consisting of 28 parts. An unusually interesting set of papers has been laid before the Society, as the report of our proceedings when it is issued will show. In *Zoology* we have had contributions from Messrs. Petterd, Johnston, Saville-Kent, Morton, and Colonel Legge, and in this section I would refer to the very important discovery of the egg of the echidna, or porcupine, at Campbell Town. In *Icthyology* we have had the very interesting paper of Mr. Saville-Kent on the acclimatisation of the salmon, besides other contributions. Mr. Johnston has furnished some valuable notes on some rare fishes of Tasmania, and Mr. Morton was able to submit a specimen of a new fish to Tasmania which was not only a new species, but has proved to belong to a new genus, and which he has named after our greatest local icthyologist, Mr. Johnston. In *Ornithology*, Colonel Legge's papers on the "Birds of Maria Island" and the "Actæon Isles" are most valuable, as well as Mr. McClymont's list of birds of Tasman's Peninsula. In *Conchology* Mr. Petterd was able to furnish a description of two new species of Tasmanian fresh water shells. In *Geology* and *Palæontology* several important papers have been read by Mr. Johnston, more especially the one entitled "Observations with regard to the nature and classification of the rocks of the tertiary period of Australasia," and Mr. Stephens made some interesting observations on the geology of the Scottsdale line. In *Botany* we have had the elaborate and valuable paper of Mr. Bastow on the "Tasmanian Hepaticæ," together with other important communications, and he has further exhibited to us most interesting objects under the microscope at our monthly meetings. We have also had some valuable contributions from our veteran contributor, Baron von Mueller, and some useful notes from Mr. Perrin and Mr. Abbott. In *Astronomy* Mr. Biggs has furnished two valuable papers, the one on the "Comets of February, 1880, and January, 1887," and the other on the double star, "Alpha Centauri, with a graphic projection of its orbit from its apparent curve." On the *Geographical* side we have had a paper from the Rev. J. B. Woollnough on Iceland, giving a graphic account of the history and present condition, both social and political, of that island, which he visited some years ago, and another from Mr. Andrew giving a very lucid description of the operations of the diamond diggings in South Africa. In *Exploration* we have no actual results to show, but we have done our best to help forward the proposed expedition to the Antarctic regions, acting in complete accord with the Antarctic Committee of the Royal Society of Victoria, and have done all in our power to press forward this movement. A deputation from the council of this Society waited upon the Government to ask their co-operation and assistance in this matter. They pointed out that not only, in common with all those interested in Antarctic exploration, did they anticipate important scientific results from an expedition to these seas, but also that Tasmania, as the most southern of the Australian colonies, was particularly interested in the results of such an expedition should it prove successful in obtaining in these regions a sufficient take of whales or any other commercial products which would make the expedition a remunerative one. The

Premier received the deputation very kindly, and said that, although he could give no pledge, he had little doubt that Tasmania would be ready to contribute her share of the £10,000 estimated as necessary to start the expedition, provided it were federally divided among all the Australian colonies. Subsequently in reply to a telegram from Sir Erasmus Ommanney, the secretary to the Antarctic Committee of the British Association, our Society signified their concurrence in a united appeal of the learned and scientific societies throughout Australia to promote Antarctic exploration. We cannot say what the ultimate result may be, but I think it will be admitted that this Society has not been wanting in its efforts to help forward to the best of its power the object of Antarctic exploration. It is very satisfactory to find that the Royal Geographical Society of London has lent its powerful aid in Antarctic exploration, and I would ask you to listen to the following extracts from an article in *The Times* of London which came by last mail showing how much the thoughts of England are directed at present to this subject. After recounting all that has been done in this direction up to the present time it says :—

"This, then, is all that has been done to advance our knowledge of the immense area which to so large an extent influences the climates of Australia, South Africa, and South America, and a knowledge of the meteorology and oceanography, which is absolutely necessary before we can pretend to understand the laws that govern the climates of our globe. Only a few patches of land here and there along the Antarctic Circle have been touched, and the big patch which Ross discovered to the south of New Zealand. What we know of these patches has only served to whet our curiosity to know more. There are certainly wonders to be discovered there not surpassed in their kind by anything which explorers have told us of the other end of the world. Of the great enterprises which go so largely to make up the accumulated glory of our country, exploring expeditions, polar and other, form a considerable part. It is for the greater good of a nation to store up such a reputation as these enterprises bring, and from this point of view alone young Australia should be encouraged to enter on the great work of exploring the vast unknown region that lies at her door. But in doing so she would be doing real service to her own material interests, and to the interests of the world at large if her work were conducted on thorough scientific principles. Any new expedition to the Antarctic should be planned with the greatest care. It should be remembered that all that has hitherto been done has been with sailing vessels ; now that we have steam the task of exploration should be much easier. It would be absolutely necessary for a party to winter at as high a latitude as possible, and two vessels at least would be required. One could steam round the verge of the ice for weeks if desirable, and watch for a favourable opening of whtch to warn the other vessel. But the great matter at present is to decide whether Australia and England can co-operate in an important undertaking which will bring credit, and mayhap profit, to both. If there is any difficulty about contributing money, there are other ways in which the Mother Country could materially co-operate with the most enterprising of her colonies."

We have given our cordial assent to a proposal for *scientific federation* of British and American geologists with the view of laying a broad foundation of geological fact, classification, nomenclature, and representation which would ultimately be adopted by other countries, as far as local diversities and differences of language would permit. This proposal originated in a communication from Sir W. Dawson, of Montreal, to the president of the Royal Society in England, which was forwarded to us in a communication from the High Commissioner of Canada to our Agent-General. We regarded the proposal as of great interest to geological investigation, and, as I have said, gave it our warmest support. In *statistics* we have had a remarkable paper from Mr. Johnston which occupied two whole meetings of the Society. The title of the paper was "How far can the general death rate for all ages be relied upon as a comparative index of the health or sanitary condition of any community," and I would say in passing that the title only partly conveys an idea of what that excellent paper contains. Some of Mr. Johnston's conclusions were powerfully contested, but I feel sure that the more his paper is read and studied, and I have done my best to make it known far beyond the limits of Tasmania, it will be acknowledged to be a masterpiece of statistical analysis. (Hear, hear.) There is but one further item in our operations in the session now about to close to which I shall direct your attention. I allude to Dr. Agnew's munificent contribution of £500 to be applied to a further experiment in acclimatising the salmon in Tasmania. (Cheers.) Since I last addressed you on this subject, the committee which was appointed to communicate with Sir Thomas Brady, who I hope will have visited our shores before we next meet, have written a long letter to him, giving him their views on the whole subject. I will not now repeat what I said at the last meeting, but I would suggest to anyone interested in this subject, that they should refer to the account of this meeting which appeared in *The Mercury*, of the 11th October, and which will, doubtless, in due time appear in the annual report of our proceedings. To what I said then there is little to add, but what there is is full of encouragement to us to go on and prosper. Two specimens of salmonidæ have since that date been received in the Museum. One was taken in a net in the saltwater at Port Cygnet, and sent to me by Mr. Kenny, who thought it different from any trout he had ever seen. The other was captured by myself with the rod at Victoria in the River Huon. The first weighed 4½lbs., and the judgment pronounced upon it by Mr. Ogilby, the distinguished icthyologist of Sydney, to whom it was sent for examination, is that it is a true *salmo trutta* having slight divergence towards the variety *S. cambricus.* The other, the one I caught, can be seen here. It weighs 29lb., was 35½in. long, and 26in. in girth, and viewed side by side with the ordinary trout the difference is most striking. I certainly congratulate myself in my good fortune in catching so noble a fish, the largest I believe yet caught in Tasmanian waters, and in being able to present it to the Museum. (Cheers.) Both of these are undoubtedly sea going fish, and in excellence for the table tread closely upon the heels of the *Salmo salar.* If they are *Salmo trutta* we have at least to boast that Tasmania produces by far the largest *Salmo trutta* in the world. If as some seem to think, these specimens are hybreds, then we must undoubtedly have the salmon here to produce them. It will be for the council to determine whether it might not be wise to send the fish I caught, which Mr. Morton has so successfully set up, to England to have a definite opinion pronounced upon it.

The very able paper we have heard to-night by Mr. Laurie, on "Common sense in education, being a brief survey of the methods of education and instruction in their bearing on the practical requirements of life." This opens up the great subject of technical education, and is too large and important a one to be discussed now. We all want more time to think it over, and we can only give Mr. Laurie our best thanks for his paper, and express our extreme pleasure and satisfaction that the Government is giving practical effect to the very excellent recomendations of the distinguished committee, of whom Mr. Laurie was one, who inquired into the subject.

Well, gentlemen, I think we may fairly congratulate ourselves on the tale of work I have laid before you. In my remarks at the opening of the session I pointed out that I scarcely thought the public generally realised how much they owe to societies of this sort, both in respect of the additions they make to the stock of general knowledge, and therefore to the amount of human happiness, and also in respect of the bearing both direct and indirect that their operations have in promoting industries, and in increasing the comforts of human existence. Since my connection with this Society I am more than ever convinced of these beneficial tendencies, and I ask you Tasmanians to cherish this Society as a powerful educator in your midst. By means of the Press who so accurately report our proceedings, and to whom our best thanks are due, our operations are known far beyond these four walls, and are read, I hope, by many with interest and profit, but we want more members. Death, alas! since our session commenced has removed one of our most valued contributors. I allude to the late Mr. Sprent, whose great loss was so feelingly referred to by several members at our July meeting. We want to increase our numbers. We want the young men to join. They will never regret doing so. We open to them new pleasures healthy and honourable, and new means of usefulness to their kind.

While much of the success of the Society depends upon each member doing his utmost to help forward its work, and we owe much to those gentlemen who have devoted so much of their time to the objects of this Society, I think a special tribute is due to our secretary, Mr. Morton—(cheers)—who spares himself no trouble, who during this session has issued a compilation of all the papers that have been read at the Society from 1841 to 1885, and whose enthusiasm stirs up all with whom he comes in contact to do, in homely phrase, "their level best" for the Society.

In bidding you farewell till April, I would say, don't let the time between this and then be lost to the Society. Its borders are so wide that there is room for receiving the work of all. Let every Fellow of the Society who has the necessary leisure devote himself to some branch of investigation, and give us the result of his work.

Besides original work having special reference to Tasmania, there is much that may be done in bringing before our Society the recent work of kindred societies in similar directions in other places, which will be found in the reports of their proceedings which are sent to our library in exchange for ours. We ought to be abreast of the times, and instead of working in our own groove, which is necessarily narrow, we should take advantage of the labours of others and widen our knowledge, and papers showing what these labours have been would be very useful to our Society. I am satisfied if we act on these lines, having the great standby of such contributors as Mr. Saville-Kent, who, I hope, will continue to submit papers, Mr. Johnston, Mr. Bastow, and others whose original work would lend distinction to any Society, that our proceedings will be such as we can regard with every satisfaction, and that they will redound to the credit of this land in which we all, whether we are permanently or temporarily settled in it, take so justifiable a pride. (Cheers.)

The Hon. P. O. Fysh said there was one pleasure in which he was sure the whole of those present would join in congratulating the Society upon—that was that His Excellency took such a lively interest in all its meetings, and that he had continued to demonstrate an interest in the work committed to the Fellows during the whole of the past year. His Excellency would perceive that their meetings were attended by scientific men, professional men and commercial men. The young men had been referred to, and he thought the young men of this community were fairly represented in the Society, and he was very glad to know that the commercial men of the community were fairly represented, seeing in this fact that those connected with scientific pursuits were working with those engaged in professional pursuits, an indication of their association outside. The culture of America was associated with Boston, and the commerce of America with New York, and it was said that Boston could not do without New York, and New York could not do without Boston. In the same manner the the Royal Society could not do without its commercial members and the commercial members could not do without the Royal Society. If science gave the commercial community any light as to the path of usefulness, commerce was sure to follow. He was very glad to see the interest Her Majesty's representative took in such a Society, the results of which were world-wide, as all benefited by the researches of science. If our young men would take an interest in its proceedings they would learn a higher culture, benefit by the high tone of the Society, and seek to be more useful men in the community. They could not do without culture, and looked to this Society to help to forward that culture without which the community could not hope to hold the position it should do. As a member of the Society he was glad to notice the valuable nature of the papers that had been delivered. The community, and the world at large, would see that Tasmania was not simply grovelling, but had higher pursuits, and that those who assembled from time to time in that room took an active interest in the papers that were contributed. The Society desired to congratulate itself on having a president who had taken such unflagging interest in its proceedings throughout the session, so he would ask the Fellows to join with him in congratulating themselves that His Excellency had presided over them, and to thank him for his address, and to rise and express their pleasure.

The members then rose and cheered.

The PRESIDENT: I thank you very much gentlemen.

LIST OF ADDITIONS TO THE LIBRARY.

NOVEMBER AND DECEMBER.

Annual Report of the Department of Mines, New South Wales, for the year 1886.—From the Department.

Annals and Magazines of Natural History—(Current Nos.)

Anuario del Observatorio Astronomico, Nacional para el. Año de, 1888, Mexico.—From the Department.

Bollettino della Sociétá Geografica Italiana, vol. xiii., September, 1887.—From the Society.

Bulletin de la Société Imperiale des Naturalistes de Moscow, No. 3, 1887.—From the Society.

Bulletin of the Museum of Comparative Zoology, at Harvard College, Vol. xiii. No. 5, Preliminary Account of the Fossil Mammals from the White River Formation, contained in the Museum of Comparative Zoology. By W. B. Scott and H. F. Osborn. No. 1, Notes on the *Taxodium distichium*, or Bald Cypress. No. 2, on the Original Connection of the

Eastern and Western Coalfields of the Ohio Valley. By N. Shaler. Annual Report of the Curator of the Museum of Comparative Zoology, 1886-7.—From A. Agassiz.

Descriptive Catalogue of the Medusæ of the Australian Seas, in two parts. Part 1, Scyphomedusæ; part 2, Hydromedusæ. By R. V. Lendenfeld.—From the Trustees of the Australian Museum.

Fifth Annual Report of the Board of Trustees of the Public Museum of the City of Milwauke, U.S., September to August, 1887.—From the Trustees.

Geological Magazines (Current Nos.)

Geology of the Vegetable Creek Tin Mining Field, New England District, N.S.W., with maps and sections. By T. W. E. David, B.A.—From the Mining Department.

History and Description of Mr. Tebutt's Observatory, Windsor, N.S.W. By J. Tebutt.—From the Author.

Ibis, The. A quarterly journal of Ornithology, vol. v, Nos. 17 to 20, 1887.

Iconography of Australian Species of Acacia and Cognate Genera, Decade 1 to 8. By Baron F. Von Müeller, M.D., Etc.—From the Government.

List of the names and contributors to the first series, vols. i. to x. of the Proceedings of the Linnean Society of New South Wales, from 1875 to 1885, with the title of and references to the papers and exhibits contributed by each.—From the Society.

Proceedings of the Linnean Society of New South Wales, vol. ii., part 3.—From the Society.

Proceedings of the Canadian Institute, Toronto, third series, vol. v, Fasc, No. 1, October, 1887.—From the Society.

Report of the Royal Geographical Society of Australasia (Victorian Branch), vol. v., part 2.—From the Society.

Report of the Board of Governors of the Public Library, Museum, and Art Gallery of South Australia. 1887.—From the Department.

Reports of the Mining Registrars of the Goldfields of Victoria, Sept., 1887.—From the Department.

Société Astronomique de France.—From the Society.

Sociédadé de Geographia de Lisbon, "Elogio Historico."—From the Society.

Statistics of the Colony of New Zealand, part 6, 1886.—From the Department.

Transactions of the Asiatic Society of Japan, vol. xv., part 2.—From the Society.

Transactions of the Seismological Society of Japan, vol. xi.—From the Society.

Verhandlungen der Gesellschaft Für Erdkunde Zu Berlin, Band xiv., Nos. 7-8.—From the Society.

Victorian Naturalist, December, 1887.—From the Society.

DESCRIPTION OF NEW OR RARE TASMANIAN HEPATICÆ

(COLLECTED BY R. A. BASTOW, ESQ., F.L.S.;)

BY B. CARRINGTON, M.D., F.R.S.,E.; AND W. H. PEARSON, ESQ., ECCLES, ENGLAND.

(Plates XXXVI. to XLIII.)

FRULLANIA DIPLOTA. TAYL.

Tayl. Nov. Hep. in Lond. Journ. of Bot., p. 405, n. 11 (1846). G. L. N. Syn., Hep. Suppl., p. 780 (1847).

Flores dioici; bracteæ 2-jugæ lobis subacutis lobulis acuminatis basi uni-laciniatis; perianthia obovata, triquetra, brevi rostellata, amenta ♂ globosa; antheridia albida.

Habitat, Mount Knocklofty, Hobart, July, 1885. 208.

On face of cliffs with an *Andreæa*.

Van Diemen's Land, J. D. Hooker, 1820. (Ex. herb. Tayl.)

Obs.—Fortunately possessing Taylor's original specimens of this species (Interior of New South Wales, Cunningham, 1836; Van Diemen's Land, J. D. Hooker, 1820), we have been enabled to arrive at a satisfactory diagnosis.

From *F. congesta*, H. f. and T., Falkland Island, it is distinguished by its more regular sub-bipinnate ramification, not irregularly branched, the remarkable areolation of leaf, which Dr. Taylor noted, the basal cells being very large when compared with the other portion of the leaf. In *F. congesta* the cells are uniform throughout, rather larger than the middle ones of *F. diplota*.

The leaves of both *F. congesta* and *F. diplota* are more or less apiculate on the young branches, evidently overlooked by Taylor in his description of *F. diplota*. The same remark is true with *F. lobulata*. (See Gott. Syn. Hep., p. 445.)

In *Frullania congesta* the underleaves are approximate, more obovate, and segments not so acute as in *F. diplota*.

Description of Pl. I.—Fig. 1, portion of stem × 64 (Van Diemen's Land, J. D. Hooker, Herb. Tayl.); 2, ditto × 64 (R. A. Bastow); 3, ditto × 64 (Interior of N. S. Wales, R. Cunningham, Herb. Tayl.); 4, portion of leaf × 290 (R.A.B.); 5, ditto × 290 (Interior N.S.W.); 6, bract and bracteole × 51 (R.A.B.); 7, perianth × 24 (R.A.B.); 8, portion of leaf of *Frullania congesta* × 290.

LEPIDOZIA CAPILLARIS (SW.) VAR. GENICULATA.

[Lepidozia geniculata Pears. Mss.]

Densely cæspitose, flagelliferous, gracile, small (2), scandent, olive-brown ; stems irregularly bipinnate, rigid ; leaves subtransverse, approximate teeth inflexed, geniculate, palmately-quadrifid to $\frac{3}{4}$ their length, with a spur at one or both basal angles ; underleaves large, ovate, quadrate, trifid, rarely quadrifid ; inflorescence ♀ on short postical branches ; bracts oblong-oval or ovate-acute, apices bidentate, margins sparingly dentate ; perianth very long and narrowly cylindrical, composed of one layer of cells, trigonous, mouth laciniate-ciliate.

Dioicous ? Densely cæspitose, erecto-precumbent, flagelliferous, flagella postical, leafless, radicellose, minute, yellowish olive-brown. Stems irregularly bipinnate, rigid, apex recurved, a cross section showing 12 large, quadrate, dark-walled cortical cells, interior ones smaller, hyaline, 6 and 7 cells in diam. The young branches appear with the leaves to be frontally compressed. Leaves transversely inserted, crowded above, approximate or loosely imbricated, and slightly incubous on the lower part of the stems, geniculate, basal portion patent, teeth erect or inflexed, sub-verticellate, when flattened out palmately-quadrifid, with a short spur on one, very rarely on both basal angles, much rarer still an additional smaller one is present; branch leaves trifid, segments $\frac{3}{4}$ths of the leaf long, subulate (at apex one cell, at base 3 and 4 cells broad and 10 to 12 cells long) ; entire portion of leaf 4 cells deep; cells minute, guttulate, subquadrate or oblong-quadrate. Underleaves large, breadth of stem at base, ovate or oblong-quadrate, trifid, sometimes quadrifid, on terminal branches often bifid. Involucre cladocarpous, postical, branches short. Bracts oblong-oval, ovate-acute, apex bidentate, margin sparingly denticulate or with two acute teeth. Perianth very long, half the length of the whole plant, narrowly cylindrical, very delicate texture, composed of a single layer of cells, 40 to 50 cells in circumference, upper portion trigonous; mouth laciniate-ciliate, about 15 cilia, 2-4 single cells long, 2-3 cells broad at the base. Pistillidia few.

Measurements: Stems, $\frac{1}{4}$ to $\frac{1}{2}$ in. long, ·125 to ·15 mm diam., with leaves ·3 mm diam.; outer cells, ·03 mm; leaves, ·275 mm long × ·275 mm broad; segments, ·2 mm long, ·05 mm to ·075 mm broad at base, ·25 × ·25 seg. ·2, ·225 × ·225 seg. ·15, ·25 × ·2 seg. ·15 ; cells, 1-65 mm ·02 mm × ·015 mm, ·015 × ·015, ·0125 × ·0125; underleaves, ·225 mm long × ·15 mm broad; seg. ·15 mm long, ·15 × ·1 ; bracts, ·9 mm long × ·6 mm broad, ·9 × ·5, ·7 × ·4; perianth, 3·5 mm long × ·5 mm broad; cilia, ·2 mm to ·3 mm long.

Hab., St. Crispin's Well, Mount Wellington, January 11th, 1886. 295.

Obs.—Differs from the type in the more transverse insertion and peculiarly sudden inflexion of the leaf, the palmatifid portion rising at nearly right angles with the base; leaves quadrifid, shorter and broader at the base, to which is attached a short or reflexed spur, on one or both sides, and the extremely long perianth. From *Lepidozia truncatella* (Nees) which has basal teeth on both sides of the leaf, by the oblique insertion of the leaves in that species, not inflexed and the much shorter triangular teeth.

In *Lepidozia nemoides*, Tayl., the leaves are erecto-patent, the teeth more slender, and composed of one or (near the base) two series of oblong cells.

[LEPIDOZIA VERTICELLATA CARR., MSS.]

This is a taller (2in. and more) and more rigid form, main stems dark brown, polished, with distant whorled leaves, branches short, spreading, bearing 2-3 short *ramuli*, on which the leaves are more closely imbricated; base of the leaves and under leaves of the main stem generally spurred. This form is referred by Mr. Mitten and others to *Lepidozia capilligera*, but anyone who will examine the engraving of that species in Lindenberg's Sp. Hep., Pl. IV., will find that *L. capilligera* belongs to the section in which the leaves are inserted obliquely like *L. prænitens*, and not to the section with verticellate leaves with transverse insertion. The recurved hooklets at the bases of the leaves and stipules are probably intended to enable the plant to climb and affix itself to other hepaticæ and mosses.

L. quadrifida, Tayl., from Auckland Island, seems to me to be the true *L. capilligera*, Lindenb.! This is growing with *L. capillaris* from Mount Wellington.

[CEPHALOZIA (ZOOPIS) LEITGEBIANA n. sp.].

Dioicous; fronds irregularly branched, distantly bipinnate, silvery green, creeping; stems linear, sub-compressed, formed of large, tumid cells, flagelliferous, branches lateral and postical; leaves succubous, sub-alate, divided to the base into two segments, connivent, upper twice the size of the lower, triangular or broadly subulate, lower subulate, cells large, reticulate, quadrate-rotund; under leaves binate, elliptic-oblong, sometimes bearing a smaller cell at the apex; involucre postical; bracts, 3 pairs, much larger than the leaves, bifid, with a short outer tooth; perianth ovate trigonous, of a single layer of cells, mouth laciniate-ciliate; androecium lateral, terminal on proper branches; perigonial leaves, bifid, with the lower segment incurved, antheridia 1-2, minute, oval.

Del. Leitg. Mittheil, des Naturw. Ver. für Steiermark, 1876 Uber Zoopsis, fig. 10.

Dioicous. Fronds slender, densely entangled, growing in flattish, shining, hyaline patches, pale green to white, prostrate, flagelliferous, flagella postical, radicellose, microphylous. Stems irregularly ramose or subbipinnate, vertibrate, slightly flattened, branches lateral or postical, patent, distant, cortical cells 5, large, hyaline, central bundle of cells, 6 or 7, much smaller and longer, chlorophyllose. Rootlets few, slender, white, proceeding from base of underleaves. Leaves succubous, sublongitudinal, distant, alternate, patent, decurrent at the base, divided to the base, or nearly so, into two subulate unequal jointed lobes, antical lobe inserted below and seated upon the former, shorter, awl-shaped, inflexed, sinus acute, leafy portions 3 cells broad, cells large, tumid, subquadrate, with rounded angles, hyaline, catenulate. Underleaves everywhere present, binate, the cells nearly parallel; sometimes a smaller terminal cell is met with. Involucre cladocarpous on short postical branches, 4 or 5 on a stem, bracts 3 pairs, much larger than the leaves, oblong quadrate, bifid,divided down to rather more than $\frac{1}{3}$,sinus acute,segments subulate, an exterior tooth near the base of the segments, bracteole simple, subulate, or bifid, oval-oblong. Perianth trigonous, ovate-oblong, composed of one layer of cells, 40 cells round, mouth laciniate-ciliate, about 4 segments 10 cilia.

Male spikes terminal on proper lateral branches. Perigonial leaves deeply and unequally bifid, the lower (antical) segment inflexed, and enclosing 1-2 minute oval antheridia.

Measurements: Stems, $\frac{1}{2}$ to 1in. long, ·2 mm diam., ·25 mm × ·17 mm, ·225 mm × ·175 mm; cortical cells, ·125 mm × ·075 mm, ·125 mm × ·1 mm; interior, ·01 mm; leaves, ·4 mm long × ·3 mm broad; seg. upper, ·275 mm long, lower ·2 mm long; cells, 1-12 mm, ·1 mm × ·07 mm, ·1 × ·06, ·1 × ·05, ·08 × ·06, ·06 × ·06; underleaves, ·15 mm long × ·075 mm broad, ·1 mm long × ·075 mm broad; bracts, 2·25 mm long × ·6 mm broad; seg., 1· mm long, 2· x 1·; seg., 1·, 1-7 × ·9 broad; seg., 1·; bracteole, 2· mm long × ·4 mm broad, 1·6 mm long × ·9; perianth, 2· mm long × ·8 mm broad; ciliæ, ·5 mm to ·7 mm long; pistillidia, ·2 mm long × 0·75 mm broad; perigonial leaf, ·5 mm long × ·35 mm broad; antheridia, ·1 mm × ·075.

Habitat.—New Zealand, Dr. Buchanan (Herb. Leitgeb); 304, St. Crispin's Well, Mount Wellington, Hobart, Tasmania. R. A. Bastow.

Balls-head Bay, Sydney, N.S.W., T. Whitelegge, June, 1885, ♂ and ♀ cum per.

Obs.—Prof. Leitgeb, of Graz, in the course of his valuable researches upon the structure of the Hepaticæ, mentions (Uber Zoopsis Mittheil. des Naturw., ver für Steiermark, 1876, p. 9) that he had found amongst a collection of Hepaticæ received from Dr. Buchanan, New Zealand, a tuft which, according to his view, was a *Zoopsis* with perfectly developed leaves, a portion of a stem of which he figures (fig. 10). A glance showed at once that our plant was identical with it.

Further on in this interesting paper Prof. Leitgeb considers its relationship to the other species belonging to this group, *Z. argentea* (Tayl.) Hook. f. and *Z. setulosa* (Leitg.), without raising it to the rank of a species. The large perfectly distinct succubous bifid leaves induce us to do so, for whatever doubts there may have been prior to the researches of Lindberg, Spruce, and Leitgeb as to the including of *Zoopsis* amongst the foliose hepaticæ, there can be none in this interesting plant, to which, with Prof. Leitgeb's permission, we attach his name.

Cephalozia (Zoopsis) Leitgebiana is more slender and of a less silvery aspect than the two known species and shrinks more when dry.

It supplies a connecting link between *Zoopsis* and *Cephalozia.*

In *Zoopsis argentea* the only trace of leaf structure consists of very narrow oblong cells, which are placed longitudinally on alternate tubercules at the sides of the main stems, while in *Zoopsis setulosa* (Leitg.) the lateral tubercules each bear a sharp terminal seta like the claw of a crab, the large cortical cells of the stem giving it a vertebrate appearance, like the backbone of a cartilaginous fish (ray or shark) are present in all the species, as well as the simple binate underleaves. The structure is very carefully described in Prof. Leitgeb's paper, Uber Zoopsis, Graz, 1876, with figures. Prof. Leitgeb appears to consider the three forms as modifications of one species, and this view may be accepted in a Darwinian sense.

Description of Pl. III.—Fig. 1, plants nat. size; 2, ditto × 16; 3-4, cross section of stem × 85; 5, leaf, antical view × 85; 6, leaf, postical view × 85; 7-8, under leaves × 85; 9, bract × 24; 10, bracteole × 24; 11, perianth × 24; 12, cross section of perianth × 24; 13, pistillidium × 85; 14, perigonial leaf × 85; 15, antheridium × 85.

CHILOSCYPHUS LIMOSUS n. sp.

Dioicous; tufts shallow, depressed, sordid green; stems sparingly branched; leaves complanate, nearly opposite, imbricate, ovate-triangular, rounded at the apex, sometimes retuse, decurrent; underleaves connate with the adjacent leaves, patent, cuneate-quadrate, divided half way into 4 acute, equal segments; involucral bracts connate about half way, irregularly dentate; perianth cyathiform, slightly alate, mouth wide, tri-laciniate-lobate, irregularly sinuate dentate; androecium amentiform, minute; antheridia single, oval.

Dioicous. Plants forming shallow, entangled tufts, attached to the surface of moist earth, of a dull green colour. Stems prostrate, linear, complanate, of moderate size, sparingly branched (on a cross section, showing 8 cells in diam., 20 to 25 cells in circumference). Leaves sub-opposite, imbricate, plane or slightly convex, ovate-triangular, entire, apex rounded, truncate, or rarely slightly retuse, antical margin of leaf decurrent, at angle of 60° postical border undulate 908; cells of a medium size, hexagonal, trigones very minute. Underleaves connate with the adjacent leaves, rarely with one only, about 1-5 smaller than the leaves, decurved, subquadrate, from a cuneate base, quadrifid for half its length, very rarely with an additional marginal tooth. Perigynium on a short lateral branch proceeding from an underleaf bearing one pair of bracts, with an additional bracteole, which are connate for the lower half. Bracts irregularly ovate, unequally dentate. Perianth cyathiform, mouth wide, tri-laciniate, on section the perianth is composed of one layer of 120 to 130 cells in circumference, slightly winged near the apex, wing 6 cells wide; mouth wide, with 3 or 4 segments, irregularly dentate. Capsule not seen.

Androecium amentiform, proceeding from below an underleaf, small, with 3 or 4 pairs of leaves, antheridia single, oval.

Measurements: Stems, $\frac{3}{4}$ in. to $1\frac{1}{2}$ in. long, with leaves spread out 3·5 mm broad; stem, ·2 mm to ·25 mm diam.; leaves, 2·2 mm long × 1·7 mm broad at base, 1·8 mm × 1·4 mm, 1·6 mm × 1·5 mm, 1·6 mm × 1·4 mm; cells, ·045 mm × ·04 mm, ·04 × ·04, ·04 × ·035, ·04 × ·03, ·035 × ·03, ·04 × ·025; trigones, ·005; bract, 1·25 mm high × 1·5 mm broad; perianth, 3· mm long × 1·5 mm wide at mouth, 2·5 mm × 1· mm; under leaves, 1· mm long × ·5 mm broad; segments, ·4 mm long, ·9 × ·6; seg., ·4, ·8 × ·6; seg., ·4, ·8 × ·5; seg. ·5, ·7 × ·5; seg. 3, ·5 × ·3; seg. ·3.

Hab., Muddy places by stream, Proctor's-road, Brown's River, Nov., 1885.

Obs.—Differs from the entire leaved form of *Chiloscyphus supinus*, Hook. f. et Tayl., figured by Mr. Mitten, Fl. N. Zel.

2 xcix. f. 2, in the shape of the underleaves, by which character it may be easily recognised.

Many of the perianths have a flap hanging from the suture, giving it a pseudo-alate appearance.

Description of Pl. IV.—Fig. 1, plants nat. size; 2, portion of stem × 16, antical view; 3, portion of stem × 16, postical view; 4, portion of leaf × 290; 5, 6, 7, underleaves × 24; 8, bract × 16; 9, perianth × 16; 10, cross section of portion of perianth × 85, showing the pseudo-wing character; 11, mouth of perianth, explanate, × 16.

[JUNGERMANIA BASTOVII n. sp.]

Monoicous, cladocarpous, pale glaucous green; stems slightly branched, creeping, filiform, rigid; branches lateral, leaves approximate, nearly transverse, subsecund, subquadrate, ovate, convexo-conduplicate, divided half way down into two acute spreading segments, sinus acute, margin entire; exstipulate; involucre on short lateral branches; bracts larger than the leaves, notched at the base; perigonial leaves 4-6 pairs, turgid at the base, monandrous.

Monoicous, laxly creeping amongst other mosses and hepatics, of a dull, pea-green colour, nearly white when dry. Stems half an inch to an inch long, slightly branched, flagelliferous, wiry, showing upon a cross section 10 to 12 cells in diam., cells of equal size, nucleate, cortical cells about 24; branches lateral, rooting at intervals up to apex, rootlets white, short. Leaves loosely imbricated, alternate, patent at an angle of 55°, insertion slightly oblique, sometimes transverse, subsecund, roundish, oval, or subquadrate, subconduplicate, scarcely carinate, divided to about the middle into two equal lobes, sinus and segments acute, patulous; cells quadrate, nucleate, small, papillose, without trigones. Underleaves none. Involucre on short lateral branches, outer bracts larger than the leaves, similar in shape with an additional postical tooth at the base; bracteole oblong-oval. Perianth (?) only a single, imperfect one observed. This had a slightly irregular margin at mouth. Pistillidia clustered, oblong, 5 or 6. Androecium on chief stem or forming short lateral spikelets, 4 to 6 pairs of leaves, perigonial leaves gibbous at base, monandrous; antheridia shortly stipitate, spherical.

Measurements: Stems, from ½in. to 1in. long, ·15 mm to ·175 mm diam., with leaves ·5 mm to ·6 mm diam.; leaves, ·45 mm long × ·4 mm broad; seg., ·2 mm long, ·4 × ·3; seg., ·2, ·325 × ·275; seg., ·15; cells, 1-50 mm, ·0125 × ·02 mm, ·02 × ·0175, ·02 × ·02, ·0225 × ·02, ·0225 × ·02, ·025 ×

·02; outer bracts, ·55 mm long × ·5 mm broad; seg., ·3 mm long; marginal notch, ·05 mm deep, ·7 × ·6; seg., ·4; marginal notch, ·125; bracteole, ·3 mm long × ·1 mm broad.

Hab., "Ploughed Fields," Mount Wellington, January 1st, 1886. 261.

Obs.—Unfortunately no perfect perianths have been found, so we hesitate as to what genus it should be assigned.

To none of the already described species can *J. Bastovii* be referred so far as we are able to say.

The discoverer, Mr. R. A. Bastow, of Hobart, Tasmania, in whose honour the name is given, and who has already considerably added to the list of Tasmanian Cryptogams, sent it as *Gymnomitrium physocaulum*, Tayl., but with that species it has nothing in common.

This is in many respects the most interesting of Mr. Bastow's discoveries; the short lateral axillary involucre and absence of underleaves distinguish it from any known species. The insertion of the leaves is nearly transverse, but undoubtedly succubous.

Description of Plate V.—Fig. 1, plants nat. size; 2, plant × 16; 3, apex of ♂ stem × 16; 4, portion of stem × 51; 5, 6, 7, leaves × 85, flattened out; 8, portion of leaf × 290; 9, 10, outer bracts × 57; 11, bracteole × 85; 12, pistillidia × 85; 13, antheridium × 85.

[Cesia erosa n. sp.]

Monoicous; loosely cæspitose, pale olive green, rhizomatous, creeping, sparingly branched filiform, fertile stems erect, clavate, leaves very closely imbricate, appressed, erect, ovate or roundish-ovate, entire, retuse or slightly notched, margin hyaline, irregularly erose, crenulate; cells minute, guttulate; bracts broadly ovate to cordate-ovate, bidentate, sinus acute, inner bracts 3-lobate, dentate.

Monoicous. Tufts intricately entangled, of a pale olive green colour. Stems on a cross section about 30 cells in circumference, 10 in diameter, 3 outer rows darker, inner hyaline, rhizomatous, simple or slightly branched, rigid, somewhat flexuose, filiform, flagelliferous; flagella with or without minute leaves, rooting; rootlets frequent, short, whitish. Leaves closely imbricated, appressed, erect, ovate, or broadly ovate, retuse, slightly notched or entire, sinus extremely shallow, segments slightly acute or rounded, margin of leaves hyaline, irregularly crenulate or erose; cells minute, guttulate, quadrate, or 5-6 sided, marginal cells long and narrow, conical or irregular in form. Perigynium on short club-shaped branches; outer bracts rather larger than leaves, broadly ovate to cordate-ovate, bidentate, sinus from 1-10 to 1-5 deep, acute, margin as in leaves; inner bracts 3-lobate, irregularly dentate. On the margins of these inner bracts were numerous *cellulæ clavulæ*, which Leitgeb states to be peculiar to *Cesia* as distinct from *Marsupella.* Pistillidia 10, long, capsule not seen. Androecia terminal on lateral branches, 4 to 6 pairs of leaves, ovate-quadrate, emarginate sinus and segments obtuse, antheridia 2 in each leaf, oval, stipitate.

Measurements: Stems, with branches, ½ in. to 1 in. diam., ·2 mm, with leaves ·3 to ·4 mm; leaves, ·7 mm long × ·6 mm broad, ·6 × ·5, ·4 × ·35; cells 1-70 mm, ·015 mm × ·015, ·0125 × ·0125, ·02 × ·0125; marginal cells, ·05 mm × ·01 mm, ·04 × ·01, ·03 × ·01, ·025 × ·0125; bracts, outer, ·7 mm × ·7 mm, ·6 × ·7, ·5 × ·5; seg., ·05; bracts, middle, ·55 mm × ·55 mm; seg., ·1 mm; bracts, inner, ·45 mm high; *cellulæ clavulæ,* ·01 mm × ·02 mm, ·01 × ·0175; pistillidia, ·275 mm long × ·05 mm broad; perigonial leaf, 4 mm × ·325 mm; antheridia, ·175 mm × ·125 mm.

Obs.—In habit resembling *Cesia corallioides.* Differs from it in its monoicous inflorescence, margin of leaves being irregularly crenulate, with long narrow cells, although in *Cesia corallioides* the margins of the leaves are so diaphanous and scariose that the cell structure can scarcely be defined, yet the cells always retain their quadrate shape.

Cesia crenulata, which it resembles in size, is also dioicous, margin of leaves more regularly and deeply crenulate, with the marginal cells shorter and more conical, leaves always bidentate.

Hab., top of Mount Wellington, Tasmania, January 1st, 1886. 284.

Description of Pl. VI.—Fig. 1, plants nat. size; 2, plant × 16; 3-7, leaves × 24; 8, leaf × 85; 9, portion of leaf × 290; 10, margin of leaf × 290; 11, 12, outer bracts × 16; 13, ditto × 85; 14, middle bract × 85; 15, inner bract × 85; 16, *cellulæ clavulæ* × 290; 17, pistillidium × 85; 18, perigonial leaf × 85; 19, antheridium × 85.

[Jungermania (Jamesoniella) teres n. sp.]

Dioicous, densely cæspitose, flagelliferous; reddish-brown colour; stems subramose, terete, wiry, rigid, filiform, flexuose, branches postical, leaves closely appressed, imbricate, subamplexicaule, erect, broadly ovate, obtuse, margin hyaline, entire; underleaves, none; involucral bracts much larger, laciniate-dentate, bracteole ovate-acute, slightly dentate; perianth ovate-cylindric, deeply, 4-6 plicate, mouth incurved, denticulate; ♂ branches postical, perigonial leaves 6-8 pairs cordate, cucullate.

Dioicous; ♂ and ♀ entangled in the same tufts, but on separate stems, loosely intricately cæspitose, prostrate, flagelliferous; flagella rooting at the end, clothed with minute leaves. Stems filiform, julaceous, about ½ in. long, of a reddish-brown colour, slightly branched, rigid, serpentine, about the thickness of horsehair, a cross section showing it to be composed of small, thick, opaque cells, branches postical. Leaves very closely appressed to stem, imbricate or approximate, obliquely erect, alternate or subopposite, succubous, entire, ovate, broadly ovate or cordate-obtuse, reddish-brown, with a paler hyaline border; cells smallish, quadrate or oblong-quadrate, 4-5 sided, trigones none, marginal cells 3 rows deep, smaller, and with thinner walls. Fertile stems suddenly bent upwards. Bracts accresent, 2nd pair irregulary dentate, innermost larger, broader than long, acutely and deeply 6-10 laciniate-dentate. Bracteole ovate-lanceolate, slightly dentate on one side. Perianth projecting half beyond bracts, oval, 4-6 plicate, composed of one layer of cells, about 100 cells round near the middle upon a cross section, mouth wide, slightly incurved, faintly denticulate. Pistillidia 12-15 long. Plant ♀ on postical branches, perigonial leaves larger, 6 to 8 pairs, hooded, unidentate near base on one side, monandrous, antheridia oblong-orbicular.

Measurements: Stems, from ¼ to ½ in. long, ·2 mm to ·3 mm diam.; leaves, ·35 mm long × ·45 mm broad, ·45 × ·35, ·4 × ·3, ·375 × ·35, ·35 × ·3; cells, 1-40 mm, ·03 mm × ·025 mm, ·03 × ·02, ·025 × ·02; second bract, ·4 mm broad × ·4 mm high; innermost bract, ·75 mm × ·65 mm, ·65 × ·55; bracteole, ·6 mm high × ·4 mm broad near base; perianth, 1·5 mm long × ·6 mm broad; perigonial leaf, ·4 mm long × ·5 mm broad; pistillidia, ·3 mm long × ·06 mm broad; antheridia, ·2 mm × ·15 mm.

Hab., near top of Mount Wellington, December 25th, 1885. 275.

Obs.—This minute and very beautiful species resembles a microscopic form of *Jung. (Jamesoniella) rubella*,, Spruce, but is abundantly distinct from that or any known species.

Description of Pl. VII.—Fig. 1, plants nat. size; 2, fertile stem × 24; 3-6, leaves × 85; 7, portion of leaf × 290; 8, second bract × 85; 9, 10, innermost bracts × 64; 11, bracteole × 64; 12, perianth × 51; 13, cross section of perianth; 14, pistillidia × 85; 15, perigonial leaf × 85; 16, antheridium × 85.

61. ANTHOCEROS LONGISPIRUS n. sp.

Monoicous; fronds large, dark green, older portion yellowish, irregularly oblong-quadrate or flabelliform, broadly nerved, lobate, lobes cuneate, flabelliform, concave, laciniate-crenate, gemmiparous, slightly glandular; involucre very long, cylindrical, remarkably thick and fleshy, mouth contracted and thinner, irregularly notched, capsule long, pale brown, slender, splitting into 2 valves; spores greenish, minutely verruculose, elaters very long, unispiral.

Plant growing in large patches of a dark green colour, the older imbricated portion discoloured, yellowish beneath. Frond large, very irregular in shape, usually oblong-quadrate or flabeliform, irregularly lobed; texture somewhat fleshy, broadly nerved, *i.e.*, thicker at the middle, gradually becoming thinner towards the margin (8 to 12 cells thick near the middle, cells small and closely packed, 1 to 2 cells thick, near the margin laxer); lobes short, cuneate, margin ascending, laciniate-crenate, much malformed and crisped by the gemmiparous growths.

Within the margin of the fronds scattered, sessile, glandular cells are met with, surface of frond otherwise smooth.

Inflorescence monocious. Involucres numerous, usually arising in two's or four's from the thickened portion of frond near the end, narrow and very long, fleshy, 8 to 12 cells thick near the middle, 1 to 2 near the mouth.

When old and dry, mouth contracted, smooth, plicate, irregularly notched. Capsule pale brown, long, slender, splitting into 2 valves; columella filiform.

Spores greenish, minutely verruculose. Elaters remarkably long, enclosing a single, broad, loosely coiled, brown spiral band.

Measurements: Fronds about 1 in. long, 1½ to 2 cm broad; lobes, 5 mm broad; fronds, ·04 mm to ·05 mm thick in the middle, ·01 mm to ·02 mm thick near the margin; cells of upper layer, ·025 mm; involucre, 1 cm to 1 cm 5 mm long, 1 mm to 1·5 mm broad; capsule, 1½ in. long.

Habitat, St. Crispin's Well, Mount Wellington.

Obs.—The remarkably fleshy involucre and the length and perfection of the elaters distinguish this species from *A. laevis*. The prescence of glands associates it with *A. glandulosa*, Lehm., but that species is covered with glands, giving the plant a very peculiar character.

Dr. Spruce mentions Amazonian species having long elaters, but no species known to us possesses the characters given in the diagnosis.

Description of Pl. VIII.—Fig. 1, 2, plants nat. size ; 3, portion of frond × 11 ; 4, cross section of frond × 16 ; 5, portion of frond showing outer layer of cells × 290 ; 6, portion of involucre showing mouth × 16 ; 7, cross section of involucre near middle × 16 ; 8, cross section of involucre near mouth × 16 ; 9-12, spores × 290 ; 13, elater × 280.

HOW FAR CAN THE GENERAL DEATH-RATE FOR ALL AGES BE RELIED UPON AS A COMPARATIVE INDEX OF THE HEALTH OR SANITARY CONDITION OF ANY COMMUNITY?

By R. M. Johnston, F.L.S.

Indices to the state of health or sanitary condition of a community are of the utmost importance to all, and especially so to those who are responsible for local sanitary provisions; and hence it is often asked, how far is the general death-rate of any year to be relied upon as a test of either the health or sanitary condition of any place or country?

I shall this evening try to demonstrate that the general death-rate of any one place, though in itself due to a combination of many complex causes, may, nevertheless, be used as a fairly reliable local index to health and sanitary condition, although a most faulty index as regards the comparative health or the sanitary condition of different localities. The dominant influences which determine the total death-rate are these:—

1. The proportions living at various age groups, especially the old age group, 60 years and over.
2. Migration, as affecting the said proportions.
3. Birth-rate as affecting the death-rate of 0-5 years age group.
4. Climate.
5. Seasonal influence.
6. Cosmical or obscure influences varying or intensifying local causes of disease over wide cycles of years.
7. War, violence, and famine.
8. Density of population as exemplified by town and country dwellings.
9. Sanitary provisions.
10. Local conditions of soil, altitude, etc.

Now, of these important influences, which together combine to make up the total death-rate, the first three, though strongly affecting it, are not in the slightest degree connected with either health or sanitary conditions. It is also obvious, so far as any one locality is concerned, that many of the conditions enumerated are more or less constant; while, as regards different localities, and especially countries widely apart, nearly all the conditions come into play as disturbers, and hence it is, that the general death-rate of any one locality may be a fairly reliable comparative index of the health and sanitary condition from year to year; while, as regards longer periods, or widely separated localities, comparisons by the indication of a general death-rate are often utterly fallacious or misleading.

Much prejudice exists in some minds against the use of figures. "Figures can prove anything," is a current popular phrase.

But even words and phrases, as such, are more easily twisted to wrong uses than figures. Yet we do not despair of arriving at correct conclusions by the aid of facts and figures, where due care, thorough investigation, and logical methods are employed. As a rule it is not so much that the results of computed figures are false, as that careless and false interpretations are put upon them. Lord Derby, while presiding over the statistical section in 1865, happily illustrated some of the mistakes of this kind, by the statement that erroneous interpretations are taken from death-rate totals where abnormal causes are not taken into account; for example, "a year of pestilence, not only by its effect on the mortality of the year of its occurrence, but by its clearing away feeble lives, and so lightening the death-rate in years immediately consequent." But, as observed by the President of Section F of the British Association at Birmingham, in 1886, "There is less to be feared from errors arising out of this source, if we lay to heart the warning uttered by Mr. Goschen on a recent occasion. 'Beware of totals';—and if we recognise more fully than we are usually apt to do that a table of figures, even if it be absolutely correct as a statement of facts, is merely raw material, not a finished product. The misfortune is that it is only too frequently treated as the latter."

Now tables of totals indicating the death-rates per year of different countries are too commonly treated as finished products, whereas I shall in the following remarks endeavour to demonstrate that they are raw materials, so far as deductions relating to comparative health and sanitary condition are concerned.

With this object in view I shall address myself to illustrate the disturbing effect of the dominant influences already indicated upon the total death-rates in different years and in different places.

The Disturbing Effect of Varying Proportions of Persons Living at Various Age Groups.

To fully comprehend the effect of disturbance from this source we must know in a general way the widely differing proportions which each age group of living persons yield to the yearly death-rate. This is best appreciated by dividing the ages into three well-marked groups; the first, 0-5 years, showing the heavy losses at the beginning of life; the second, 5-60 years, or vigorous period, showing the sudden descent to a minimum, covering the period of youth and middle age; the third, 60 years and over, or old age period, suddenly curving upwards and marking the maximum of loss occasioned by the natural decay and termination of the more vigorous lives.

The tables and diagrams give a vivid picture of the broad proportional agreement that exists in different countries as regards the losses of life at the three great age groups. For, notwithstanding the fluctuations caused in different countries, whether due to climate or peculiarities of local condition, there is a wonderful similarity in the proportions which different countries yield at each respective age group.

The *first* ranges between	27·65	and	50·60	per 1,000 living.
The *second* ,, ,,	5·60	,,	12·66	,, ,, ,,
The *third* ,, ,,	49·18	,,	70·39	,, ,, ,,

The mean of each age group shows the relative proportion still more clearly thus:—

0-5 years' age group yields	42·15	deaths per 1,000 living.
5 under 60 years ,, ,,	7·73	,, ,, ,, ,,
60 years and over ,, ,,	61·53	,, ,, ,, ,,

Thus it appears that there is a very wide difference in the proportion of deaths yielded by each age group, and hence it is that if there be any wide difference in the proportions of the respective groups living in different places, as in young Colonies, the total death-rate would be so much disturbed thereby, that comparisons, so far as they refer to health or sanitary condition, would be erroneous and misleading. That this is to be expected is made still more apparent by contrasting the percentages of ages living with the percentages of deaths per year under corresponding age groups.

AGE GROUPS.

Age Group.	Persons Living. Percentage.		Deaths Per Year.			
			Rate per 1,000 Persons Living within same Age Limit.		Percentage to Total.	
	Variation.	Mean	Variation.	Mean	Variation.	Mean
1. 0-5 years	13·5 to 17·01	14·63	27·65 to 50·60	42·15	34·92 to 45·65	39·69
2. 5-60 years	77·93 to 83·18	80·62	5·60 to 12·66	7·33	28·34 to 53·79	39·80
3. 60 years and over ..	1·87 to 8·04	4·75	49·18 to 70·39	61·53	6·38 to 36·74	20·51

A study of the foregoing table reveals that if 1 and 3 group, together representing 19·38 per cent. of the living population, yield as much as 60·20 percentage of the whole deaths for one year, it follows, if there be any material difference in the respective living groups of different countries, that the total death-rate would show a corresponding difference, even though the proportion of deaths yielded at each age group were identical in the several countries compared. Thus, though the death-rate of each specific age group were identical in two countries, still the country having the smaller percentage of old age and children living would show a *lower death-rate.* Nay, more. If the variation be considerable, the country with the *smaller* percentage of extremes of youth and old age living would show a *lower total death-rate,* even where the ratio of deaths at specific ages was much *higher.* Take, for example, two towns of 100,000 inhabitants, as in the following illustration :—

Illustration of two towns, each with 100,000 inhabitants, but differently proportioned as regards age groups living, although the proportion of deaths yielded by both are the same in relation to each age group.

	Pop.	Percentage living at			No. Deaths per Year				Deaths per 1,000 Persons at each Age given.				
	No.	0-5	5-60	60 and over.	0-5	5-60	60 and over.	Total.	0-5	5-60	60 and over	Total.	
Town A	100,000	13·50	84·63	1·87	613	474	92	1179	38·00	5·60	49·18	11·79	Dif. of 2·82 per 1,000
Town B	100,000	17·01	74·95	8·04	646	420	395	1461	38·00	5·60	49·18	14·61	

This is a good illustration of cases where the total death-rate is a faulty comparative index to the state of health or sanitary condition, for the difference 2·82 per 1,000 is due entirely to the varying proportion of persons living at each age group, and not to any difference in the proportion of deaths yielded by them.

Illustration of two towns each with 100,000 inhabitants, but differing in proportion as regards age groups living, and also differing in the proportions of deaths yielded by each group.

	Pop.	Pop. Percent. Living at each Age Group.			No. of Deaths per Year.				Deaths per 1,000 Lives at each Age Group.			
	No.	0-5	5-60	60 and over.	0-5	5-60	60 and over.	Total.	0-5	5-60	60 and over.	Total.
Town C ..	100,000	13·50	84·63	1·87	569	654	115	1338	42·15	7·73	61·53	13·38
Town D ..	100,000	17·01	74·95	8·04	646	420	395	1461	38·00	5·60	49·18	14·61
Town E ..	100,000	17·01	74·95	8·04	717	579	494	1790	42·15	7·73	61·53	17·90

This comparison again still more forcibly illustrates the faulty indication of the total death-rate, as regards the comparative state of the health or sanitary condition of the two towns taken; for it so happens that D, which has a much smaller yield of deaths relative to each age group, is nevertheless made to appear 1·23 per 1,000 person *higher* than C by the total death-rate; whereas the true relation of C, in relation to health and sanitary condition, as compared with D, can only be ascertained by computing C's death-rates at each age group in connection with the same living age group proportions, as in D. By this means alone would a true comparison be effected between them as regards health and sanitary condition, and instead of C being 13·38 per 1,000 persons, and lower than D by 1·23 per 1,000, it is, as regards health in relation to D, really equivalent to 17·90 per 1,000 persons living, or equal to 3·29 per cent. per 1,000 *above the index of D.*

Since the *Health Standard* was proposed by me in 1882, another method for effecting truer comparisons than offered by the total deaths between different countries has been adopted by Mr. Hayter (Year Book for 1885, pp. 264-268), termed by him the *Absolute Death-rate.* This consists of ignoring actual proportions living at each age altogether, and artificially substituting uniformity of proportion, by recognising fifteen age groups of equal value (say 1,000 for each). It makes no allowance for the element of old age, and consequently this health element neutralises the true approximate indication of proportion from preventible causes. It is, however, an admirable method in many respects, although its general results would still produce anomalies in comparisons relating to health and sanitary condition.

The method would be greatly improved if the fixed standard for the various age groups were more closely approximated to the actual proportions living in different countries. By dividing them into three groups, as follows, this might be effected very closely, viz.:—

Let A = Represent proportion of ages living 0-5 years = 3 *
B = " " " " 5-60 " = 16*
C = " " " " 60 and over = 1 *
R a = Death-Rate actually yielded by ages living 0-5
R b = " " " " 5-60 "
R c = " " " " 60 & over
D. = Relative Death-Rate for all ages.

Then,

$$\frac{AR^a + BR^b + CR^c}{A+B+C} = D$$

* These figures are the lowest simple relative approximates to the mean proportions living within the respective age groups.

A *Relative Health Standard* might be fixed similarly for comparison between different countries, by combining age groups under 60 by the same fixed values and by eliminating $\frac{CR^c}{C}$ Thus :—$\frac{AR^a + BR^6}{A + B}$ = H or *Relative Health Standard.*

If the death-rates for Australasia be compared by these methods, the following would be the results for each Colony :—

DEATH-RATE PER 1,000 PERSONS LIVING.

		All Ages.			"Health Standard" (Ages under 60.)	
		Absolute.	Actual.	Relative.	Actual.	Relative.
New Zealand ...	1885	16·20	10·76	11·54	9·51	9·59
Tasmania ...	1885	20·74	15·40	13·75	10·59	10·77
South Australia	1885	17·67	12·48	12·91	10·74	10·81
Victoria	1885	21·48	14·73	15·49	12·23	12·84
New South Wales	1884	19 99	15·88	15·55	13·23	13·32
Queensland ...	1885	26·04	19 58	21·09	18·48	18·68

As regards the value of these five standards as comparative indices of health and sanitary condition, there can be no doubt of the superiority of the *Actual* and *Relative Health Standards*, and the following may be taken as the order of their respective values as health indices :—

1. Actual Health Standard (ages under 60).
2. Relative Ditto Ditto.
3. Relative Death-Rate for all ages.
4. Absolute Ditto Ditto (Hayter's method).
5. General Total Death-Rate for all ages.

Thus there are five methods for effecting comparison.

1. The Total Death-Rate for all ages, which makes no allowance whatever for the varying proportions of age groups.
2. Hayter's Absolute Death-Rate for all ages, giving an arbitrary fixed value of 1,11 and 3 to ages living 0-5, 5-60, 60 and over, respectively ; superior to total death-rate, but defective inasmuch as the arbitrary fixed values do not approximate to the average mean of the actual proportions of the several age groups, and because it ignores the disturbing element of old age in comparisons regarding health and sanitary condition.
3. "The Relative Death-Rate" for all ages, giving a fixed value of 3,16 and 1, for ages 0-5, 5-6, 60 and over, respectively, based upon the actual average proportions of the several age groups living, but defective as a standard of health, by including the old age element.
4. "The *Relative Health Standard*" for ages under 60, giving a fixed relative value of 3,16 to the two groups 0 5 and 5-60, and so approximating to actual living proportions. This method eliminates the old age element,

and is convenient for effecting comparisons with countries where the rates yielded for the particular groups are already computed.

5. "The *Actual Health Standard*" for ages under 60, giving the true yield of deaths per 1,000 persons actually living under the same age limit in each country, and thus effecting the best form of index as regards the comparative health and sanitary condition of different countries, by the elimination of the healthy old age element.

Of course these and other standards are supplementary to the more minute analysis, showing the actual death-rate at each specific age group.

That there is a great disparity in the proportion of living persons at each age group in the Australasian Colonies has already been shown, but it is nowhere so strikingly apparent as in the Colonies of Tasmania, Queensland, and New Zealand.

This is at once apparent by observing the proportions in each Colony of persons living, and of deaths occurring in the old age group.

PERCENTAGES OF DEATHS 60 YEARS AND OVER.

	Persons living 60 years and over.			DEATHS, 60 yrs. & over.		
1. Tasmania ..	8·04	percent.	(1881 census.)	36·74	percent.	(1885)
2. Victoria ...	4·65	"	"	20.75	"	"
3. South Australia ...	4·13	"	"	17·48	"	"
4. N. S. Wales ...	4·31	"	"	16.34	"	"
5. New Zealand ...	2·72	"	"	14·67	"	"
6. Queensland ...	1·87	"	"	6·38	"	"

Here we are at once struck with the fact that, included within the total death-rate in Tasmania (15·40 *per* 1,000 persons), there is 36·14 per cent. of the total deaths for ages 60 years and over. While in the total death-rate of Queensland (18·47 per 1,000 persons) there is only included 6·38 per cent. of the total deaths for ages 60 years and over. That this is solely due to the greater number of persons in Tasmania living at this age group (8·04 per cent), and not because of lack of health, is made unmistakably evident by computing the mean of all ages at death in the 60 years and over age group. This would show:—

	Percentage of death 60 and over.	Mean age at death.
{ Tasmania	36·74 ...	77·71 years.
{ Queensland	6·38 ...	70·31 "
Victoria	20·75 ...	71·54 "
South Australia ...	17·48 ...	72·69 "
New South Wales ...	16·34 ...	72·63 "
New Zealand	14·67 ...	71·36 "

This again proves that the true test of the death and sanitary condition for the *old age group* is longevity rather than the *accidental proportion* to the comparatively small number living at this age; and according to this test Tasmania, with a mean age of 77·71 years for all deaths at age group 60 years and over, is far above any other country.

Where, as in Tasmania, the mean age of 36·74 per cent. of the deaths exceeds the allotted span of life, "threescore years and ten," and where old age in itself among specific causes heads the list, it is evident that the total death-rate, which includes and conceals this important element, must in itself be a most unsatisfactory test of health or sanitary condition between different countries or places, although fairly good enough where comparisons are made for different years in relation to the same locality.

Extreme old age, *per se*, is an infallible index of health, whether due to the life or its environment. Therefore, to mingle deaths from extreme old age with deaths from the more or less preventible causes in any common rate used as a test of sanitary condition, must, as I have shown, frequently result in anomalies and confusion.

Under any circumstances, as already urged by me in my report on Vital Statistics for 1882, it would seem to be most desirable to separate the deaths from extreme old age from other causes in analysis of matters bearing upon health or sanitary condition; for although in imagination we could, with Dr. Richardson, conceive of the future *Hygeia* as perfectly freed from preventible causes of death, yet if it be admitted that the fully ripe aged must die sooner or later, we must also conceive that, as we approach the ideal City of Health, the proportions of death in childhood, youth, and middle age can only diminish as the proportion of old age increases. Thus, when the future Registrar-General can record deaths from extreme old age "100 per cent.," there will be perfect health and peace, and the only value of the annual death-rate for all ages will be merely as a measure of the natural increase or decrease of population. From these considerations it is clear that the ordinary death-rate index for Tasmania is not a fair test of her sanitary condition as compared with the neighbouring Colonies, for of all countries with whose statistics I am acquainted there is none which so closely approaches the ideal standard of perfect health.

It may be that one is generally more satisfied with a bantling of one's own creation; but, making allowance for this, I am also strongly convinced that the *Health Standard* proposed by me in 1882 (viz., deaths under 60 years compared with the population living under the same age limit) would more fitly than any other method fulfil all the conditions required in a general death-rate for testing the health and sanitary condition of different places.

By this standard two very desirable objects are secured. First, the widely disturbing effect of differing proportions of the old age group is entirely eliminated and truer comparison as regards comparative health may be attained; and second, the element of *old age*, whose proportions over 60 are in themselves good indices of environment, are not mixed up with deaths due to adverse causes, and so producing confusion in the general result, as in the total death-rate and other standards for all ages. The national death-rate for all ages, it is true, is a very simple and ready test, and may still be used with advantage in some countries where the age relations are comparatively stable, but in the Colonies, where these relations are continually disturbed by migration, the *Health Standard*, as already defined, is more reliable, can be applied universally, is simple, and, for comparison, easily computed.

It would also be of the greatest value in the comparison of different cities in Europe, by minimising the errors of comparison arising out of migration between town and country districts.

To Health Officers, who are responsible for the sanitary conditions of towns, such a test would prove of great advantage, and it would often save them from unmerited opprobrium based upon the unreliable total death-rate index, which takes no account of the important disturbances caused by the variation of age group proportions.

Mr. N. A. Humphreys, in 1874, read a masterly and useful paper before the Statistical Society of London, in defence of the general utility of the total death-rate as an index to comparative health so far as England is concerned; but he admitted its defects, and many of his conclusions have been combated by Mr. Thos. A. Welton, Dr. Letheby, and other well-known authorities on vital statistics.

As regards the disturbed age groups of the Colonies, however, Mr. Humphreys would probably admit that the general death-rate for all ages would be unsatisfactory and misleading as a comparative index of health.

These conclusions are fully borne out by placing the results of the two methods side by side as applied to the Australasian Colonies.

	Deaths all Ages, Per 1,000 persons.	"Health Standard." Deaths under 60 Years. Per 1,000 persons under same age.	Deaths over 60 Years. Per centage to total Deaths.	Deaths over 60 Years. Mean Age at Death.
New Zealand, 1885	10·76	9·51	14·67	71·36
Tasmania, 1885 ...	15·40	10·60	36·74	77·71
S. Australia, 1885	12·48	10·74	17·48	72·69
Victoria, 1885	14·73	12·23	20·75	71·54
N. S. Wales, 1884	15·88	13·24	16·34	72·63
Queensland, 1885	19·58	18·48	6·38	70·31

Thus, by the total death-rate, the several Colonies take up the following order, in which Tasmania is made to occupy the fourth position, while, by the more accurate *Health Standard*, Tasmania rightly occupies the second position.

By the *Total Death-Rate* index:—1, New Zealand; 2, South Australia; 3, Victoria; 4, Tasmania; 5, New South Wales; 6, Queensland.

By the *Health Standard*:—1, New Zealand; 2, Tasmania; 3, South Australia; 4, Victoria; 5, New South Wales; 6, Queensland.

The order of greatest percentage living over 60 is also shown thus:—1, Tasmania; 2, Victoria; 3, South Australia; 4, New South Wales; 5, New Zealand; 6, Queensland.

The true test of comparative health for this group is longevity, and in this respect Tasmania again heads the list:—1, Tasmania; 2, South Australia; 3, New South Wales; 4, Victoria; 5, New Zealand; 6, Queensland.

The misleading nature of the total death-rate as a test of comparative health and sanitary condition is still more forcibly illustrated in regard to comparisons made between cities where the age groups are differently constituted. Thus the total death-rates for the following cities are placed in the order of the highest death-rate for all ages.

	Death Rate per 1,000 persons.
1. Hobart, 1885	24·70
2. Sydney, 1884	23·33
3. Brisbane, 1885	21·64
4. London, 1885	19·7
5. Adelaide, 1885	18·9

But, when we come to analyse the figures, it is at once made apparent that the order is far from correct, as indicating comparative health or sanitary condition, for the proportion of age group 60 and over is extremely variable, thus:—

	Percentage of Deaths over 60 years.	Mean age at death.
Hobart, 1885	43·46	74·30
Adelaide, 1885	18·80	71·91
London, 1885	12·89	73·37
Sydney, 1884	11·96	71·22
Brisbane, 1885	8.54	71·08

From this it is clear that the Hobart total death-rate of 24·70 per 100, which includes 43·46 per cent. of ages 60 and over, cannot fairly be contrasted by this means (from a health point of view) with the other cities, which only contain from 8·54 to 18·80 per cent. of the old age group, especially so when we consider that in Hobart the mean age at death of the group is the highest.

The truer index of the relative health and sanitary condition, as computed by the *Health Standard,* would place Hobart far before the others. It is not always possible, however, to make a close estimate of the ages living under 60 in cities, but if we measure deaths under 60 by the estimated total population, we get a close approximation to relative value of the condition affecting health and sanitation in the cities compared, thus :—

	Deaths under 60 years per 1,000 persons living.
1. Hobart, 1885	13·97
2. Adelaide, 1885	15·42
3. London, 1885	17·16
4. Sydney, 1884	19·52
5. Brisbane, 1885	19·79

Thus it is evident that the true index to health and sanitary condition of different places can only be obtained by eliminating the old age group, as in the method of the *Health Standard.* Comparisons by the usual mode are widely misleading. The very remarkable circumstance that Hobart shows 43·46 per cent. of the total deaths, as being 60 years and over, with a mean age at death of 74·30 years, is of itself sufficient as to prove the reasonableness of these conclusions.

The Influence of Migration

The death-rate for all ages is also greatly affected by Migration, as it invariably disturbs the proportion of the principal age groups.

The bulk of Immigrants to cities and young Colonies consists of persons between the ages of 5 and 50. This is the period of life, as already explained, when deaths are at a minimum, relative to the same age group living. In most of the Australasian Colonies the death-rate for this group ranges between 5·60 and 7·72 persons per 1,000 living.

Where Immigration is large in proportion to the original population, there will certainly be a very great fall in the total death-rate, without any change in the proportional yields for each age group, and without any material change in the conditions affecting health.

Thus if a stream of Immigration equal to 10,000 per year of ages between 5 and 50 were absorbed by a young Colony whose original normal population was 200,000, with a total death-rate of 15·40 per 1,000; then if the death-rate for ages 5-60 was only 6·17 per 1,000, it follows that in ten years the total death-rate would be reduced to 12·32 per 1,000—that is a fall of 3·08 per 1,000 in the total death-rate without any alteration whatever as regards death-rate yield for particular ages, and with no material alteration in the conditions affecting the health or sanitary state of the Colony.

A corresponding increase in the total death-rate, however, need not be expected in the country from whence Immigration proceeded, as the numbers in most cases would be comparatively insignificant.

Thus if the country from whence Immigration proceeded originally numbered 36,000,000, with a normal death-rate for all ages of 20 per 1,000—then a stream of Immigration, equal to 10,000 per year for ten years, of persons between 5 and 50 years of age would only have the effect of increasing the total death-rate for all ages, by about 0.004 per 1,000.

From such considerations therefore, it is evident that a very considerable decline in the death-rate of a young Colony, which yearly absorbs a large number of Immigrants, may be almost entirely ascribed to this cause, and not to any improvement in local health or sanitation.

From similar considerations it is also evident that the comparatively low death-rates of some large cities may be due in great measure to the absorption of fresh country lives between 15 and 40 years, and not to the comparative health and sanitation of the city. The comparative high death-rate of young lives in rapidly growing cities confirms this view of the case. These considerations should be borne in mind in comparing the total death-rates of different places; and here again it may be safely affirmed that the *Health Standard* would prove to be more reliable than the total death-rate as a test of comparative health and sanitary condition.

The Influence of the Birth-Rate.

The next most important influence acting as a disturber of the comparative value of the death-rate for all ages is the birth-rate.

To appreciate the effect of the birth-rate disturbance it is necessary to bear in mind that the deaths under 1 year of age range from about 96 to 220 per 1,000 births per year, and comprise from about 22 to 25 per cent. of the total deaths. It follows, therefore, if the birth-rate be abnormally high in any year, that the total death-rate would be considerably increased without any disturbance of the local condition affecting health.

It has long been observed that an improvement in material welfare leads to a corresponding increase in the marriage and birth rates; and hence it follows that any unusual improvement in the material welfare of a country has an intimate relation with causes which tend to increase the proportion of deaths under one year of age, and thus considerably increase the total death-rate for all ages without any disturbance of matters affecting the local health and sanitary conditions.

The foregoing influences may be described as the principal disturbers of the death-rate index, although in no way affecting the conditions connected with health and sanitation.

The influences commented upon hereafter (viz., season, climate, cosmical or epidemic visitations, war, famine and violence, density of population, etc.,) form a group which greatly affects both health and death rates for all ages, even though the state of sanitation be good, or at any rate normal, and therefore comparatively neutral as regards death-rate variations.

The Influence of Climate.

Independently of all other causes enumerated, the death-rates of different countries are seriously affected by special diseases, which are more or less restricted to given geographical limits. Yellow Fever may be taken as an example of diseases of this kind, being mainly restricted to certain tropical latitudes, and there, again, mostly confined to low-lying plains adjacent to the sea.*

The total death-rate for such places certainly may give a fair index of its health from year to year; but its presence or absence in different countries is a condition of latitude rather than local hygiene.

* Hirsch states that in the Western Hemisphere its range extends between 32°·46 N., and 22°·54 S., and in the Eastern Hemisphere between 14°·53 N., and 5°·7 N.

The Influence of Season.

The seasonal influence has an important bearing upon health, although its influence is similar in different years. Its effect, therefore, is seen in the varying monthly or quarterly death-rates rather than in the total yearly death-rate.

If we take our own local experience of the influence of each month, and reduce it to a diagraphic form, we readily perceive that there is an intimate relation between the temperature and the death-rate.

These temperature extremes are in January and July, the first showing the maximum, the second the minimum. Now, extremes of heat and cold are both injurious to health, although, upon the whole, the former is more fatal. The death-rate curve for the year sensitively follows the double curves of temperature, although the second curve occurring between April and November appears in inverse order. Thus the double death-rate curves and double temperature curves run together (between November and May, and May and November), the maxima of the two death-rate curves closely corresponding respectively with the maximum and minimum curves of temperature, thus:—

	Temperature.*		Death-Rate.† per centage.	
November	57°·8		7·03	
December	60 ·1	Max.	8·97	Major max.
January	63 ·3		9·48	
February	60 ·8		8·64	
March	59 ·3		8·28	
April	55 ·9		7·93	
May	50 ·5		8·39	
June	46 ·9	Min.	7·67	Minor max.
July	45 ·7		8·90	
August	48 ·7		8·62	
September	52 ·1		8·18	
October	53 ·6		7·91	
Mean	54 ·4		8·33	

These curves are best appreciated when shown in diagraphic form, and comparisons in this way show the close correspondence which exists between deaths from zymotic diseases, deaths of children, the major maximum total death-rate curve, and the maximum curve of temperature.

At the same time there may be seen also a close correspondence between the curves of deaths relating to old age, deaths from diseases of the respiratory system, the minor maximum seasonal death-rate curve, and the minimum curve of temperature.

It is clear, therefore, that the death-rate variation of particular months is of no value in itself as an index of local sanitary condition, which seldom varies to any extent within the space of one year; and therefore this form of death-rate variation must, in nearly all cases, be ascribed principally to seasonal influences lying beyond human control. The Typhoid seasonal curve is a very remarkable one. It is at its lowest point invariably from July to November inclusive, rising rapidly to its highest point in March, and from that point falling as rapidly to the beginning of its minimum period in July.

This curve is not in any way disturbed by the rise and fall of its death-rate in different years. A glance at the diagram showing the deaths from Typhoid in Australasia shows clearly a periodic rise and fall during the last twenty years, with an average duration of fully four years for each period.

The close agreement between the various widely separated Colonies in these periodic curves teaches us caution in referring the unusual rise or fall to causes altogether local.

Local causes, no doubt, are fairly indicated by the smaller or greater intensity of the rise or fall, but the actual tendency in itself to rise or fall during each period is more probably referable to some hidden cosmical influence.

Thus there are probably three great causes operating, as regard the variations of Typhoid, viz:—1. Local hygiene; 2. Seasonal influence; 3. Cosmical influence. None of which may be neglected in forming a correct opinion from local death-rate data.

The Influence of Cosmical or Obscure Causes, such as Epidemics, in Adding to or Varying the Intensity of Local Causes of Disease Over Wide Cycles of Years.

If we study the diagram showing the movement of the death-rate in Australia and Europe since 1850, we at once perceive a series of waves generally covering a period of ten to eleven years. These are somewhat modified in different countries by what we may term subordinate ripples upon the greater wave, but these in no way disturb the close agreement of the greater waves, or cycles. The length and the time occupied by each great cycle closely correspond with the sun-spot periodicity.

There can be no doubt of the marked agreement of the disturbance of the general death-rate of the various Colonies in Australasia, each of which differs in the actual death-rate relative to their respective populations. It becomes a most important question, then, to enquire whether and how far these wave-like disturbances—not the relative local death-rate peculiar to each place—are within the limits of human control, and, therefore, to what extent are they of value as an indication of local sanitary conditions?

The cause of this periodic rise and fall in the death-rate occurring simultaneously in different widely separated countries is, I admit, a most difficult question. It is open to us to consider the results as due

1. To human neglect of, or attention to, sanitary conditions fluctuating simultaneously in different countries, in accordance with the periodic fluctuations of the death-rate.
2. To periodic fluctuations in the intensity of specific zymotic diseases in centres where they are endemic—but periodically becoming epidemic or pandemic when the period of intensity is at its height.
3. To periodic fluctuation in the medium or channels of conductibility from endemic centres, the death-rate decreasing with the increase in non-conductibility and increasing with its increased powers of conductibility.
4. To hidden cosmical influences simultaneously affecting the life and activity of disease germs throughout wide

regions of the earth's surface, and fluctuating in a wave-like rise and fall of longer or shorter cycles, as in the well-known fluctuations of magnetic variations and sun-spot intensities; favourable or unfavourable conditions in different regions,intensifying or diminishing the general effect, but not altogether dissipating its influences.

As regards the first of these (human action or inaction) it needs only to be mentioned to be at once rejected; for whatever value we may ascribe to the ameliorating influence of human action in improving sanitary and other conditions connected with health and the treatment of injury or disease, and thus lessening the severity of attacks of disease, whether epidemic or endemic. Still we can hardly conceive that men's minds and action should act in concert, consciously or otherwise, in all local centres over many countries so as to produce a rhythmic result upon local health, corresponding to the rhythmic rise and fall observable in the actual death-rate of countries widely separated during many years.

It must be borne in mind that knowledge tends always to increase, and improvement must needs follow in one direction, however slow it may be. Action, though fitful, always follows upon increasing knowledge; and although it may be more than counterbalanced by the tendency of people to become unduly aggregated in old or new centres, still the failure to advance with increasing needs would not result in such rhythmic rise and fall in relation to the generally improving provisions, so as to agree with the death-rate cycles referred to.

Again, the habit of referring any unusual epidemic visitation to a chance medium for its communication from a distant endemic centre, either by infection or contagion, is a most unsatisfactory explanation.

This only places us a link further back in a possible chain of causation. Is it true that the channels of communication from endemic centres are only open to infection or contagion at periods corresponding to local death-rate cycles? Even if we admitted this in some cases, it would still leave us without an answer in respect of the fluctuations of intensity over well-marked cycles, in the very centres where a specific disease is endemic and never wholly absent.

The only natural explanation of these extraordinary fluctuations, as regards origin, is to refer them to unknown or obscure cosmical influences, the sum of which may harmonise with the known periodicity of the death-rate occurring simultaneously in countries wide apart. This reference is justified by analogy, with known modes of cosmical or superterrestrial disturbance. For example, we know the seasonal variation of temperature corresponds with the seasonal death-rate variation, and, whether it be a direct or indirect relation, we must admit that the varying intensity of the sun's energy from season to season, has much to do with the varying effects upon human life.

If, therefore, the small variation of the sun's position, and consequent energy relative to a given portion of the earth's surface, produces such noticeable effects within each year upon temperature, and through it the death-rate, is it not very reasonable to suppose that variations in the sun's energy, independent of the earth's distance from it, should produce corresponding disturbances in harmony with the larger cycles covering periods of several years? It is not necessary to indicate the special form of direct energy exerted by the sun over terrestrial matter, whether of light, heat, or magnetism. It is enough for my argument to claim that all of these, directly or indirectly, exert a most powerful influence upon terrestrial life and motion. Now, it has been clearly proved that the sun's energy is subject to cycles of disturbance, in the shape of violent photospheric storms, producing a perceptible diminution of light emitted, if not of heat; and what is more important, for the purpose of my argument, these periodic sun storms—termed sun-spots—have been proved, by careful observation, to produce upon the earth a marked corresponding wave of variation in the magnetic curve.

If this be so, and I see no good reason for doubting the alleged facts, does it not follow that the variation of the sun's energy in light and magnetism must produce effects upon terrestrial life corresponding in time with its periodicity, and in effect, though differing in degree, corresponding with the shorter cycles of seasons recurring year by year?

This may be termed a craze, like all other suggestions of a far-reaching and novel character, but I am quite willing to run the risk of being accused as crazy on this subject if fact and reason give it support. That it has much support, though falling short of perfect demonstration, is very suggestively borne out by the close correspondence that exists between the periodicity of the sun spots and that of the Australasian death-rate during the last twenty years. The general agreement in Australia between each distant Colony, as illustrated in diagram, is all in its favour. And, as already suggested, it may be that in the young Colonies where the mean death-rate is lower than that of Europe by 10 per 1,000 persons living, and where local artificial causes of death are at a minimum, the death-rate more sensitively indicates the effects of obscure superterrestrial influences than in crowded centres of population, as in Europe and other Old World centres.

In any case, whatever difficulty remains unexplained as regards the periodicity of the death-rate, the reference to a cosmical or superterrestrial influence has more to commend it than the other three sources so frequently referred to without support of a satisfactory character.

Let me not be understood, however, to assert the valuelessness of human effort by ascribing the periodical death-rate, rise, and fall, mainly to far reaching superterrestrial causes, among which the sun's varying energy plays a large part. On the contrary, I desire to affirm that human effort, directed to selection of sites for dwellings; supplies of pure food and water; to provision against poisonous food and drinks; to improvements in sanitary matters, and to facilities for healthful recreation; to improvements in workshops and factories; to the multiplication of acknowledged health safeguards and of convenient centres for the proper treatment of disease, as well as to improvement in treatment of injuries and diseases. In all such matter human effort does much, and can do more, to mitigate the intensities of attacks of disease, from whatever source they come, even if it cannot wholly subdue them. That sanitation and improved treatment have done much in England during the last twenty years to lower the death-rate of the younger lives cannot be reasonably doubted, and this of itself should encourage local effort to strive for further improvememt.

Man's Influence. Density of Population and Hygiene.

Except as an ideal standard of health, there is not much value in making comparisons between urban and country districts, because density of population is itself an important factor in raising the death-rate. If we examine the mean death-rate of urban and country districts during the years 1882-5, we find, after making due allowance for old age, hospitals, and public institutions, that the former indicated for ages under 60, 13·83 per 1,000, and the latter 8·13 per 1,000; that is a difference of 70·1 per cent. This is an enormous difference in favour of country districts. It is true that the centralisation in the urban districts of the sick in Hospitals, and of paupers and criminals from all parts of the country, artificially increases the death-rate of the former, and lessens that of the latter, to a much greater extent than happens in countries where Hospitals and Asylums are more generally distributed. Notwithstanding this, however, and while recognising on the average that the occupations of townspeople are more unhealthy than those of people living in country districts, and making due allowance for the important excess of the age element in urban districts, there is still a very great difference, which is difficult to account for satisfactorily in a young country; and while I am of opinion that the lower death-rate in country districts is not due to the relative superiority in artificial modes of sanitation as compared with urban districts, it is becoming evident that the closer contiguity of dwellings in towns demands that artificial sanitary measures in the latter should be specially framed to provide for those unfavourable conditions peculiar to all crowded centres of population. In villages and townships the several dwellings, even although more imperfectly conditioned in themselves as regards local sanitary provision, are naturally more perfectly insulated from each other by more or less broad regions of pure air. The poisoned exhalations of every individual dwelling do not spread and become more virulent by coming into direct contact with the poisoned atmosphere of neighbouring dwellings, but are at once dissipated or purified by that septum of pure air which it is reasonable to infer insulates dwelling from dwelling in thinly populated country districts. In urban districts, on the contrary, the septum of pure air surrounding each dwelling does not exist, or only exists temporarily or imperfectly, and consequently, notwithstanding special medical supervision, purer water supply, and in many cases superior sanitary provisions, the death-rate is invariably higher, and the atmosphere of every well regulated dwelling, is more or less in direct contact with the exhalations of every noxious centre within the town. Hence it would appear that the absence of the insulating septum of pure air around town dwellings renders the inmates of every house more liable to the attack of all infectious diseases which may be floating in any part of the atmosphere within the town. Even the otherwise healthy wind may be the agent which directs the fatal effluvia from an unhealthy centre upon a relatively pure and healthy division of the town.

A town dwelling, therefore, unlike country dwellings, is insecure as regards health so long as any centre or dwelling within its boundaries is allowed to vitiate the common undivided atmosphere with poisonous exhalations. A special responsibility therefore rests upon Town Boards of Health to prevent, as far as possible, the creation and spreading of all noxious exhalations anywhere within their province. Improved antiseptic measures should be devised and rigorously enforced in every part of the community.

There can be no doubt that urban and country district death-rates prove that the crowding together of human beings in particular centres is injurious to the health, and although the social needs of modern civilization render it impossible to prevent such aggregation, wise provision may mitigate its attendant evils by reducing this tendency to a minimum. This may be more easily effected in new countries, by only allowing town allotments to be proclaimed after the careful selection of healthful sites situated in localities where a good water supply and healthful drainage can be secured. Good ventilation, at the same time, can only be secured by a proper system of streets and lanes, and central reserves for parks. By prescribing the breadth of great intersecting broadways for each division; the minimum width of streets and lanes; the minimum area of central parks within each division; and the minimum air space in dwellings and workshops for each person, the tendency to overcrowding would be minimised, and a healthful circulation in all quarters secured.

No building should be allowed to be erected until plans of the same, completed according to prescribed forms of structure, ventilation, and drainage, were passed and approved by a permanently appointed Board of competent advisers; and the removal of all refuse and filth should be effected entirely by the town authorities, by the best methods suited to the particular locality.

Together with these provisions we must also include the influence of man in the prevention and treatment of injury and disease. The healthful selection of Hospitals, the proper isolation of cases deemed to be contagious or infectious, and the proper treatment of cases, have also a very important influence upon the death-rate of each locality.

CONCLUSION.

In conclusion I think it has been made tolerably clear by these observations, that while the total death-rate for all ages may be used locally as a fairly reliable index of the health and sanitary condition of the same place from year to year, it has been proved to be a most fallacious index as regards the comparative health and sanitary condition of different localities, owing mainly to the extreme variability in the proportions living in different places under the principal age groups. The elimination of old ages, as in the *Health Standard*, has been shown to be a more reliable index between different countries. As regards variations from year to year, it is hoped that the observations made may be helpful to others in making proper deductions therefrom.

DEATHS FROM ALL CAUSES, YEAR 1885.

Colony.	Total Populat'n (mean).	Number. 0-5	5-60	60 and over.	Unspecified.	All.
Victoria	975,040	5181	6185	2980	19	14,364
New South Wales, 1884	895,533	6228	5550	2324	118	14,220
Queensland	318,415	2419	3354	398	64	6235
South Australia	319,515	1820	1469	697	1	3987
Tasmania	132,166	711	577	748	..	2036
New Zealand	565,012	2345	2839	892	5	6081
Percentage.						
Victoria		36·07	43·06	20·75	0·12	100·
New South Wales, 1884		43·80	39·03	16·34	0·83	100·
Queensland		38·80	53·79	6·38	1·03	100·
South Australia		45·65	36·85	17·48	0·02	100·
Tasmania		34·92	28·34	36·74	..	100·
New Zealand		38·56	46·69	14·67	0·08	100·

DEATH-RATE AT EACH AGE GROUP, AND FOR ALL AGES, YEAR 1885, Compared with Percentage of Population Living under the same Age Group.

Colony.	Percentage Proportion of Living Persons, Census 1881. 0-5	5-60	60 and over.	All Ages.	Death-Rate at each Age Group and for All Ages. 0-5	5-60	60 and over.	AllAges under 60.	All Ages.	Mean Age at Death of Age Group, 60 & over
Victoria	13·22	82·13	4·65	100	40·19	7·72	65·72	12·225	14·73	71·54
New South Wales	14·84	80·85	4·31	100	45·08	7·37	57·92	13·233	15·88	72·63
Queensland	14·95	83·18	1·87	100	50·81	12·66	66·84	18·476	19·58	70·31
South Australia	14·89	80·98	4·13	100	38·25	5·67	52·81	10·737	12·48	72·69
Tasmania	14·03	77·93	8·04	100	38·34	5·60	70·39	10·597	15·40	77·71
New Zealand	17·01	80·27	2·72	100	27·65	6·17	49·18	9·51	10·76	71·36

DEATHS FROM TYPHOID (1882-1886.)

	Tasmania.				Victoria.	
	Hobart. No.	Launceston. No.	Country Districts. No.	Total. No.	Melbo'rne No.	All Victoria. No.
1882	5	16	15	36	197	472
1883	10	26	28	64	275	661
1884	14	11	5	30	220	456
1885	14	11	5	30	183	424
1886	9	25	13	47	...	..
Total for 5 years ..	52	89	66	207		

DEATHS FROM TYPHOID (1868-86).

	Absolute No.	Deaths per 10,000 of the Population.	
	Tasmania.	Tasmania.	Victoria.
1868	32	3·21	
1869	32	3·16	
1870	26	2·59	
1871	8	0·79	
1872	30	2·93	
1873	24	2·32	3·68
1874	44	4·22	6·05
1875	50	4·81	5·78
1876	26	2·49	4·71
1877	41	3·86	6·58
1878	50	4·61	6·48
1879	38	3·42	5·25
1880	29	2·55	3·49
1881	33	2·81	4·04
1882	36	2·98	5·30
1883	64	5·15	7·21
1884	50	3·89	4·82
1885	30	2·36	4·35
1886	47	3·43	...
	Mean	3·24	5·28

Comparative Table showing the suggested coincidence between the Death-rate and certain super-terrestrial phenomena.

ANNUAL DEATH-RATE OF VARIOUS COUNTRIES.

	Europe.		Australasia.							Mean of principal States of Europe.	Mean of the Seven Colonies of Australasia.	Sun-spot Numbers. (Wolf's.)	Relative position of Jupiter in his orbit.
	England.	Sweden.	Victoria.	New South Wales.	South Australia.	Queensland.	Western Australia.	New Zealand.	Tasmania.				A. Aphelion. P. Perihelion.
1804	..	..	..	..	..	..	..	..	..	..	..	73·1*	..
1810	..	..	..	..	..	..	..	..	..	..	..	..†	..
1816	..	..	..	..	..	..	..	..	..	..	..	46·4*	..
1823	..	..	..	..	..	..	..	..	..	..	..	1·8†	..
1830	..	..	..	..	..	..	..	..	..	..	..	70·7*	..
1833	..	..	..	..	..	..	..	..	..	..	..	8·5†	..
1837	..	..	..	..	..	..	..	..	..	..	..	138·2*	..
1839	21·8	..	..	..	..	..	..	..	..	..	..	..	A.
1843	21·2	..	..	..	..	..	..	..	..	..	..	10·7†	..
1845	20·9	..	..	..	..	..	..	..	..	..	..	..	P.
1848	24·7	..	..	..	..	..	..	..	..	..	..	124·3*	..
1851	22·0	20·8	..	..	..	..	..	..	..	..	..	..	A.
1853	22·9	23·7	..	..	..	..	..	..	..	..	..	..	..
1856	20·5	21·8	..	..	..	..	..	..	17·80	..	..	4·3†	P.
1857	21·8	23·7	..	..	..	..	..	..	17·10	..	..	..	..
1860	21·2	17·6	..	..	..	..	..	..	19·92	..	..	95·7*	..
1861	21·6	18·5	..	..	..	..	..	..	16·36	23·4	..	77·2	..
1862	21·4	21·4	..	..	..	..	..	..	15·01	23·1	..	59·1	A.
1863	23·0	19·3	..	..	..	..	..	..	15·49	24·4	..	44·0	..
1864	23·7	20·2	..	..	..	..	..	..	15·34	25·5	..	46·9	..
1865	23·2	19·4	16·97	16·41	14·30	21·42	..	15·13	13·40	26·0	16·3	30·5	..
1866	23·4	20·0	19·37	17·47	17·20	25·67	..	12·86	14·19	28·8*	17·7*	16·3	..
1867	21·7	19·6	18·06	19·64	17·48	17·80	..	12·78	14·44	25·5	16·7	7·3†	..
1868	21·8	21·0	15·00	15·83	14·41	17·36	..	11·94	14·75	25·9	14·9	37·3	P.
1869	22·3	22·3	15·47	14·05	12·37	16·20	..	11·73	13·24	25·4†	13·8	73·9	..
1870	22·9	19·8	14·61	13·27	13·94	14·59	..	11·13	14·08	26·1	13·6	139·1*	..
1871	22·6	17·2	13·46	12·54	12·87	14·83	..	10·13	13·46	27·0	12·9†	111·2	..
1872	21·3	16·3	14·38	14·11	15·33	14·97	14·02	11·68	13·83	25·4	14·0	101·7	..
1873	21·0	17·2	15·02	13·84	13·48	16·06	16·24	12·67	14·60	27·4*	14·6	66·3	..
1874	22·2	20·3	15·72	15·12	17·05	17·98	18·74	13·05	16·22	25·0	16·3	44·6	A.
1875	22·7	20·2	19·42	18·09	19·45	23·80	17·88	15·92	20·01	25·4	19·2*	17·1	..
1876	20·9	19·5	17·02	18·11	16·28	18·82	14·18	12·66	16·87	24·3	16·2	11·3	..
1877	20·3	18·5	15·80	15·28	13·99	17·29	15·70	11·47	19·19	23·9	15·5	12·3	..
1878	21·6	18·0	15·46	15·88	15·44	20·41	14·07	11·01	15·67	24·2	15·4	3·4†	..
1879	20·7	16·9	14·53	14·29	14·09	14·97	14·46	12·46	15·18	23·7	14·3	6·0	..
1880	20·6	18·1	13·70	15·57	14·85	13·59	13·24	11·46	16·12	24·29	14·0†	32·3	P.
1881	18·9	17·7	14·16	15·12	14·49	15·02	13·80	11·13	14·77	23·30†	14·0†	54·2	..
1882	19·6	17·4	15·11	16·03	15·15	17·99	14·16	11·19	15·79	23·51	15·2	..	..
1883	19·5	17·3	14·18	14·57	14·86	18·82	17·93	11·45	17·06	22·93	14·45	..	..
1884	19·6	17·5	14·27	15·88	15·24	22·97	21·87	10·39	15·50	20·5	15·09	..	..
1885	19·0	17·8	14·73	16·42	12·48	19·58	17·61	10·76	15·40	21·5	14·83	..	..
1886	..	..	..	..	..	..	..	..	14·58	..	..	..	..

* Maximum years. † Minimum years.

NOTES ON A NEW PLANT TO TASMANIA.

By R. A. Bastow, F.L.S.

RICCIA NATANS.

Nat. Ord. Hepaticæ.

Gen. Char.—Small, frondose, terrestrial or aquatic. Capsule immersed in the frond. Calyptra cohering with the globose capsule. Spores angular.

Riccia natans, Linn.—Fronds floating, yellowish-green above, bordered with dull purple, obcordate, channelled, simple or proliferous from the notches, with long purple serrate fimbriæ below. (Pl. 1).

Ref.—Flora Nov. Zealandiæ ii., p. 172. Hooker's Botanical Miscellany 1., pl. 23.

Hab.—Floating on Black Lagoon near Tamar Heads. Miss Oakden, Dec., 1886.

The small plant referred to this genus is perhaps the most simple of all the Hepaticæ. It is found floating on water, and may be passed by as a *Lemna* if not closely observed. The fronds are fleshy and inversely heart-shaped, being clothed beneath and at the edges with long, pendant, purple *fimbriæ*; these may be observed on the stage of one of the microscopes on the table.

The plant introduces a new genus to Tasmania, and I fail to find any previous record of *R. natans* being observed in Australasia, with the exception of one locality, and that is Lake Roto-a-kiwa, North Island, New Zealand; the collector, Mr. Colenso. To the description of that plant in Flor. Nov. Zeal., the author has added the bracketed remark " (a native of England)." In connection with this, it may be stated that Miss Oakden's specimens are different to the British states of the species in the purple bordering of the fronds. In Hooker's Botanical Miscellany the plant is most accurately illustrated as it is found in Tasmania, but the specimen from which the drawing was made was *R. natans* from North America. The Tasmanian and the British plants are mounted side by side in a jelly medium on a glass slip and are under the microscope; the drawing of the American plant is also on the table, so the members of the Society may compare the plants for themselves. If our *R. natans* is not a native of Tasmania, but has followed in the wake of civilisation from Great Britain, it has wonderfully improved by the change. If injurious plants thus imported increase in vigour in a similar ratio it will be advisable to keep a sharp look out for the first appearance of any of them and at once destroy them.

Explanation of Plate I.

Fig. 1.	*Riccia natans*.	nat. size.
Fig. 2.	" "	spores magnified.
Fig. 3.	" "	nat. size, North American.
Fig. 4.	" "	Tasmanian, mag. 7 diam.
Fig. 5.	" "	Tasmanian, serrations of *fimbriæ*, $\frac{1}{4}$in. obj.
Fig. 6.	" "	" " " $\frac{1}{2}$in. obj.
Fig. 7.	" "	North American, magnified.
Fig. 8.	" "	Tasmanian, upper surface of frond, $\frac{1}{2}$in. obj.
Fig. 9.	" "	North American, sect. through frond, showing immersed capsule containing spores.

Observ. on Nitella.

I have placed a fragment of Nitella on the stage of one of the microscopes in order that the rotation of the protoplasmic fluid may be observed.

It has been found inscribed in the "Book of the Strata" that there are forty species of the Natural Order Characeæ met with from the Triassic to the Tertiary, so that from a remote period of time masses of this most curious order of plants have vegetated in the lagoons and sluggish fresh water streams of temperate climates. The Order is remarkable for the singular nature of its reproductive bodies, and for the distinctness with which the circulation of the fluids may be seen; on this account it possesses a peculiar interest to microscopists. The fluid passes steadily up one side of the internode and down the opposite side, it carries granules of starchy matter along with it, and these granules appear at times to rotate on their own axes as they pursue their course around the interior of the internode. The movement may be due to diffusion of gases required by the plant, through the cell-walls, but if that is the case, diffusion goes on at comparatively excessive speed. The rapidity of the movement may perhaps be accounted for by the size of the cavity between the nodes of the stem and the continual change in temperature and barometric pressure, the rotation being easily accelerated by warmth or rendered sluggish by cold.

THE COMETS OF FEBRUARY, 1880, AND JANUARY, 1887.

By A. B. Biggs.

Notwithstanding the apparent contradiction, the circumstance which rendered the late Comet especially disappointing and tantalising to observers, as well as detracting from the general interest which is usually taken in these casual visitors, may be considered, from one point of view, as investing it with peculiar interest. I refer to its *headless* character. In this respect it is, so far as I am aware, almost, if not quite unique. I can account for only two others that can at all compare with it, namely, Tuttle's Comet of 1790, and that which bothered us so in 1880. Tuttle's Comet, however, which is described as "a confused nebulosity, without indications of a nucleus," was presumably of moderate dimensions, whose position was measurable; whilst that of 1880 furnished some questionable indications of a head from which approximate positions were obtained, although, so far as I am aware, nothing certain in this respect was obtained by any one.

Our last visitor appears to have completely baffled everyone in the search for any point of condensation. I can only describe it as a *mere wisp*. Many hours were spent by myself in sweeping about in the direction of the streak with the 8½in. reflector.

The comparison between our late visitor and that of 1880 is rendered still more interesting by other points of resemblance. The accompanying rough chart, constructed from my own notes of both Comets will, I think, indicate these points with sufficient clearness. In this chart the positions of both Comets and their apparent lengths are laid down as accurately as could be ascertained by reference to known stars. Instrumental measures of such ghost-like objects were, speaking generally, useless or impossible, except as regards the last position of that of 1880, when the object had diminished to a mere telescope speck, its then position being read off from the circles of the equatorial.

The several positions as laid down in the chart would appear almost to indicate the progress of the *same Comet* from day to day. It is important to observe that the positions correspond as to *time of year*, consequently the projection of the orbits upon the back-ground of the sky would not be materially

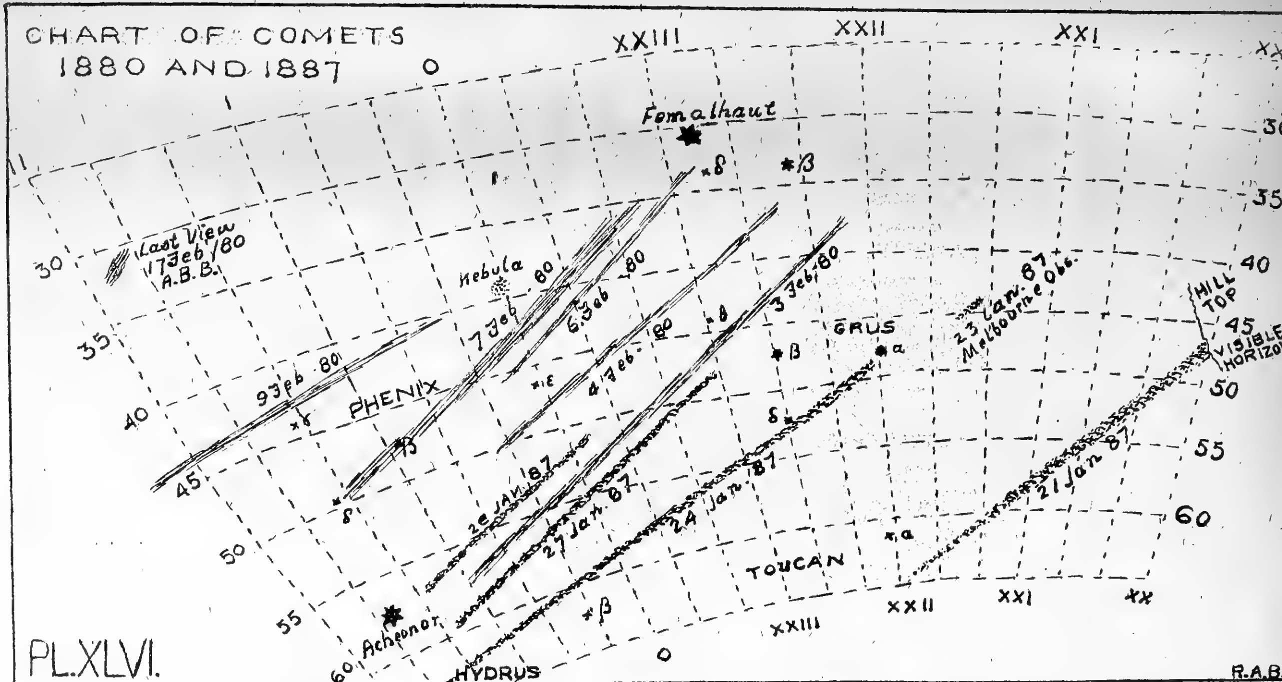


CHART OF COMETS
1880 AND 1887
PL.XLVI.
Fomalhaut
Last View
17 Feb/80
A.B.B.
Nebula
7 Feb. 80
6 Feb. 80
4 Feb. 80
3 Feb. 80
9 Feb. 80
PHENIX
GRUS
23 Jan. 87
Melbourne Obs.
26 JAN. 87
27 Jan. 87
24 Jan. 87
21 Jan. 87
TOUCAN
Achernar
HYDRUS
HILL TOP
VISIBLE HORIZON
XXIII
XXII
XXI
XX
R.A.B.

affected by the position of the earth in its orbit or the direction of the earth's motion; that is, the orbits of both Comets are practically from about the *same view-point.* A rough heliocentric projection of the paths of each of these Comets, which I have attempted from the very indefinite data which alone we possess, appears to me to indicate orbits very closely approximate.

We have here, then, two cometary apparitions strongly resembling each other in their peculiar *headless character*—in general appearance—length of tail, and in their apparent paths. So far as all this goes there would appear to be strong indications of identity.

The *headless character* of these Comets involves, I think, some interesting questions. The *nucleus* of a Comet, and it alone as pertaining to the Comet, obeys the laws of gravitation and projectile velocity. The *tail* holds no allegiance to such laws, it is governed only by the head, as being an appendage to it, swinging itself round on the outside of the curve as the Comet pursues its path round the sun. But, what governs the motion of a *tail without a head?* If these Comets were really headless (of which invisibility must of course not be taken as absolute proof) I cannot conceive of their pursuing any rational path in space. Their apparent *orbital motion* would indicate that they must be *ponderable* matter, which the tail of a Comet pretty certainly is not.

I cannot help thinking that, under the conditions, it is not an unreasonable supposition with regard to both of these bodies, that they might be the main body of a stream of meteoric matter whose orbit intersects the ecliptu, not very far from the position of the earth at the time of appearance (January and February), such stream being rendered visible by its compactness, illuminated by sunlight, and by its nearness to the earth at the time of passing. In this case, however, the "wisp" should coincide with the actual orbit of the stream. The great inclination of the former from the ecliptic, (not far from a right angle) can only be reconciled with that of the orbit by supposing the body to have been at the time not far from the earth, that is, much nearer to the earth than to the sun. This I think was the case, judging from the very meagre data available. Such a supposition however implies an orbit differing considerably from that of the Great Comet of 1882-3, with which the orbit of that of 1880 was supposed to correspond.

DESCRIPTIONS OF TWO NEW SPECIES OF TASMANIAN FRESH-WATER SHELLS.

By W. F. Petterd.

Plate XLIV.

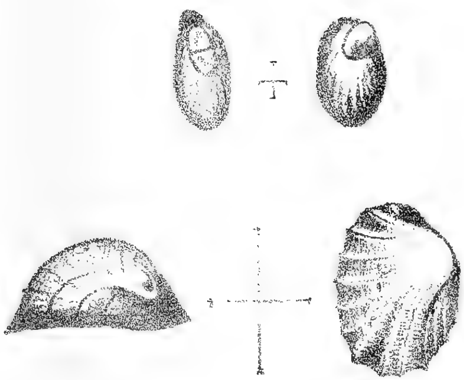
ANCYLUS IRVINŒ. N. SP.

Shell thin, diaphanous, horney-brown, delicate; inflated, with about 12-14 distant, distinct, irregular, somewhat angular radiating riblets, concentrically, finely, irregularly striate with a silky appearance; apex prominent, recurved dextrally; aperture orate, margins expanded; interior shining, plainly showing the impression formed by the riblets.

Length, 19 mill.
Breadth, 14 „
Alt., 7 „

Habitat—the Great Lake (Irvine).

This wonderfully fine and interesting addition to our Mollucan fauna was obtained by Mr. R. Irvine, of Launceston, during an excursion to the Lake district. It was found attached to the rocks in the shallow margin of the lake, and although apparently numerous at the particular locality visited but only a very limited number of examples were collected. Associated with it was found *Cyclas Tasmanica, Tenison Woods*, and an apparently new species of *Physa*. Unfortunately I have not had an opportunity of examining the animal or lingual membrane. This species is not only the finest form of the genus discovered in this island, but is also by far the finest in the world. It is quite distinct from all the species hitherto known—the nearest is our *Ancylus Cumingianus Bourguignat* (Pro. Zoo. Soc., 1853) from above New Norfolk, but from it may be known by its much larger size and by the unique character of being radiately ribbed. The few species described from Australia are all very minute and have no resemblance to either *A. Cumingianus* or the form now described. It is dedicated to Mrs. Irvine, sen., a great lover of shells.



W.J.P.

PL. XLIV

The following is a list of the Tasmanian species of Ancylus :—

A. Cumingianus. Bou.
A. Tasmanicus. Tenison Woods.
Var. A. R. M. Johnston.
A. Woodsi. R. M. Johnston.
Var. A. do.
Var. B. do.
Var. Y. do.
A. Irvinæ, mihi.

GUNDLACHIA BEDDOMEI. N. SP.

Shell small, thin, reddish-brown, diaphanous obliquely conical, concentrically striated with lines of growth; aperture elongately ovate, interior shining, inner aperture semicircular with a darker margin; apex, with distinct outline and of a darker shade, obliquely inclined posteriorly and protruding beyond the margin of the outer aperture.

Length,	$4\frac{1}{2}$ mill.
Breadth,	3 ,,
Alt.,	$1\frac{1}{4}$,,

Habitat—Pool off the Brown's River road (Beddome).

This species differs in shape, colour, and is of a much larger size than the only other form known here—*G. Petterdi, Johnston.* (Pro. R.S. 1878)—described from specimens found near Launceston. The genus is a small but very interesting one from the remarkable double-tierred structure. The number of species are very limited—about 7 or 8—and are, with the exception of the Tasmanian forms, confined to the West Indian Islands and central America. More recently Prof. Tate has discovered *G. Petterdi,* or a form much like that species, in the vicinity of Adelaide, South Australia. The specie is dedicated to its discoverer, Mr. C. E. Beddome, the well known conchologist of Hobart.

NOTES ON THE TASMANIAN "BUTTER FISH" (*CHILODACTYLUS MULHALLI*), MACLEAY.

By W. Saville-Kent, F.L.S., F.Z.S., &c., Superintendent and Inspector of Fisheries.

From among the specimens of fish that I have had the pleasure of contributing to the Tasmanian Museum within the last few months, and which have hitherto been unrepresented in that institution, I would direct brief attention on this occasion to the form known to the local fishermen by the name of the "Butter Fish." This species is evidently identical with the type taken near Port Jackson, and first described by Macleay in the Proceedings of the Linnæan Society of New South Wales, p. 366, 1882, under the title of *Chilodactylus Mulhallii*. The probable identity of that species with the Tasmanian Butter Fish has been already recognised by Mr. R. M. Johnston in the appendix to his Catalogue of Tasmanian Fishes, published in the same year. The only point in which these respective forms perceptibly differ from one another is afforded by the number of spinous rays developed in the anal fin. In the Tasmanian variety three such rays were present in each of the several examples that have been examined by Mr. Johnston and myself, while in the Sydney type only two such rays are stated to exist. The third spinous ray is, however, so closely bound up with the succeeding soft rays that it has very probably been overlooked by Macleay.

The information that is yet wanting to render the description of the Butter Fish complete relates to its natural colours. In Mr. Johnston's catalogue, already quoted, it is described as of a "uniform brownish-black," while in Macleay's diagnosis the distinguishing colours of the body are worded as bluish-grey above and whitish in the ventral region. Both of these descriptions were taken from dead specimens, and neither of them accurately represent the colours of the living fish. In two examples that were brought to the Fisheries establishment at Battery Point in February last, and kept alive there for some time, the body in each instance while agreeing with Macleay's description with respect to its ground tint of bluish-grey, was diversified by as many as seven broad transverse bands or bars of irregular shape, and a blackish hue which, originating from the summit of the dorsal region, were produced just as far as or a little below the lateral line, while a few dark grey or blackish blotches were present on the head. The ground colour of the fins generally was greyish-blue, variously shaded, the free edges of the ventral and anal fins being a pure sky blue; the anterior or spinous portion of the dorsal fin was variegated with black, the caudal fin was darkest towards its superior and inferior edges and had a narrow posterior margin of pure white. Soon after removal from the water the fish lost all its characteristic markings and faded to a uniform leaden grey.

A drawing, illustrating the natural colours of one of the specimens was made from life, and these I have reproduced upon the plaster cast subsequently made from the same fish, and which I also now present to the museum. This cast, in which the precise shape and natural attitude of the living fish has been accurately modelled, will, I trust, prove an acceptable addition to the preserved skin of the original exhibited beside it, but in which, as in all similarly preserved specimens, it has not been found possible to retain either the natural colours or the exact contour of the living fish.

In communicating this note upon the Butter Fish, *Chilodactylus Mulhallii*, I may take the opportunity of recording my opinion that the fish figured and described by Macleay in the proceedings of the Linnæan Society of New South Wales (p. 440, pl. xxii) 1884, under the title of *Psilocranium Coxii*, must be regarded as identical with this species. With the form given in the illustration quoted, and in all more important details of its diagnosis it essentially agrees. The only feature upon which, so far as I can perceive, its claims to separate generic and specific titles have been founded, is the somewhat smoother surface of the head as compared with the ordinary members of the genus *Chilodactylus*. This characteristic is, however, equally distinctive of *Chilodactylns Mulhallii*, as may be verified by its comparison with, say, the more familiar type locally known as the Carp, *Chilodactylus Allporti*, and of which I also exhibit a coloured plaster cast. The more cylindrical contour of the body, which is quoted by Macleay as substantiating its claim to separate generic distinction, can, I think, scarcely be invested with so important a significance, more especially, as admitted by Macleay in his original description of this type, his diagnosis was formulated from a skin from which the fish's body had been already separated and thrown away. I may add that Mr. Morton, who is personally familiar with the typical examples of *Chilodactylus Mulhallii* and *Psilocranium Coxii* preserved in the Sydney Museum, has experienced equal difficulty with myself in detecting any essential points of distinction between these respective types.

NOTES ON THREE SPECIMENS OF FISH HITHERTO UNRECORDED FROM TASMANIAN WATERS.

By Alexander Morton (Curator of the Tasmanian Museum.)

To the fishermen and others I am greatly assisted in getting together what I hope will soon be a fairly complete collection of all the known fishes inhabiting Tasmanian waters. During the past two years several additions hitherto unrecorded in Mr. R. M. Johnston's valuable catalogue of the Tasmanian fishes, published in 1880, have been brought to the Museum. The three specimens on the table belong to a genus new to our waters.

Family Kurtidæ.

Genus Pempheris, Cuv. and Val. Body compressed, oblong; eye large; cleft of mouth oblique; lower jaw prominent; snout very short; one short dorsal fin with six spines; anal elongate, scaly, with three spines; scales rather small; villiform teeth in the jaws and on the vorner and palatine bones. Seven branchiostegals, air bladder divided into a anterior and posterior portion. Pyloric appendages moderate number.

Indian Ocean, Australia, Tropical Pacific.

Pempheris Macrolepis, Macleay.

D. 5/12, A. 3/33, V. 1/5, P. 1/6.

Macleay's catalogue, p. 151. Height of body, twice and two-thirds in the total length; eye very large, its diameter more than half the length of the head, and covered with a loose skin; scales large, more particularly behind the pectoral fin; lateral line extending to the extremity of the tail, and consisting of about sixty scales; caudal fin moderately forked; colour silvery, with small brown spots towards the back and tail; fins of a dullish colour; eye yellow.

King George's Sound, Port Jackson.

Mr. W. L. Boyes, to whom the Museum is greatly indebted for several rare specimens added to the collection, captured these fine examples at George's Bay. On examination, I found one of the specimens differed slightly in the formula in having D. 4/12, A. 3/31; in other respects they are indentical with Macleay's *P. Macrolepis*.

DESCRIPTION OF TWO RARE TASMANIAN FISHES.

By R. M. Johnston, F.L.S.

Genus Histiophorus.

Body rather compressed and elongate ; the upper jaw much produced, conical, extending far over the lower. Two dorsals, the anterior of which are much longer than the posterior, and formed by spinous and soft rays. Ventrals to a single or two or three spines. Scales, none sometimes rudimentary dermal productions. Small teeth in the jaws and on the palatine bones, none on the vorner. Seven branchiostegals ; air bladder present. Pyloric appendages exceedingly numerous. (Gunther).

Histiophorus Herschellii, Gray.

D. 42/7, A. 12/6, V. 1.

The greater portion of the dorsal fin much lower than the body. The height of the body is more than one-half the length of the head and one-seventh of the total. The upper jaw is rather depressed, rounded superiorly and inferiorly; its length from the nostrils is nearly three-quarters the length of the head. Dermal productions, numerous bifurcate hidden in the skin.

A fine specimen, 13ft. 6in. total length, was recently discovered by me stranded and half buried in the sand bank communicating with a large lagoon, immediately to the north of Cape Fredrick Henrick on Forestier Peninsula. It answers in all characteristic points to the above species so far as could be observed. Unfortunately it was much decomposed internally, and the ventral and anterior portions of anal fin were destroyed. The anterior part of spinous dorsal was elevated into a crest composed of about 11 spines, curving between the occiput and a line passing through posterior of præoperculum; somewhat truncated at its point of junction with the rest of dorsal spines, which were uniformly only about 2in. high to junction with soft rays near peduncle, which are slightly higher than the posterior portion of spinous dorsal rays. The longest rays of first dorsal were about 12 to 14 inches. The soft anal is developed similarly to the soft dorsal, each composed of seven rays. The characters and dimensions as observed were:—

	Feet.	Inches.
Length of head to extremity of upper jaw ...	4	0
Breadth of expanse of tail forks	4	4
To greatest depth about	2	0

D. 11·31/7, A. -/7, V. P. 14 falcate.

Dermal productions, bifurcate or lozenge shaped; skin thick hard and bony.

As Dr. Gunther states that specimens of this genus are few and imperfect in museums, and as it is desirable to make further observations on large individuals, it is of the greatest importance that this noble specimen should be secured for our Museum. The specimen was too large for me to carry to town, as I was at the time travelling on foot; but I have urged Mr. Frank Rush, to whom I have explained its nature and position, to bring it to town as perfectly as possible on his next trip to that locality. It would be desirable for the Museum authorities to assist in defraying the expense of its removal to Hobart. It would prove a most interesting as well as valuable addition to their collection.

The addition of the above species of swordfish to our catalogue of Tasmanian fishes, will be of much interest to ichthyologists generally.

I have heard of a swordfish having been seen prior to the publication of my catalogue and observations on Tasmanian fishes in 1880, but being in doubt, I omitted it from the list of fishes then given.

Genus Lamna.

The first dorsal fin opposite to the space between the pectoral and ventral fins, without spine, the second and the anal very small; a pit at the root of the caudal which has the lower lobe much developed; side of the tail with a keel; no membrana nictitans; spiracle none; mouth wide; teeth large; lanceolate not serrated, sometimes with additional basal cusps; gill openings very wide.

Temperate and tropical seas. (Gunther).

Lamna cornubica. Gm. (Porbeagle shark.)

Præoral portion of the snout longer than the longitudinal axis of the cleft of the mouth, conical pointed; angle of the mouth nearly midway between the gill opening and nostril; teeth $\frac{13}{12}$-$\frac{16}{14}$ on each side, lanceolate, with a small basal cusp on each side in adult specimens ; in young specimens these cusps are absent; the *third tooth* on each side of the *upper jaw is very small*; the width of the first gill opening is nearly equal to its distance from the last; origin of the dorsal fin above the root of the pectorals, which are somewhat falciform, the length of their lower margin being nearly one-fourth of that of the upper.

A fine specimen, about three feet long, was recently captured by Mr. Frank Rush in a graball net, and to him I am indebted for the opportunity of making these observations and for enabling me on his behalf to present to the Museum collection the valuable addition of so rare a species in our waters. Mr. Morton has since most skillfully stuffed the example which may be seen in the Museum.

NOTES ON THE IDENTITY OF CERTAIN TASMANIAN FISHES.

By W. Saville-Kent, F.L.S., F.Z.S.

The opportunity recently afforded me of inspecting the collection of fish contained in the Australian Museum, Sydney, has enabled me to establish the identity of two species inhabiting Tasmanian waters, concerning which there has hitherto been some amount of uncertainty. The first of these is the large species of Parrot Fish, abundant on many parts of the Tasmanian coast, and familiarly known to the fishermen by the title of the "Bluehead." I have hitherto experienced considerable difficulty in my endeavours to identify this fish with either of the several varieties of Parrot Fishes, genus *Labrichthys,* included in Mr. Johnston's catalogue of Tasmanian fishes, and had anticipated it might possibly prove identical with *Cossyphus Gouldii,* the so-called "Blue Groper" of the Sydney fishermen, referred to in the same catalogue as a common Tasmanian form. On submitting a coloured drawing of the Tasmanian "Bluehead" to Mr. Douglas Ogilby, of Sydney, he at once, however, recognised it as being identical with a species that he has quite recently described, Proc. Linn. Soc., N.S.W., under the title of *Labricthys cerulieus.* A reference to the type specimen contained in the Australian Museum has satisfied me as to the correctness of this identification.

The second species to which I have to draw attention is the fish commonly known as the "Magpie Perch." It is not unfrequently exposed for sale in the Hobart Fish Market, and has been referred with some doubt by Mr. Johnston to the *Chilodactylus Gibbosus* of Richardson. On visiting the Manly Aquarium at Sydney, I observed some fish placarded with this name in one of the tanks that were entirely distinct from the Tasmanian variety. With the assistance of Mr. Ogilby, I subsequently referred to the original figures and description of Richardson's species, and thereby ascertained that the "Magpie Perch" of Tasmania is perfectly distinct from *Chilodactylus Gibbosus,* and apparently represents an hitherto undescribed species. For the purposes of comparison I made a hastily-coloured sketch of the New South Wales species, and which I now submit in company with one of the

Tasmanian form. As will be at once recognised, the proportions of the two fish essentially differ, for while in the typical *Chilodactylus jibbosus* the body is comparatively elongate, its total length being equal to about three and-a-half times that of its greatest depth, in the shorter and thicker Tasmanian species the length is equal to only two-and-a-half times that of the maximum depth. The colours, or rather the arrangement of the colours, in the two forms is also very distinct. In both species the ground colour is pearl-grey or nearly white, variegated with bands of dark brown or black. In the typical *Chilodactylus jibbosus* these bands are comparatively narrow, and are developed in an oblique or longitudinal direction; the most conspicuous of these bands originate near the anterior region of the dorsal fin, and passes obliquely and longitudinally backwards into and throughout the lower boll of the caudal fin; a second band is developed from the anterior edge of the dorsal, and is continued obliquely downwards to the ventral fin. A third band passes in a similiar direction immediately behind the head and through the root of the pectoral fin, and a fourth, bifurcated at its upper extremity, passes obliquely downwards and backwards through the eye, meeting the one last described in the ventral region. A short, imperfectly developed band crosses the upper region of the snout.

In the Tasmanian "Magpie Perch," the dark brown or blackish bands are fewer in number, and are developed girdle-wise, almost at right angles to the principle axis of the body, and are so broad as to occupy nearly as large an area as the intervening white or colourless spaces. Two only of these broad bands encircle the body, a third narrower one passing across the eye and cheek. The tail is usually coloured light red, and the tips tinged with the same hue. It being apparently desirable to associate a new specific title with this Tasmanian species, I propose, with reference to the broad bands that encircle its body, to distinguish it provisionally, the title of *Chilodactylus vizonarius.*

Among the rarer fish that have been recently taken in Tasmanian waters, I may make mention here of an example of the New Zealand Frost Fish, or Scabbard Fish, *Lipidopus Candatus,* that was brought to me on Saturday, the 12th inst, and which was captured struggling on the surface of the water in the Fishermen's Dock. The specimen has been remitted to the Museum for preservation.

LIST OF HEPATICÆ

COLLECTED BY R. A. BASTOW, ESQ., F.L.S., NEAR HOBART, TASMANIA, 1885-6; BY B. CARRINGTON, M.D., F.R.S.E., AND W. H. PEARSON, ECCLES, ENGLAND.

1. FRULLANIA MONOCERA, Tayl., ♂ and ♀ cum per. 175. On tree, Jonathan's Track, Mount Wellington.

2. FRULLANIA FALCILOBA, Tayl., ♂ and ♀ cum per. 207,208. On rocks, Proctor's-road. 165,168. On rocks, Mount Nelson. 357. Spring's Walk, Mount Wellington. 234. Cascades, Mount Wellington.

3. FRULLANIA DEPLANATA, Mitt., ♂ and ♀ cum per. 175. On trees, Jonathan's Track, Mount Wellington, growing with *Frullania monocera*, Tayl., from which it is at once distinguished by its flat, smooth perianth, *F. monocera* having a spiny one.

5. FRULLANIA REPTANS, Mitt., ♂ and ♀ cum per. 167,198. On rocks, Mount Nelson.

6. LEJEUNEA (DREPANO-LEJEUNEA, Spruce) LATITANS, Tayl. 175. On tree, Jonathan's Track, Mount Wellington.

7. LEJEUNEA MIMOSA, Tayl. 344. Wellington Falls.

8. LEJEUNEA (EN-LEJEUNEA, Spruce) GUNNIANA, Mitt. 180,181. On tree, Jonathan's Track, Mount Wellington.

9. POLYOTUS MAGELLANICUS (Lamarck). 27. Springs, Mount Wellington; Falls, Mount Wellington (L. Rodway). 237. Forth Creek, Huon-road (L. Rodway). 367.

10. RADULA BUCCINIFERA, Tayl., ♂. St. Crispin's Well, Mount Wellington. 171.

11. LEPIDOZIA QUADRIFIDA (Kz.). 295.

12. LEPIDOZIA GLAUCOPHYLLA, Tayl. 370. St. Crispin's Well, Mount Wellington.

13. Lepidozia laevifolia, Tayl., cum per. 186. On old logs, Jonathan's Track, Mount Wellington; Wellington Falls (L. Rodway).

14. Lepidozia pendulina, Lindenb. 271. Springs, Mount Wellington.

15. Lepidozia pendulina, Lindenb, var. robusta, Carr et Pears. A large, distinct looking form, but not different from the type in its microscopic characters. 282. Top of Mount Wellington. 373. St. Crispin's Well, Mount Wellington.

16. Lepidozia ulothrix, Lindenb. 225. Proctor's-road. 367. St. Crispin's Well, Mount Wellington.

18. Bazzania Novæ Hollandia (Nees). Fern Tree Gully. 237. Forth Creek, Huon-road (L. Rodway). 370.

19. Bazzania Colensoii (Mitt.) ♀ jun. 373. St. Crispin's Well, Mount Wellington.

20. Trichocolea mollissima, Hook. f. et Tayl. 241. Falls, Mount Wellington (Rodway).

21. Cepholozia (zoopsis) argentea (Hook. f.). Spruce. 169. On a fallen tree, Jonathan's Track, Mount Wellington.

23. Cephalozia (Cephaloziella S.) exiliflora (Tayl.) Huon-road (L. Rodway).

24. Blepharostoma pulchellum (Hook.). Spruce. Forth Creek, Huon-road (L. Rodway).

25. Adelanthus magellanicus (Lindenb.) 349. Wellington Falls.

26. Adelanthus falcatus. (Hook.) ♀ 27. Springs, Mount Wellington. 348. Wellington Falls.

27. Lophocolea muricata (Lehm.) ♀ cum per. 171,177. On trees, Jonathan's Track, Mount Wellington. 241. Mount Wellington (L. Rodway).

28. Lophocolea bidentata? (L.) 217. Proctor's-road, 171. On trees, Jonathan's Track, Mount Wellington, 180.

29. LOPHOCOLEA BICILIATA, Mitt. 373. St. Crispin's Well, Mount Wellington.

30. LOPHOCOLEA HETEROPHYLLOIDES. Nees. 210. Proctor's-road. 215.

31. LOPHOCOLEA HETEROPHYLLOIDES. Nees. var. canaliculata (Hook. f. Tayl.). (Chiloscyphus canaliculata, Hook. f. Tayl.), 372. St. Crispin's Well, Mount Wellington. 192.

32. CHILOSYPHUS COALITUS (Hook.) Corda et. Dum. ♂ St. Crispin's Well, Mount Wellington.

33. CHILOSCYPHUS SINUOSUS (Hook.) Corda et Dum. 367. St. Crispin's Well, Mount Wellington.

34. CHILOSCYPHUS FISSISTIPUS. Hook. f. et Tayl. 174. On fallen tree, Jonathan's Track, Mount Wellington.

36. JUNGERMANIA (CHILOSCYPHUS) ? CYMBALIFERA. Hook. f. et Tayl. 255. Mount Wellington.

37. SCHISTOCHEILA (Gottschea) LEHMANNIANA (Lindenb). 302, 304, 306, 373. St. Crispin's Well, Mount Wellington. 236. Forth Creek, Huon-road. (L. Rodway.)

38. PLAGIOCHILA FASCICULATA Lindenb. 241. Mount Wellington. (L. Rodway.)

39. PLAGIOCHILA DELTOIDEA Lindenb. ♂ 293. St. Crispin's Well, Mount Wellington. 211. On rocks, Proctor's-road. 346.

40. PLAGIOCHILA OPISTHOTONA. Hook. f. et Tayl., ♂ and ♀ cum per. 348. Wellington Falls.

41. PLAGIOCHILA LYALLII, Mitt. 296. St. Crispin's Well. 296. Mount Wellington. 348. Wellington Falls.

42. PLAGIOCHILA MICRODICTYON, Mitt. 294. St. Crispin's Well, Mount Wellington.

43. JUNGERMANIA STRONGYLOPHYLLA, Hook. f. et Tayl. ♂ and ♀ cum per. 340, 348. Wellington Falls.

44. JUNGERMANIA MARGINATA, Mitt. ♀ cum per. 349. Wellington Falls.

45. Jungermania rotata, Hook. f. et Tayl. ♂ and ♀ cum per. 346. Wellington Falls.

46. Jungermania perigonialis, Hook. f. et Tayl. ♂ cum per. 342. Wellington Falls. 3,000 ft.

48. Jungermania atro capillaris, Hook. f. et Tayl. ♀ and ♀ cum per. Ben Lomond, Tasmania (De Bomford). 4,000ft.

51. Jungermania (Jamesoniella) colorata (Lehm). ♀ cum per. On rocks, Proctor's-road. 211.

52. Tylimanthus tenellus, Hook. f. et Tayl. Mitt. ♂ and ♀ 238. Fork Creek, Huon-road (L. Rodway). 303. St. Crispin's Well, Mount Wellington. 370.

53. Tylimanthus saccatus (Hook.) Mitt. ♂ 235. Fork Creek, Huon-road (L. Rodway).

54. Podomitrium Phyllanthus (Hook). Mitt. ♂ and ♀ cum per. 244. Falls, Mount Wellington.

55. Symphyogyna Hymenophyllum (Hook). Mont. ♀ cum per. Tree Fern Gully.

56. Symphyogyna obovata (Hook. f. et Tayl.) St. Crispin's Well, Mount Wellington. 243. Falls, Mount Wellington. 232. Cascades, Mount Wellington.

57. Symphyogyna flabellata (Hook). (Umbraculum Gotts.) 343. Falls, Mount Wellington. 228. Cascades, Mount Wellington.

58. Aneura crassa (Schwægr.) 351. Wellington Falls, Mount Wellington.

59. Metzgeria furcata (L)? Mount Wellington. On trees, Jonathan's Track, Mount Wellington.

60. Marchantia tabularis, Nees. 307. St. Crispin's Well, Mount Wellington. 187. On old fern stumps, Jonathan's Track, Mount Wellington.

NOTES ON SOME NEW AND RARE PLANTS.

By Baron F. Von Mueller, K.C.M.G., F.L.S., &c., &c.

New Localities for Rare Tasmanian Plants.

Bellendena montana R.Bn.; Mount Bischoff. F. Kayser.

Richea pandanifolia, J. Hooker. N.W. Tasmania, at Alpine Heights. Ch. P. Bennett.

Prionotes cerinthoides R.Bn. Cradle Mountain. W. R. Bell.

Richea Gunnii, J. Hooker. Cradle Mountain. W. R. Bell.

Donatia Novæ Zelandiæ, J. Hooker. Cradle Mountain. W. R. Bell.

Milligania densiflora, J. Hooker. Upper Huon Ranges. F. Abbott.

Vascular Plants New for Tasmania.

Potamogeton Cheesemanii, A. Bennett. Near Swanport. Dr. Story.

Sporobolus virginious Knuth. Near the entrance of the Tamar. Miss Oakden.

Though recorded already by R. Brown in his Prodromus, it was missed for all other publications on Tasmanian plants.

Fungs New for Tasmania.

Diploderma glanoum, Cook and Mass. Scamander River. Wintle.

Castoreum radioatum, Cooke and Mass. Near St. George's Bay. Wintle.

Both give additional genera for the Tasmanian Flora.

OBSERVATIONS ON THE ACCLIMATISATION OF THE TRUE SALMON (*SALMO SALAR*), IN TASMANIAN WATERS, AND UPON THE REPORTED SALMON DISEASE AT THE BREEDING ESTABLISHMENT ON THE RIVER PLENTY.

By the Superintendent and Inspector of Fisheries,

W. Saville-Kent, F.L.S., F.Z.S., Etc.

Being unavoidably absent from the meeting of this Society held on August 15th, I was unable to contribute my remarks, as I should have willingly done, upon the subject of the disease among the salmon under cultivation at the breeding establishment on the River Plenty, recorded in *The Mercury's* report of the proceedings of the meeting, together with the announcement that it had been considered desirable to remit specimens to skilled zoologists and botanists in Sydney to report upon its nature. The wording of the announcement referred to being, though probably unintentionally, such as to lead the reading public to imagine that a peculiar and hitherto undetermined malignant disease had attacked the fish, which was quite beyond the powers of our local specialists to diagnosis, I avail myself of this earliest opportunity, and through the same source, of allaying the public mind upon the matter.

The disease, as I recognised immediately upon reading the announcement referred to, is one prevalent among the fish to a greater or less degree at every breeding season, and is caused by the growth upon some wounded or abraded surface of the fishes skin of a species of aquatic fungus, known technically by the name of *Saprolegnia ferax*. From the point first attacked the fungus gradually invades and disintegrates the surrounding tissues, living at the expense of and absorbing all their nutrient juices and ultimately, if not eradicated, destroys the fishes life. The spores or germs of this fungus are almost constantly present in pond or river water and naturally germinate and flourish luxuriantly upon any submerged dead or putrifying animal matter. The mildew-like growth that develops upon dead flies immersed in water, represents one phase of this fungus, and I exhibit this evening examples of it growing on pieces of dead fish and mussel, that have been purposely cultivated for the occasion. Also, fragments of the felt- or paper-like masses characteristic of the growth of this *Sapro-*

legnia upon diseased fish and which have been detached from one of the salmon that recently died at the Salmon Ponds. Mounted specimens, illustrating the more minute structure of this fungus, are exhibited in the adjacent microscopes. This more minute structure as there shown, and which I have also delineated on the accompanying diagram, consists of an interlacing network of branching threads or hyphæ, commonly called the "mycelium" of the fungus, and from which arise erect sub-cylindrical or club-shaped seed capsules or "sporangia." Within each such sporangium may be developed several hundred microscopic seeds or zoospores, every one of which, should it alight upon congenial soil, such as a sore on a fish's back or any dead animal matter, is capable of developing into an extensive fungus colony. Millions of these minute seeds or zoospores may be developed from a single tuft of fungus not more than one quarter of an inch in diameter, and as these are provided with locomotive organs or cilia, wherewith they can traverse the water in every direction, it may be anticipated that in those waters where the fungus is abundant, a wounded fish has little or no chance of escape. There is yet another form of seed or spore known as the "oospore" by which this fungus may be developed, but which is of much rarer occurrence and provides for the latent or resting phases of the species.

At the spawning season when the male fish fight and lacerate one another, and also abrade the surfaces of their bodies in excavating the nests or "redds" in which the ova of the females are deposited, the fungus, *Saprolegnia*, almost invariably attacks them. On some occasions it is so abundantly developed as to constitute a veritable epidemic which may be communicated to apparently healthy fish. It is more than probable, however, that in such cases the tissues of the fish affected are already in a diseased and impoverished state, and present a suitable nidus for the establishment of the fungus. As will be familiar to many present, a very destructive outbreak of this fungoid disease attacked the salmon in the English and Scotch rivers in the year 1878, and has been more or less prevalent in later years. Thus, in the annual report of the local Board of Conservators of the Tweed district for the year 1881, it is recorded that no less than 14,600 salmon had succumbed in that river to this disease, making with the two preceding years a total of over 22,000. While up to the present time nothing is known absolutely or accurately concerning the immediate origin of these epidemic outbreaks, there is, I think, much evidence to show, in the case more especially of apparently healthy fish being attacked, that the absence of sufficient oxygen in the water for the healthy maintenance of the fish, either through over-crowding, abnormal temperature, or by direct pollution, represents a very if not the most important factor. Notwithstanding, however, the apparently exhaustive onslaughts of this formidable epidemic it is satisfactory to know that the returns of the fish captured in these previously affected rivers within later years has been in no way diminished, but even increased. It is indeed advocated by some authorities on fisheries matters that good is accomplished through the visitations of this epidemic, since it operates as a check by which the old male fish or kelts, which systematically lay in wait for and prey upon the young salmon smolts when descending to the sea, are periodically eliminated.

Whatever good ends in the scheme of Nature may be attained through the advent of this fungus disease in association with the salmon rivers and the natural spawning beds, it cannot be denied that where it invades and affects those artificial conditions brought about by human intervention, the consequences may be altogether disastrous. In illustration of this, I may now refer to the circumstances and phenomena attending the presence of this disease at the salmon and trout breeding establishment on the River Plenty. For many years, or in fact ever since artificial breeding operations have been conducted there, a greater or less number of the breeding fish have been attacked by this parasitic phase of the fungus, *Saprolegnia*, and many fish have died. This mortality, however, has hitherto been associated with ordinary trout, *Salmo fario*, and salmon trout, *S. trutta*, both of which species, being firmly established in this colony, can be easily replaced at the breeding ponds. With the true salmon, *Salmo salar*, however, the case is different. The only breeding stock of this species that has been available this past winter for artificial propagation has been a series of thirty fish developed from the salmon ova brought out by the s.s. Abingdon, in 1884, hatched out that same year, and since retained in the Ponds. These fish, or rather what remain of them up to the present time, not having migrated to salt water, are in a relative dwarfed or undeveloped condition. The largest of them scarcely exceeds a foot in length and they still retain their immature or parr markings. The majority of them have nevertheless manifested a tendency to propagate, and from the entire series a number of ova little short of 4,000 have been artificially expressed and fertilised. I should rejoice to be able to congratulate the colony upon having in this most auspicious anniversary of Her Majesty's reign, and after many years of indefatigable and self-denying perseverance on the part of that very worthy body of gentlemen, the late Salmon Commissioners, succeeded in establishing in Tasmania a race of this noble fish that would propagate and grow to maturity in its lakes and rivers without requiring to migrate to salt water, and which race might be most appropriately distinguished by the title *par excellence* of the "Jubilee salmon." I fear, however, that the prospects of this achievement are not altogether encouraging.

On September 1st I visited the establishment at the River Plenty, with the object of making myself perfectly acquainted with all the details and circumstances attending the breeding and development of these fish which are now laid before you. From the approximate number of 4,000 fertilised ova obtained by artificially stripping ten female and as many or more male fish, 2,000, or 50 per cent. of dead ova had been already abstracted. It is plain from their appearance that a very large portion will have yet to be removed, and that, as commonly occurs under similar conditions, there will be a large number of deformed fish among the fry that may hatch out. All the ova, in fact, are exceedingly small and wanting in that density and tenacity of the investing membrane as compared with those of mature sea-going salmon. The circumstances that have to be recorded concerning the parent fish are, I regret to say, scarcely more promising. Out of the stock of 30 no less than 17 have died. What is more unfortunate is the fact that 14 out of the 17 were male fish, so that it is doubtful whether any male fish are left for future experiments. The ultimate cause of the death of these fish has been the attacks of the fungus disease described in the earlier paragraphs of this paper, and the thread of which subject may be again taken up with reference to its special manifestations in association with and bearings upon these particular fish. The fungus, as I have determined to my entire satisfaction, is indistinguishable from the cosmopolitan species, *Saprolegnia ferax*, already described, and which engenders a similar disease among Salmonidæ in the three continents of Europe, Asia, and North America.

The form under which this disease has manifested itself at the Salmon Ponds is not that of an epidemic attacking clean and healthy fish, but has in all cases been associated with fish that have received injuries attendant upon the operation of spawning, or at a time when their system is in a low and exhausted state, and, as it were, predisposed to the attacks of the parasitic fungus. The artificial conditions under which the salmon are necessarily maintained at the Ponds is undoubtedly accountable to a large extent to the high rate of mortality among them that is here recorded. Left to follow their natural instincts these fish immediately after spawning would have dropped down stream to the saltwater, and which, as has been ascertained by direct experiment, has the effect of entirely eradicating the fungus from their system. As a matter of fact, I may state that these small parr-marked spawning fish, had they been permitted to migrate to the sea this last and the preceding spring, should by this time on returning have developed into mature salmon weighing as many or more pounds as they now do ounces. Should the few remaining salmon and their progeny, if reared, be maintained under their existing artificial conditions there is, I fear, but little prospect of their subserving any other purpose than that of confirming the results of previous experiments, and thereby demonstrating that the species will not develop to its normal size and quality if constantly restrained from spending, as is its nature, a large portion of its existence in saltwater. With the view of assisting as far as possible towards the successful conduct of the experiments that may be continued, and towards lessening to the greatest extent the delterious action upon the fish cultivated of the parasitic fungus which represents their most formidable enemy. I would submit the following suggestions :—

In the first place, it is desirable that more than ordinary care should be exercised in the manipulation of these valuable fish for artificial propagation. During the Conferences at the International Fisheries Exhibition, London, 1883, at which I had the privilege of being present, one of the most important papers contributed was that by Professor Huxley on "Fish Diseases." In this paper the fatal malady caused by or associated with the fungus, *Saprolegnia ferax*, was specially dealt with, and in the discussion that followed many new and valuable data were elicited. In this direction Mr. Wilmot, the Chief Commissioner of the Canadian Fisheries, bore testimony to the fact that at the hatching stations in Canada they formerly lost a very large number of the salmon manipulated through the fungus. "Round the tail, where the men had caught the fish, this fungoid growth appeared and spread until the fish was killed." Also, in handling the salmon "three or four finger marks might be left across the fishes back; a few days after they invariably found three or four stripes of fungoid growth, and the fish invariably died." In order to combat the mortality from this cause, india-rubber gloves were supplied to the hatcheries for the manipulation of the fish and have been used ever since with gratifying results, it being found that the salmon were much less liable to injury and to the attacks of the fungus when so treated. Similar simple mechanical appliances might undoubtedly be profitably introduced at the hatchery on the River Plenty for the future handling of the survivng fish.

While the prevention of the disease should undoubtedly be advocated as being of primary importance, the means that may be adopted for its cure comes next in order for consideration. At various aquaria the rubbing of the fish affected with salt, and more especially in the case of coarse fish such as roach, dace, pike and carp has been long known to be a fairly successful remedy, but there is no doubt, and more especially in the case of Salmonidæ that the immersion of the diseased fish in sea water works a yet more effectual cure. At the instance of Professor Huxley and as recorded in his paper just quoted, both salmon and sea-trout affected by the salmon disease were confined in coops in the estuary of the Tweed at Berwick in the year 1882. The fish, on being transmitted to him after a short treatment, were found on careful examination being made, by means of sections prepared for the microscope, to be entirely cured of the disease for which they had been treated. The subject of provision being made for the similar treatment of special fish, such as the salmon under cultivation at the Salmon Ponds, is well worth consideration. At a comparatively small cost, tanks or baths of salt water transported in casks from the mouth of the Derwent, might be fitted up at the ponds for the temporary immersion of the affected fish. Or arrangements might be made when the fish are so few in number and of such value, for their transport after breeding operations to salt-water ponds or enclosures that might with facility be constructed in the Derwent estuary. By the adoption of such a system, in point of fact, a solution would be arrived at of the problem of rearing salmon to maturity, and to their normal size and quality, while still retaining them under artificial cultivation, and by such means, in fact, a breeding stock of the species might possibly be permanently maintained.

Before leaving the subject of the fungus disease, I propose to make a few remarks upon its bearings with relation to fish other than the cultivated or acclimatised Salmonidæ, and with regard to the as yet imperfectly understood primary causes of its appearance and development into a devastating epidemic. I would especially draw attention, in this connection, to the circumstance that some 17 or 18 years ago an epidemic, apparently and most probably identical with the fungus disease of the British salmon rivers, broke out among the fish of this colony, popularly known as the fresh water herring or cucumber mullet, *Prototroctes marena*, but which may be more correctly described as a close ally of the European grayling, *Thymallus*. This fact is recorded in Mr. R. M. Johnston's excellent catalogue of the fishes of Tasmania, and has been attested to me by many residents. The fish at this particular period are stated to have been seen floating down the rivers in thousands, covered more or less extensively with a cottony fungoid growth. So virulent and exhaustive was this epidemic that many, more especially of the southern rivers, were more or less completely denuded of their stock of this species and have so remained up to the present date, though I am trusting that by perseverance with the operations of artificially propagating the species conducted by me within the past two years it may soon again be restored to the Derwent and other southern rivers in its former abundance. The questions very naturally arise as to how, when and where this most malignant epidemic originated, and whether at the time there were any particularly abnormal, natural or artificial conditions associated with the infected rivers? Further information as to the precise date of its appearance, and more especially as to whether it occurred at or about the natural spawning season of the species, March and April, or at a time of drought, with the water at a high temperature, or in an impure condition, would be of much service in the consideration of these questions. The approximate date of the appearance of this epidemic would appear to be about the year 1869 or 1870, periods it may be remarked, of great activity in association with the distribution of the fry of the newly acclimatised Salmonidæ in the rivers of this colony. Is it possible, it may be suggested, that the fungus, *Saprolegnia*, was hitherto unknown to Tasmania and was introduced with the ova of these Salmonidæ, or more probably in the moss wherein they were packed? Under such conditions the germs or spores, like the microbes of measles or smallpox, arriving on a virgin and congenial soil, might be expected to spread with devastating virulence among the aboriginal inhabitants. Again, it might be asked, was the period of its appearance coincident with the first introduction on an extensive scale throughout the riverine districts of the colony of some special fertilising manure, that might be subsequently washed into the rivers by means of floods, or of the general adoption of some poisonous description of sheep dip, and in either of which instances the water might become so polluted as to jeopardise the lives of the fish?* In the case of sheep-washing, more particularly, conducted on the large scale peculiar to the Australian Colonies, associated with the extensive use of caustic alkaline "dips," and at a time when the rivers are usually at their lowest, it is quite possible that the fish may be affected thereby in a literally wholesale manner.

The circumstance is very familiar to me of the fungus disease developing itself fatally among fish in aquaria supplied with water containing an excess of lime or which would be popularly described as being of more than ordinary hardness. When the lime is present in yet greater excess and

* I have received authentic information of ducks being killed in a rivulet in the neighbourhood of Spring Bay which had become poisoned by the chemicals used at an extensive sheepwash.

of a caustic nature, as in tanks newly lined with Portland Cement, the symptoms of the disease are greatly aggravated. In all of these instances the parasitic growth is commonly known as the Aquarium fungus and was formerly supposed to represent a distinct species. A careful investigation has, however, demonstrated it to be in all respects identical with the *Saprolegnia ferax* of the salmon disease. I would dwell longer upon this circumstance of the alkalinity of the water in association with this fungus, since it has been recognised by one of our highest authorities at Home as not improbably furnishing the key to the origin of the disease. In the course of the discussion following upon the paper on the salmon disease contributed by Professor Huxley to the International Fisheries Exhibition Conference, 1883, already quoted, the Marquis of Exeter, who is a most enthusiastic trout and salmon breeder, drew attention to the fact that the water in the district of his hatcheries was very highly impregnated with lime, that the fish hatched were very extensively attacked by the fungus, and the only remedy for the fish when so attacked being a bath of salt-water. In responding to this and other observations, Professor Huxley remarked:—"That he had been much interested in what Lord Exeter had said respecting the limy character of the water of his district, because when the Fisheries Exhibition was opened all the trout and other fresh water fish in the new tanks, with one consent began to show disease. In fact he had an opportunity of studying in the Aquarium the fungus on one of these fish, and of satisfying himself that it was exactly the same thing as the salmon disease. That interested him very much in consequence of a remark made by Mr. Saville-Kent, who had paid considerable attention to these subjects. He (Mr. Saville-Kent) had said to him as they walked round the Aquarium—that the disease was a matter of course, because the water had not been allowed to run sufficiently long through the newly cemented reservoirs and tanks, and wherever that was the case the *Saprolegnia* was almost certain to make its appearance. That opened up his mind to a very interesting chapter of inquiry. It was very possible that any super-abundance of lime in the caustic state might have a very considerable effect in bringing about the development of the disease. In the first place, fungi of all kinds were extremely sensitive to small degrees of acidity and alkalinity in the water, and secondly, the condition of acidity and alkalinity was extremely likely, however small its extent might be, to have a very definite effect on the epidermis of the fish. This, therefore, suggested a line of investigation that was likely to prove extremely fruitful."

Subsequent to this conference, experiments were instituted by Mr. George Murray, of the British Museum, at the request of Professor Huxley, with the view of ascertaining what influence lime in the water had in the development of the disease. The results obtained were, however, to a great extent of a negative character only, furnishing at the most, as remarked by Mr. Murray, "starting points for fresh experiments" (Annual Report of the Inspector of Fisheries England and Wales, for the year 1883). To my mind, from a perusal of the report quoted, the lime used in these experiments was probably deficient in strength or in caustic properties, or possibly, the fungus experimented with had been cultivated to such an extent as to have, so to say, lost its virus, or in other words its capacity for propagation.

The actual *rôle* played by caustic lime, acids, or other chemical compounds in the development of the fungus disease on the epidermis of a fish appears to me to be purely mechanical, and in fact identical with that exerted by hard water on a delicate human skin. It causes it to become, as it were, chafed or chapped in the fishes skin, probably imperceptibly to the human vision, though at the same time in the form of minute raw surfaces sufficiently large for the lodgment and further development of the microscopic spores of the parasitic *Saprolegnia*. Unless in fact there is a crack or abrasion of the cuticular surface, be it however small, the fungus spores may swarm in the neighbourhood without exerting any ill effect whatever upon the fish. In demonstration of this proposition I may mention that at the Fisheries Establishment, Battery Point, I have up to a recent date kept several varieties of indigenous fish, including native trout, *Galaxias truttaceus*, blackfish, *Gadopsis marmoratus*, and the little native perch, *Microperca Tasmania*, in tanks in which the fungus has for many months past developed luxuriantly on any small fragments of mussel or other animal substances used as food and left for a few days at the bottom of the water (Specimens exhibited). Notwithstanding its presence in such abundance the fish have enjoyed a vigorous state of health, their sound and healthy skins, according to my interpretation, affording no foothold for the attachment of the parasitic fungus. Now it so happened that in recently moving the boxes, slates, and other apparatus from certain of the breeding troughs one of the little trout got bruised upon the head, with the consequence that the fungus has immediately seized upon it and its development, if not arrested, will without doubt prove fatal to the fish. This specimen I exhibit on this occasion and propose, should it live long enough, to attempt its cure with a salt-water bath. No more fitting illustration could, I think, be given of the phenomena attending the origin and development of this disease than are embodied in this brief history.

Proceeding now with the subject of the acclimatisation of the true salmon in Tasmanian waters, it may be remarked that the recommendations already made concerning the construction of salt water enclosures for the temporary lodgment of the fish are necessarily brought forward under the supposition that it is considered desirable to maintain a permanent breeding stock of salmon under artifical cultivation, and premising also that the latest attempts to effect the natural acclimatisation of the species in Tasmanian waters, shall, as in fomer instances, be productive for all practical purposes of negative results. Should, as I would be only too glad to have to report to you, the species naturally establish itself from the supplies of fry developed from the "Yeoman" importation and liberated in various rivers of this Colony in the year 1885, such special provision for the maintenance of a so-to-say domesticated breeding stock will necessarily be superfluous. On this point, however, I regret to say we have as yet no very encouraging evidence to adduce. In the British salmon rivers it has been conclusively ascertained that the young salmon change from parr to their smolt, or first migratory condition in varying numbers at the end, respectively of their first, second, and third years, they then repair to the sea and may return to their natal rivers the following autumn as half grown salmon or grilse, ready to deposit their spawn. According to statistics collected by Mr. Dunbar, who annually hatches about 500,000 salmon fry in the Thurso River, Caithness, as recorded in Dr. Day's "Fishes of Great Britain and Ireland," about 8 per cent. of the salmon parr become migratory smolts at the end of the first year, about 60 per cent. at the end of the second year, and 32 per cent. at the end of the third year. It is recorded in the same treatise that through experiments with marked fish, instituted by Mr. Ashworth, at Stormontfield, near Perth, it was ascertained that many of the fish belonging to the first migratory batch returned to the rivers as grilse, weighing from five to nine pounds and prepared to spawn the following autumn, or, within twenty months only of their deposit in the river in the form of ova.

Applying these ascertained facts to the case of the Tasmanian-bred fish, a large portion of the Yeoman fry liberated in the year 1885, should have been, and were to my knowledge, ready to migrate to the sea in the spring of the year 1886, and should have arrived on the spawning ground this past winter (antipodean, June and July) of 1887 weighing several pounds. With the spring now opening out we might also have expected the advent in the rivers from the sea of a yet larger number of fine fresh run grilse. Neither of these two phenomena can as yet be recorded, though there is yet time for the grilse to put in their appearance, the recent inclement weather, accompanied by much snow water in the rivers, having possibly retarded it. If, however, these grilse do not shortly appear, and still more, if the next autumn and winter of 1888 fails to bring up the main body of spawning fish, the conclusion must, I fear, be reluctantly accepted that the true salmon (*Salmo salar*) does not find the climatic or other surrounding conditions adapted to its permanent residence in Tasmanian waters. This subject has been dealt with in my recently published report, and wherein I put forward what appears to me to be the most probable interpretation of the phenomenon, namely, that the smolts in their descent to the sea, or after a short residence therein, find the temperature of the water so much higher than that in which the species flourishes in the northern hemisphere that they wander away to colder regions, and do not return to their natal streams. In search of a more congenial clime, they might proceed south towards the southern coast of New Zealand, or to Patagonia or the Antarctic icefields. Or possibly, following a uniformly cold abyssal route, they might reappear upon the shores of Japan or North-Eastern Asia, and in which latter region they would have advanced far towards coming in contact again with the northern representatives of their own race. In this connection it is of interest to remark that some few years since the report was circulated that a large number of salmon had been seen taken on the coast of Japan, and it was suggested at the time that these fish had developed, and possibly migrated there, from fry originally liberated in Tasmanian waters. I should be very glad to receive further and more definite information concerning this reported occurrence of salmon on the coast of Japan.

Premising, by way of argument, and in order to account for their otherwise mystical disappearance, that some such suggested migration of the salmon hatched out and liberated in thousands in the rivers of this colony since the year 1864, has actually taken place, such interpretation is found on nearer examination to be supported by many substantial data. In the first place, quoting from one of our highest European authorities, Dr. Gunther, "Introduction to the study of fishes," we find stated—"the true salmon, *Salmo salar*, is not subject to variation, and is very sensitive to any change of external condition, and to every kind of interference with its economy." Now, on proceeding to examine the external conditions to which it has been attempted to reconcile this species in this colony, it is found that they differ very materially from those which surround the species in its native waters. As pointed out in my report, the temperature of the sea round Tasmania is considerably higher than that of the British Seas, and more nearly approximates that of the Mediterranean shores of the South of France, and where repeated attempts to acclimatise the salmon have entirely failed. The fry liberated in the Rhone and other rivers of Lanjuedoc have thriven therein for the first year or so, but after taking their departure for the sea, as smolts, have failed to return as mature fish to the rivers in which they were originally born and bred.

Regarding this question of temperature, I have instituted during the maintenance of the fisheries establishment at Battery Point a systematic series of diurnal observations, with the view of ascertaining the average range of temperature of the water in the tanks and ponds and in the adjacent sea throughout the year, anticipating, as happens in the present case, that such data might prove of service. These observations have elicited the fact that the temperature of the sea-water in the tanks and ponds ranges from 40deg. Fahr. in winter to 80deg. in summer, while the smaller range of from 50deg. to 70deg. represents for the South Coast the corresponding limit of variation in the adjacent sea. The mean isotherm in either case is consequently denoted by 50deg. Fahr. When recording these observations in my report, I expressed regret that no similar data were available concerning the corresponding temperatures of the British seas, as these might prove of great value in the conduct of this and kindred acclimatisation experiments. It so happens that in the scientific journal "Nature," for June 30th, 1887, quite recently to hand, an announcement is made that such a series of observations is now in course of progress, under the auspices of the British National Fish Culture Association—of which I believe I enjoy the privilege of being a dormant member—and that the results recorded will be shortly published. The same announcement, moreover, contains a record of observations upon temperature made during the past three years in the tanks of the Association's Marine Aquarium at South Kensington, and with relation more especially to its influence upon the vitality of various marine fish. Although no systematic table is given with this announcement, a series of temperatures are recorded indicating a range of from as low as 32deg. Fahr. in winter to 70deg. in summer. This yields a mean isotherm for the entire year of 51deg. only as compared with that of 60deg. which obtains under similar conditions in Tasmania. An analagous comparative ratio will, it may be predicated, be found to obtain in the waters of the open sea on the British coast, and these figures of themselves furnish, to my mind, an ample reason why, that in dealing with a species of fish so "sensitive to any change of external conditions" as is the salmon, the efforts to permanently establish it in Tasmania have so far proved fruitless.

I may suitably mention here that prior to obtaining this practical information regarding the conditions of temperature, I was inclined to anticipate that some mistake had been made as to the description of ova remitted from England during the earlier years of the acclimatisation operations. This interpretation was to some extent supported by evidence tendered to me, and there, in point of fact, appeared to be no other logical explanation of the circumstance that no undoubted, or at all events matured, examples of *Salmo salar* could be shown for the many thousands of fry distributed in the rivers of this colony for several successive years following upon that of 1864. And taking also into consideration the fact that its near congener, the salmon trout, *S. trutta*, was, and is still, abundantly represented in these waters. A closer enquiry has elicited evidence showing that there is no reason to doubt the specific identity of the salmon ova forwarded in the first consignments through the instrumentality of Mr. J. A. Youl, C.M.G., and certainly, no doubt whatever can be entertained as to the genuineness of the importations more recently received, collected and packed under the personal direction of Sir Thomas Brady, and from which importations the specimens furnishing the subject matter of this communication have been mainly derived.

In conclusion, I would remark that every resource at the command of human skill has been brought to bear upon the naturalisation of the salmon in Tasmania, and no more fitting opportunity than the present could be selected for placing on record the indebtedness of the colony to that body of gentlemen, the late Salmon Commissioners, who have so perseveringly devoted their time and best energies for many years to these acclimatisation operations. And if, owing to an inflexible law of nature, this one species has proved intractible, they will have the satisfaction of knowing that through their accomplished establishment in Tasmania of many varieties of the allied and more plastic forms of *Salmo trutta* and *Salmo fario*, they have conferred on the community at large, if not an equal, yet a very substantial benefit.

NOTES REGARDING THE EXISTENCE OF LOWER COAL MEASURES AT PORT CYGNET AND HAREFIELD.

By R. M. Johnston, F.L.S.

PORT CYGNET.

Recently the author has had an opportunity for examining the geological features of the country lying between Port Cygnet, Garden Island Creek, Mount Cygnet, and Long Bay. The evidences gathered have enabled him to determine that the Mount Cygnet coal measures are the equivalents of the Adventure Bay group, and consequently they must be classed with the upper division of the lower coal measures. The plant remains associated with the coal seam are very abundant, although almost restricted to one form, viz., *Vertebraria australis.* The only other associate discovered rarely is a dwarf form of Gangamopteris, probably identical with *G. spathulata*, M'Coy. The absence of *Nœggerathiopsis*, *Glossopteris*, and *Schizoneura*, of the lower division—so common in the Mersey on the one hand—and the absence of *Phyllotheca* and *Sphenopteris*, so common in the upper division of the lower coal measures, as in the Newcastle coal beds of New South Wales—on the other hand—suggest that the Mount Cygnet beds form an intermediate group; the typical plant, *Vertebraria australis*, of the group indicating the closer affinity with the Newcastle group. The coal beds of Mount Cygnet immediately overly the upper palæozoic marine beds, and conform with them in the dip to the south. This position is the exact parallel of the Adventure Bay coal measures. There is evidently a very great stratigraphical break, therefore, between the Mount Cygnet coal measures and those of the Sandfly under Mount Grey, lying against the same greenstone axis at a greater height a few miles to the north.

The crest of Mount Cygnet is composed of greenstone, as in the main spur forming the divide running southward from the slopes of Mount Wellington to its termination near Three Hut Point. From Mr. Ford's mill at Garden Island Creek it presents a low, rounded, conical appearance, rising to a height of about 900 feet from a horizontal sandstone terrace, the remains of which are also found forming escarpments here and there against the neighbouring greenstone spurs on both sides of the main divide. Some of these sandstones of the lower coal measures are found in a nearly horizontal position or with a slight dip to the south, at an altitude of nearly 600 feet along the cuttings of the Garden Island Creek tramway, leading upwards in the direction of The Gap to Long Bay.

The higher ridges are clothed with the prevailing trees of the blue-gum (*Eucalyptus globulus*), some of which attain immense proportions. The lower butt of one of these giants pointed out to the writer by Mr. Ford measured about 55 feet in circumference.

The coal seam of Mount Cygnet is worked by an inclined adit or drive on the northern slope, near the bed of one of the tributaries of Gardner's Creek, and the coal is carried a distance of about two miles westward by a wooden tramway to the jetty at the township of Welsh, near Port Cygnet.

The main drive from the creek level follows the seam of coal, which averages about 2 feet 8 inches thick, at an angle of about 1 in 6, dipping S.S.E. into the mount. The extreme length reached by this main drive at present is about 6½ chains, and in this distance two step faults running east and west have been met with successively, throwing down the seam 2 feet 3 inches and 2 feet respectively without materially affecting the angle of dip. The coal measures have been pierced near this spot by several bores, and the evidence collected shows that they are frequently faulted and dislocated to a very considerable extent. The slopes along the valley have been subjected to much denudation, and hence it is difficult to predict, with anything approaching certainty, the exact position where the coal seam may be struck, even in the immediate vicinity of the present workings. It is also impossible to say, at present, whether there is more than the one seam, as no bore has yet pierced beyond the first one met with, and in each case the seam so reached appears to be identical with the one now being worked; for although the levels at which the coal seam was struck are extremely variable, the differences in absolute level are no more than might be occasioned by the angle of dip, and especially by the numerous faults and dislocations.

The seam at Mount Cygnet is invariably overlaid by a greyish flaggy sandstone, which, according to the extent of denudation, may be found from a few feet to 100 or 200 feet in thickness. Thus, although the seam at the workings crop out in the creek, a shaft cut to it about two chains from this point on the slope of the hill shows the following section in a downward direction:—

	ft. in.	ft. in.
Grey flaggy sandstones, with occasional carbonaceous streaks	60 0	
Shaly parting	0 1	
Coal, slaty and anthracitic...	2 8	
Coal glance, brilliant lustre	0 8 to	10 0
Greyish-black arenaceous and carbonaceous clod, verytrace	0 4 to	0 18
Dark brownish clod and shales, full of impression of *Vertebraria australis*, *Gangamopteris spathulata*	Unknown thickness.	

It is probable that the seam extends to the Garden Island Creek vicinity, where, judging from the prevailing dip, it may yet be found possibly at a much greater depth. It is interesting to observe that the writer also found what appears to be the sandstones of the system abutting against the greenstone axis at about the same vertical height on the eastern slope above Long Bay.

The study of the rocks about Port Cygnet presents very many interesting features. The low rounded hills in the neighbourhood of the township are, for the most part, composed of an intrusive felspar porphyry, there largely used for road metal. The felspar porphyries are very beautiful and extremely variable. The triclinic crystals of felspar with microscopical striated surfaces are most variable in size, colour, and abundance. The crystals are grey, white, yellow, or flesh-tinted, embedded in a pasty mass; sometimes normal in size, and thickly and uniformly distributed, at other times large and sparsely distributed. Intimately associated with the more pronounced forms of felspar porphyries is to be found a close-grained dark-greenish metamorphic rock of a chloritic appearance, streaked and marbled with greenish-white lines and blotches; nests of pyrites occurring in great abundance in the centres of the larger greenish-white blotches.

At Lymington, in the same locality, gold in an alluvial form has been worked with more or less success in the valleys associated with this porphyritic rock, and it is a question of much interest to ascertain by careful experiment whether the pyrites of the metamorphic rocks associated with the porphyry may not also be auriferous. Apparently no other rocks of an auriferous character are now to be found in the vicinity.

Traversing these felspar porphyries and associated metamorphic rocks southward in the direction of the lower coal measures at Mount Cygnet, the following rocks are to be met with in ascending order:—

1. Felspar porphyries and associated metamorphic rocks.
2. Dark-blue, friable, shaly mudstones of Upper Palæozoic Age, quietly reposing upon the denuded surfaces of No. 1, dipping at an angle of 15deg. S.S.E.
3. Spirifer zone* of the Upper Pal. marine beds succeeding No. 2 along the course of Gardner's Creek, same dip as No. 3.
4. Fenestella beds* succeeding No. 3, same dip as Nos. 2-13.
5. Lower coal measures, succeeding No. 4, still bearing the same angle of dip.

The distance from No. 1 to No. 5 in a straight line may be roughly estimated at about three miles.

It will be seen, therefore, that the relation of the lower coal measures to the marine beds at Mount Cygnet corresponds closely to that of the Adventure Bay coal measures immediately to the south, towards which they dip.

* Species identical with the common forms at Variety Bay.

HAREFIELD, FINGAL BASIN.

Under the direction of Mr. Bateman a trial bore by means of the diamond drill was sunk recently at Harefield to a depth of about 723 feet in search of coal seams. Sections of this bore were submitted to the writer from time to time, and from the evidence of contained plant impressions and other fossils, it was clearly revealed that a thin deposit of the lower coal measures existed below the marine beds of Upper Palæozoic Age and directly reposing upon the common soft clay states of the district of Upper Silurian Age.

The following is an abstract of the principal rocks passed through in this bore:—

	ft.	in.
Mesozoic.		
Surface soil, black clay, and drift ...	3	0
Sandstone	7	0
Shale	16	6
Sandstone	0	8
Coal	3	6
White band	0	10
Coal	1	3
Shale	2	1
Sandstone, with thin coal flakes... ...	12	0
Coarse sandstone	17	6

	ft.	in.	ft.	in.
Mesozoic.				
Sandstone	5	2		
Shale and coal	0	8		
Sandstone	15	7		
Shale and coal	1	0		
Coarse sandstone	1	0		
Shale	7	6		
Coal, with thin partings of sandstone ...	3	6		
Sandstone, with streaks of coal	18	0		
Black shale, including 2in. of coal ...	7	6		
Sandstone, with coal flakes	3	3		
Coal	2	9		
Black shale...	7	0		
Fireclay and shale	2	6		
Black and blue shales, including 8in. coal and 1 foot of sandstone	6	6		
Sandstone, with coal flakes	1	8		
Sandstone	19	8		
Coal and black shale	0	6		
Grey sandstone	16	6		
Shale and fireclay	15	0		
Sandstone, with coal flakes	5	8		
Blue shale	3	6		
Coal	0	5		
Hard sandstone	1	4		
Black shale	3	6		
Sandstone	2	3		
Black shale and coal	0	4		
Dark sandstone	1	6		
Black and blue shales, including two thin partings of coal and one of sandstone	11	3		
Shale, with layers of sandstone	5	7		
Shale, including 1 foot coal	11	1		
Sandstone	5	0		
Dark shale and fossil wood	0	2		
Shale and fireclay	6	2		
Sandstone	1	0		
Shale coal and fossil wood	0	4		
Sandstone	2	0		
Shales, with fern impressions forming base of mesozoic rocks	2	0		
			264	0
Carboniferous (Upper Pal.).				
Upper Marine Beds.				
Coarse and hard sandstone	13	2		
Hard blue rock, with pebbles	16	6		
Blue shale	40	5		
Blue shale, with marine fossils	11	7		
Blue shale	9	0		
Conglomerate	2	0		
Hard grey rock	6	6		
Green sandstone	11	0		
Conglomerate	1	0		

	ft. in.	ft. in.
Fossiliferous limestone, with *Fenestella*, etc.	28 6	
Limestone and conglomerate	23 6	
Fossiliferous limestone and mudstones...	79 8	
Layers of mudstone shale and hard rock, with water-worn pebbles	13 7	
Hard grey rock, with pebbles	11 10	
Shale and sandstone	46 0	
Sandstone	8 8	
	——	313 0
Lower Coal Measures.		
Conglomerate	1 0	
Soft shale	2 6	
Conglomerate	3 1	
Hard white sandstone	1 8	
Grey sandstone, showing coal stains ...	7 0	
Hard black shale	3 6	
Sandstone	3 8	
Dark sandstones	5 7	
Conglomerate	0 10	
Hard dark sandstone	2 10	
Conglomerate	0 4	
Hard black shale	1 5	
Conglomerate and sandstone	1 10	
Shale; impressions of *Schizoneura (?)* ...	0 2	
Coal	0 1	
Hard black shale	4 4	
Sandstone, full of coal stains	57 11	
	——	97 9
Upper Silurian.		
Soft grey foliated slates, pierced to a depth of ...		40 0
Total...		714 9

The foregoing section is of the greatest interest, as it forms one of the best evidences yet obtained regarding the stratigraphic relation of rocks of the Fingal basin. The particulars were most carefully tabulated by Mr. Bateman at the close of each day, and may, therefore, be depended upon as being fairly accurate.

It is clear, although, unfortunately, no important coal seams were met with, that the lower coal measures exist in this district below the *Fenestella* limestones and mudstones of Upper Palæozoic Age, and the existence of a very thin coal seam together with shales containing plant impressions akin to the *Schizoneura* and possibly *Gangamopteris* of the Mersey District indicate that the beds are probably the equivalents of the lower coal measures of the Mersey. It is of interest to observe also that the Mersey coal measures also repose upon Silurian rock, although in the latter district limestones are probably of Lower Silurian Age.

The following summary may be of further interest in showing the parellelism between the rocks of the two districts :—

Mesozoic Rocks.	Bore at Tarleton.* DEPTH.	Bore at Harefield † DEPTH.
1. Upper coal measures, with Thinnfeldia, etc.	Apparently absent	About 270 feet.
Carboniferous System.		
2. Upper Marine beds, with limestones containing *Spirifera* and *Fenestella*	Apparently absent	327 feet.
3. Lower coal measures, with *Gangamopteris*, *Schizoneura*, etc.	About 200 feet	98 feet.
4. Lower Marine beds	170 feet	Apparently absent
Devonian System.	Apparently absent	Apparently absent
Silurian System.		
5. Upper Silurian slates, grits, etc.	Apparently absent	40 feet where depth of bore reached.
6. Lower Silurian limestone.	Pierced 36 feet when drill withdrawn	

* Mersey district. † Fingal district.

It is probable that the lower coal measures of the Fingal district are of limited extent, as the sections to the west and north do not disclose their existence. To the east an important fault, throwing up the older rocks, cuts them off. It would seem, therefore, that it is only possible for them to show greater development in a southerly direction—that is, towards the Fingal Tier, where the upper coal measures of Mesozoic Age are again largely developed, abutting against or underlying the greenstone rocks which characterise the greater portion of the crest and upper levels of the tier.

NOTES WITH RESPECT TO THE FRESH WATER FISHES, AND THE LAND AND FRESH WATER MOLLUSCS OF KING'S ISLAND.

By R. M. Johnston, F.L.S.

Mr. John Brown, Surveyor, has always taken a commendable interest in matters relating to the natural history of Tasmania, and for many years past he has made valuable collections in remote parts of the island, which have yielded novelties of great interest to science. Recently he has spent some time on King's Island, and at my request has carefully observed the nature of the rocks of this dependency, and has also made up a very interesting series of the same, upon which I shall have pleasure in making some observations on another occasion. He has also made a very interesting collection of the fresh water fishes, together with a typical series of the land and fresh water molluscs. These valuable collections, together with notes of distribution, he has very kindly placed at my disposal, and having examined them I think it best to state the results for the information of the members of this Society, and also in order that they may be made of permanent value to naturalists generally by being placed upon the Society's records.

The collection, so far as I have observed, contains four species of fishes, and nine of molluscs of which the following list gives fuller particulars :—

Fresh Water Fishes.

Microperca Tasmaniæ. Johnston.

Locality, Yellow Rock Creek ; also inhabits the waters of the Northern rivers of Tasmania.

Galaxias truttaceus. Cuv. and Val. (Common spotted variety.)

„ *attenuatus.* Jenyns.

Locality, Yellow Rock Creek ; also common throughout Tasmania.

Galaxias attenuatus, Jenyns, has a very remarkable range of distribution, as it is reported to be common to the fresh water rivers of New Zealand, Falkland Islands, South America (Southern parts), Tasmania, and adjacent islands.

It has, therefore, a great interest in the eyes of those who are working out the problems connected with original centres of distribution.

Anguilla australis.

Locality :—Yellow Rock Creek ; also common to the waters of Tasmania, Australia, and New Zealand.

Land Molluscs.

Helix ruga. Cox. Common.
„ *Brunonia*, nov. sp. Common.
„ *cæsus.* Cox. Very abundant.
„ *pictilis.* Tate. Common.
„ *Wynyardensis.* Petterd. Very abundant.
Vitrina Verreauxi. Pfeiffer. Common.
Succinea australis. Pfeiffer. Very abundant.

Fresh Water Molluscs.

Physa Tasmanica. Ten.-Woods. Common.
Pisidium Tasmanicum. Ten.-Woods. Common.

These shells have all been collected in or near Porky Lagoon on the West Coast of King's Island. With the exception of *Helix Brunonia,* mihi, which appears to be a new species, all are common to Tasmania, and some of them inhabit the Southern coasts of Australia.

Helix Brunonia, mihi, is a fine shell nearly an inch in greatest diameter, a description of which is hereafter submitted.

HELIX BRUNONIA. NOV. SP.

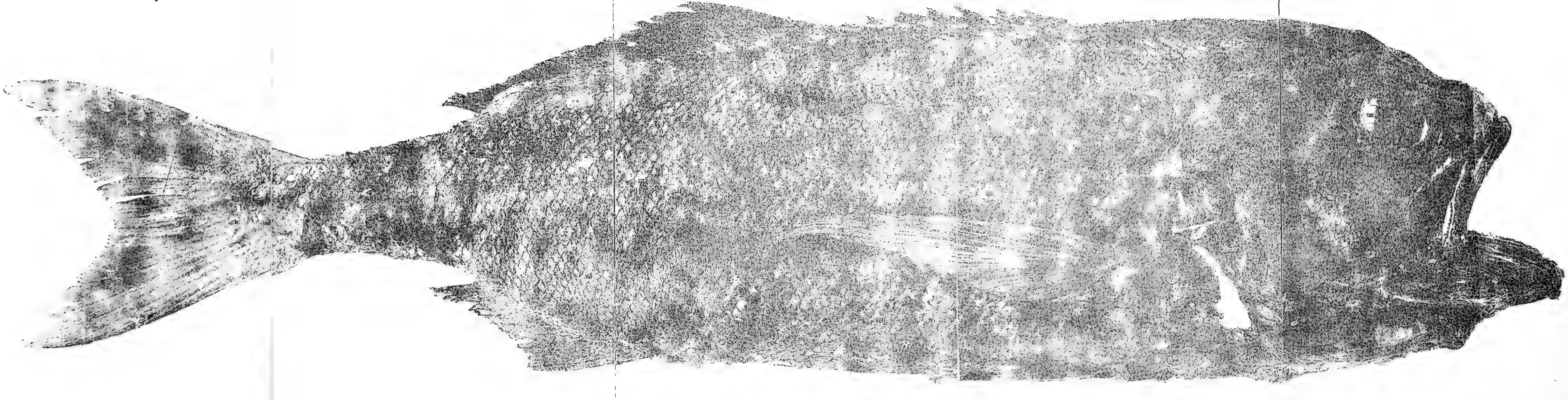
Shell perforated, convex or depressedly conical, thin translucent, somewhat coarsely and irregularly striated with lines of growth ; surface ornamented with a fine tesselated or scaly epidermis ; tesselation, as seen under lens—oblique, crossing curved lines of growth. Colour dull, pale to dusky purplish brown, lighter underneath ; spire conoidly convex ; nucleus slightly raised ; whorls 4½ convex ; suture well marked, and grooved along its course internally ; periphery and base roundly convex ; aperture oblique, lunately rounded ; peristome simple, sometimes with slightly granular margin ; margins distant, the columellar margin dilated and reflected, almost covering the minute perforation.

Diameter, greatest 0·87, least 0·75 ; height 0·50.

Collected by Mr. J. Brown, Surveyor, at the Springs, near Cape Wickham, King's Island, in moist situation in ti-tree scrub, among decayed vegetable matter.

This fine shell closely approaches *H. bisulcata*, Pfr., and *H. lamproides*, Cox, in some respects, but it is easily distinguished, by the almost closed perforation, by the very convex base, and by its peculiar ornamental shagreen surface. It has a still more close alliance with *H. atramentaria*, of Victoria, from which it differs in the dull, coarse and more concatenate form of the surface rugæ; in the smaller size and in the greater convexity; and especially in the much less gradual enlargement of the whorls. The outer margin is not so boldly curved, nor is the margin flattened at the crown of curve as in the general form of *H. atramentaria*. In the small and partly closed perforation, and in the convex base, it has characters which run very close with the latter species. The relative dimensions, taking as maximum diameter, show more clearly their differences.

		H. Brunonia.	*H. atramentaria.*
Relative diameter	Max.	1	1
„ „	Min.	0·86	0·74
„ height		0·67	0·52



Eurumetopos

Johnstonii N.S.

-- Half full size --

DESCRIPTION OF TWO NEW FISHES.

By Alexander Morton, Curator of the Tasmanian Museum.

Genus Eurúmetopos, n. g.

Seven branchiostegals. Single row of villiform teeth. The spinous dorsal continuous with the soft, and composed of nine spines, operculum having a soft, fleshy point. Scales ctenoid. Tasmania.

Eurumetopos, Johnstonii, nov. sp.

B, 7; D, 9 1-9; A, 3-13; V, 1-5 P.

Length of head, 4; of caudal, 4 2-3; of pectoral, 4 1-5; height of body, 12-3 in the total length. *Eyes.*—Diameter, 4 1-4 of the length of head; interorbital space convex; upper profile of the head convex; jaws nearly equal, maxilla, with a few small denticulations in front, reaching in a line to the centre of the orbit. *Teeth.*—A single row of villiform teeth in the jaws, about the 16th of an inch. *Fins.*—Dorsal commences in about a line with the base of the vertical; spines short and strong, the first the shortest, the fifth and sixth being the longest. Pectoral nearly as long as the head, ending in a line with the 4 dorsal ray. Anal commences opposite the seventh dorsal ray, the two first spines being very short, hardly perceptible, the anal ending in a line with the anterior part of the soft dorsal, Ventrals short and strong, caudal deeply forked. All the vertical fins with minute scales. Scales finely ctenoid. approaching to cycloid. Total length 3 feet 3 inches.

This very remarkable Fish was found washed on the beach at Bridgewater. Unfortunately the crows had eaten a great part of one side, taking the eyes and the intestines out. I was therefore unable to examine the internal parts. On a recent visit to Sydney the specimen was carefully examined by Mr. J. Douglas Ogilby, the Assistant Zoologist at the Australian Museum, but he was unable to place it in any genus. I have therefore formed a new genus for it. It bears in many respects a close resemblance to the *Oligorous*, though in the *Oligorous* the teeth are more numerous, and not in a single band, as in this species. I have great pleasure in giving this very remarkable genus the specific name of *Johnstonii*, in honour of R. M. Johnston, Esq., F.L.S., whose very valuable works in all matters relating to the Natural History of Tasmania and the Geological features of the Island place him as the foremost scientist in Tasmania.

Genus Tripterygium, Risso.

Body not very elongate, covered with rather small or with scales of moderate size. Snout of moderate extent, jaws with a band of villiform teeth; teeth on the palate. Three dorsal fins, the two anterior spinous, the middle one longest. Ventrals jugular, with two soft rays. Six *Branchiostegals Pseudobranchiæ.*

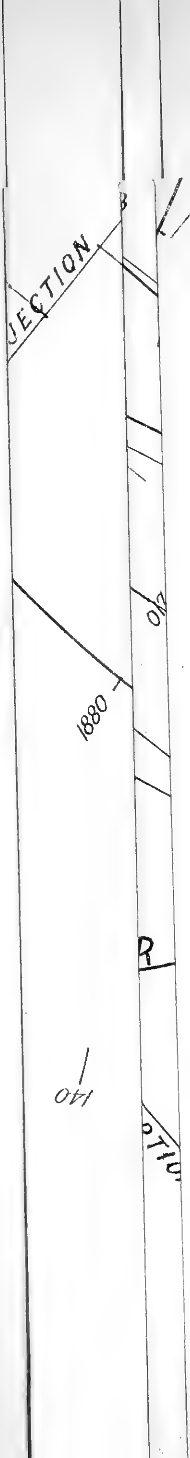
European, New Zealand and Australian Coasts and Rivers.

Tripterygium Clarkei, nov. sp.

B, 6; D, 3, 16-11; A, 23; P, 15; L, 26; L. trans, 3-8.

Length of head, 3 and 3-5; height of body, 5 of the total length. Eyes large, 1-3 of the length of the head; head convex, a small tentacle at the nostril; lateral line very distinct, terminating in a line with the eighth ray of the third dorsal; numerous small punctures about the head; head scaleless. Villiform teeth, several of the upper jaw being larger than the lower ones. Total length, 3 inches.

Locality: Clarke's Island. Mr Maclaine.



— ELEMENTS —

☊	25°
λ	50°
i	79°
ε	·543
P (– precession)	83·7 yrs.
PP	1875·6
a	18″·6

Max

Max.ᵐ Elong.ⁿ 23″·25
t. 1818

α Centauri

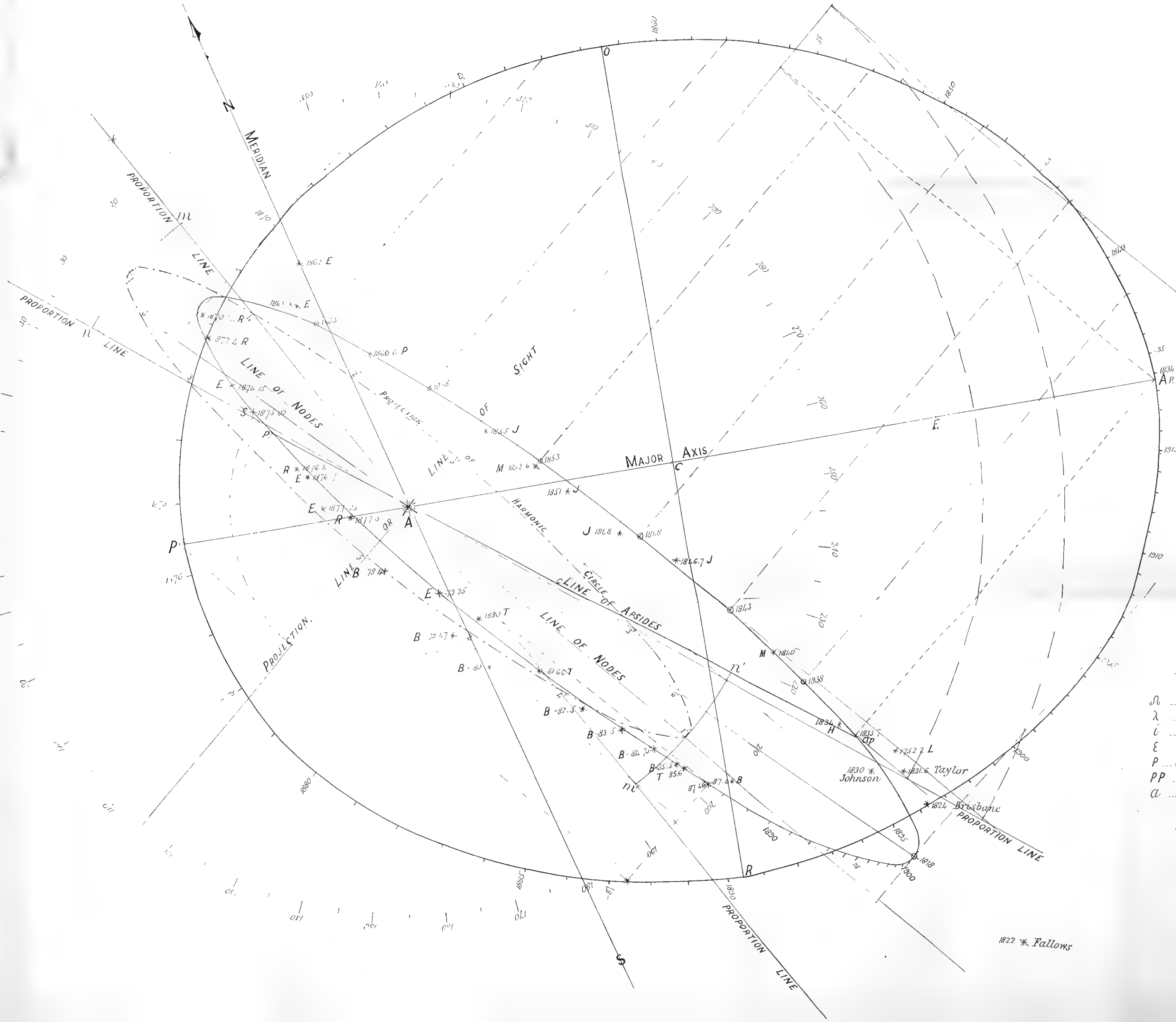
Projection of its Orbit from its Apparent Curve

by

A. B. Biggs, Launceston.

1887.

— Scale – One Second = 0·4 Inch —



— Symbols —

L	Lacaille
H	Herschell
M	Maclear
J	Jacobs
P	Powell
E	Ellery
S	Seliger
T	Tebbutt
B	Biggs

✳ Observed positions.
⊙ Calculated do

— Elements —

☊	25°
λ	50°
i	79°
ε	·51.3
P … (–precession)	83·7 yrs.
PP	1875·6
a	18·6

Max^m. Elong^n. 23″·25
t. 1818

a. CENTAURI, WITH A GRAPHIC PROJECTION OF ITS ORBIT FROM ITS APPARENT CURVE.

By A. B. Biggs.

Several circumstances invest the star Alpha Centauri, one of the brightest in our southern sky, with special interest. It was one of the earliest whose annual parallax (from which is deduced its distance) was approximately ascertained. It is, so far as at present known, by much the nearest of the fixed stars to our system. It is perhaps the most magnificent of double stars. And (what invests it with special interest to us) it is, from its great southern declination, invisible to the Observatories of the Northern Hemisphere. Science is therefore dependent entirely upon southern observations for all that can be known of the relative movements of its components. Its distance from the solar system is about 225,000 times that of the earth from the sun.

Various attempts have been made from time to time to determine its orbit and period, the latter varying from 75 years by Powell in 1854, to $88\frac{1}{2}$ years by Dr. Doberck in 1879. My own observations of the star extend from about the latter date to the present time. In venturing to attack the problem, I have therefore the advantage of combining my own more recent measures with the anterior ones of other observers.

A brief description of my method will furnish some criterion of the value of the result. I first drew up a table of every observation I could find recorded (including those in Crossley G. and W's work on double stars). These I laid off in a curve, on plotting paper (ruled decimally in millimetre squares) taking dates and position-angles for ordinates an co-ordinates. The distance measures were treated in the same way. After smoothing each curve into reasonable symmetry, I drew up a table for every 5th degree of position-angle, with date, as ascertained from the curve. The next process was to draw a circle, with radii to every 5th degree, the centre being the locus of the principal star A. On these radii I laid off by dots the distance answering thereto by date, of the star B. A figure was thus obtained approximating to that of a long ellipse, answering to the apparent curve of the star B round its primary. But it was *not* a true illipse, and it ought to have been. I wasted much time in trying to construct an ellipse that should fairly represent a mean of all the different positions, the early measures constituting the difficulty ; and at length came to the conclusion that I could only succeed by discarding them altogether. A glance at the diagram will show that those of 1822-24-30 and 31 are mutually inconsistent, and widely out of any rational curve, especially that by Fallows, in 1822, showing an elongation of 28″·75. The positions about the apparent periastron, 1876 to 1879, also are rather wide of the curve, but that is not to be wondered at, considering the difficulty of measurement of so small an interval (less than two seconds of arc), answering to one inch at nearly one and three-quarter miles. At that time, except to high telescopic power and fine definition, the pair appeared as a single star.

The apparent curve of course represents the real orbit *in perspective.* We have then to determine how much it is tilted, and in what direction? These questions are determined by the projection of the harmonic circles, in which the radii 1, 1′, 2, 2′, 3, 3′, etc., are in harmonic proportion to the corresponding radii of the apparent elliptic path of the star.

The projection of this circle being itself an ellipse, the direction of its major axis gives the line of nodes (the intersection of the plane of vision with that of the orbit), and the foreshortening is in the direction of its minor axis, and is in the proportion of its major and minor axes; that is as mm′, is to mn′. The lines nn′ and mm′ serve as proportion lines, on which are marked off the spaces above or below the line of nodes, which are set up at right angles to the nodal line. Setting off the points P′ A C′ and ap. in this way, we get P A C and Ap., the major axis of the real orbit, of which A C is the eccentricity, from which the length of the minor axis O R is deduced. A few more points sets off similarly from various parts of the curve should lie on the circumference of an ellipse, having P Ap. and O R for its major and minor axes. This came out fairly well.

I have laid off, about the apparent curve, a very few of the actual observations from which the curve was obtained, with dates, and the symbols of the observers My own observations extend from about 1878 to the present time. The earlier measures were made with a fine photographic reticle scale, in squares of 1-200th inch linear. The result proves such an instrument quite inadequate for such delicate measurements, the measures being manifestly wild. The later ones, from 1882·5 were taken with a new micrometer of my own, designed specially for such work. A description of this apparatus may serve for a future paper if acceptable. The measures by this instrument were very closely consistent, both with themselves and with the curve. The measures embrace an enormous number of observations, of which I have taken the means in convenient groups, with the means of the dates.

I estimated the period separately both from the apparent curve and the real orbit. First, from the apparent curve, I start from its greatest elongation, the date of which I make to be 1818. Kepler's 2nd law of planetary motion is:—that "the Radius Vector describes equal spaces in equal times," and this applies equally to the real and the apparent curve. The whole area of the apparent curve is 165·75 square seconds. Taking the maximum elongation in 1818 as a starting point, we have the sector between that and my last position (1887·46) to be described, in order to complete a revolution. The sector measures 29·9 square seconds. Deducting this from the whole ellipse, we have 135.8 square seconds traversed in 69·46 years. The proportion will give 15·3 years to complete the curve, making the whole period 69·46 + 15·3 = 84·76 years.

In the same way, from the real orbit, I deduce a period of 84·85 years.

I have not, so far, complicated the problem by allowing for *precession*, by which the meridian (the standard of reference) has a minute progressive shifting of its position. I reckon this would make a difference of about a year, shortening the period.

An analysis of the diagram yields the following results:—

Apparent Curve.

Position of Node	25°	
„ „ Apsides...	75°—255°	
Apse from Node	50°	
Semi axis major of apparent ellipse ...	17″	
„ „ minor „ „ ...	3″·1	
Maximum elongation	23″·25	*t.* 1818
Apparent periastron passage...	1″·7	*t.* 1878·2
Period	84·76 years.	

Real Orbit.

		Dr. Doberck's Elements, 1879.
Node (position)	25° ...	... ... 25·14
Apsides „	75°-255°	
Apse from Node	50° ...	... ... 45°·58
Semi axis major	18″·6 ...	... ... 18″·45
Eccentricity	·543 ...	... ... ·5332
Inclination of plane of Orbit from line of sight (= angle V A X)	79° ...	... ... 79°·24
Periastron passage... ...	1875·6 ...	... ... 1875·12
Period (diminished by precession)	83·7 ...	... ... 88·556 years.

(I have appended Dr. Doberck's elements for comparison.)

My measures (discarding the earlier ones), are as follows:—

Date.	*Position Angle.*	*Distance.*
1882·5	195°·7	10″·15
83·5	198 ·3	11 .63
85·47	200 ·15	14
86·8	201 ·1	14 ·83
87·46	201 ·72	15 ·2

I venture the following Ephemeris up to 1901:—

Date.	*Position Angle.*	*Distance.*
1888	202°·2	15″·9
89	202 ·9	17
90	203 ·6	18
91	204 ·3	18 ·9
92	205	19 ·7
93	205 ·6	20 ·4
94	206 ·2	21
95	206 ·7	21 ·5
96	207 ·2	21 ·9
97	207 ·8	22 ·3
98	208 ·3	22 ·6
99	208 ·8	22 ·8
1900	209 ·3	23
01·7	210	23 ·25 Maximum elongation

The actual mean angular distance of A..B (=the semi-axis-major of the real orbit), is 18″·6. The accepted parallax of this star is 0·928″. The actual mean distance of the companion from its primary in terms of the earth's mean distance from the sun will be 18″·6÷0″·928=20·043,—a distance slightly greater than that of Uranus from the Sun, with a period almost identical. If B revolved round our Sun at the above distance, its period would be 89·732 of our years. Its actual period being only about 84 years it is evident that the gravitational force of A (and therefore its mass) is greater than that of our sun. How much? The calculation is:—89·732 years squared÷83·7 years squared=1·1493. That is, its mass is greater than that of our Sun in the proportion of 1 to $1\frac{1}{7}$ nearly. We cannot thus estimate the mass of the smaller star B, there being no visible object revolving round it.

A FIRST LIST OF THE BIRDS OF MARIA ISLAND.

By Colonel W. V. Legge, R.A., F.Z.S., &c.

Of late years much has been added to our knowledge of the local distribution of birds in Europe and Asia by the publication of "Lists of Birds" in such journals as the "Ibis," "Stray Feathers," and the Proceedings of the Zoological Society, and the information afforded by such papers has proved of the greatest advantage to authors in the publication of recent works. The "Distribution of Birds" is not, however, solely a matter of interest when dealing with large continental areas, for there is much to be learnt by attention to it in connection with comparatively small insular regions, in which food, climate, and topographical aspect exercise a considerable influence on the movements and the permanent or temporary location of the feathered creation; and it has therefore occurred to me that something might be done in the pages of our journal towards increasing our knowledge of the distribution of Tasmanian birds. The large islands round our coasts appear to furnish the most interesting fields of observation, and in the present instance Maria Island has been chosen as being a place to which no little attention has of late been drawn in connection with settlement and fertilisation, and where there may some day be a considerable population. The geographical features of the island are such as to be favourable in a large degree to bird life. Its climate is mild, and it is for the most part forest-clad, with a consequently abundant food-supply. A lofty range of mountains, attaining, at its northern end, an altitude of 3,000 feet, runs from north to south of the larger half, which shelters the east and west coasts from the opposite blowing winds, and in the gullies of this range there is ample room for our forest-loving species. The western shores are flat and intersected here and there by lagoons, the home of water birds; and round the isthmus or "neck" there are extensive beaches such as are frequented by shore species. Beyond the isthmus lies the southern portion of the island, sparsely timbered, but no doubt containing a good many birds, although the information I have obtained does not extend beyond the "neck." Unable to visit the island myself, I sent my son, who is an enthusiastic young collector, to spend his Easter holidays there, and he succeeded in observing a fair number of species which, combined with those concerning which Signor Bernacchi, his kind host, gave him information and a few additional species on which Mr. Morton has obligingly given me notes, make up a list of sixty-four. This is comparatively small, owing to the absence of the large family of *Procellariidæ* (petrels) from the list, and the season of observation occurring after the return migration of our summer visitants.

As is usual in framing distribution lists, I have taken the opportunity of making remarks on the various species which may be of value to ornithological readers of the paper at Home, as well as to those who make a study of our species here.

The letters "L" and "B" in brackets indicate the authority: my son or Signor Bernacchi, and the letter "M" denotes that the curator of the Tasmanian Museum supplied the information.

ACCIPITRES.

1. Uroætus audax, *Latham.*

Found in the forests, and rather numerous. Three or four have been seen together (B). The forest-clad range in this island forms a secure home for this grand eagle, but its destructiveness will lead to a great reduction in its numbers as the island becomes populated. It is abundant in the ranges of the opposite mainland.

2. Haliætus leucogaster, *Gmelin.*

Found sparingly round the coast (B). My son saw one at the settlement. This widely-spread Sea Eagle is not so common about the indented coast of the south of Tasmania as I should have expected. During the last three years only three examples have been seen by me in the Derwent. It builds occasionally on the Actæon islands, on one of which Mr. Joseph Graves found a nest in November, three years ago. It was made on the ground among the rank vegetation and low scrub. Gould draws attention to its habit of building on the ground in the islands of Bass Straits where the structure is formed of the "twigs and branches of the Barilla bush." In Ceylon, where it is far more abundant than in these latitudes, and where every inland tank of any size has one or two pairs frequenting it, this eagle always builds on a lofty tree. Gould speaks of the Sea Eagle being very common in D'Entrecasteaux Channel. I know of one pair building there, but I fancy its numbers have decreased before the efforts of the wild fowler.

3. HIERACIDEA ORIENTALIS, *Schlegel.*

One example seen near the settlement (L).

The open sheep runs and plains of the Midland Districts are the great home of this bird. It has the habit of another well-known member of the *Falconinæ*, the Kestrel, of hovering poised in the air, over a coveted object on the ground and then descending on it, very similarly to the Kestrel. These weak-legged, round-winged falcons, represented by the two so-called Brown Hawks of the Australian region, are very interesting members of this sub-family. To the typical bill of falcon they unite the wing and leg, to some extent, of the goshawk, and they have the ignoble habits of the Harrier with the hovering propensity of the long-winged Kestrels.

4. NINOX MACULATA, *Vig. and Horsf.*

The Spotted Owl is recorded by Signor Bernacchi. Probably both species of Hawk-owl are found in Maria Island. These owls are variable in their choice of abode—woods, plantations near houses, and even localities in the heart of towns are chosen as dwelling places, in support of which I may state that recently I observed a fine example of the spotted owl sitting at dusk on a conservatory in Macquarie-street.

5. STRIX CASTANOPS, *Gould.*

Found occasionally near the settlement (B).

PSITTACI.

6. CALYPTORHYNCHUS XANTHONOTUS, *Gould.*

Found in the forests on the hills (B).

7. PLATYCERCUS FLAVIVENTRIS, *Temminck.*

Common on the West Coast, and observed close to the rocky shore (L).

N.B.—From all accounts the "Rosella" appears to be singularly absent from this island, as Signor Bernacchi has not observed it. This species is likewise not found on the N.W. Coast about Circular Head. Its favourite habitat has always doubtless been the sparsely timbered country, and its translation to the cleared districts where once the virgin forest reigned is evidently a matter of some time.

8. PEZOPOROUS FORMOSUS, *Latham.*

The Ground Paroquet is common on the West Coast. Observed on the swampy, marshy lands near Long Point, near the "Neck," and on Penguin Island near the settlement (L).

9. Lathamus discolor, *Shaw.*

A small flock seen near Long Point so early as the month of August (M).

The Swift Paroquet appears in great numbers when the blue gums are in blossom (B).

10. Trichoglossus pusillus, *Shaw.*

The Little Lorikeet is recorded by Gould as found on the island, but there is some doubt about the locality, as he says "On Maria Island, near the entrance of Storm Bay."

PICARIÆ.

11. Cuculus flabelliformis, *Latham.*

Several examples seen along the coast in lightly timbered country not far from the sea (L).

One seen in August in the vineyard near the homestead (M).

Note.—The season for cuckoos had passed when my son visited the island, and so the above was the only species seen. The pallid cuckoo, and probably the bronze cuckoo (*C. plagosus*), are no doubt found here throughout the migratory months, September to March. The occurrence of the Fan-tailed Cuckoo so early as August is remarkable, and would almost indicate that the individual had not migrated.

12. Podargus cuvieri, *Vig. and Horsf.*

The "More-pork" is found near the settlement (B).

PASSERES.

13. Corone australis, *Gould.*

The White-eyed Crow is abundant (L).

It is a disputed point among Australian observers whether there are, or are not, two species of *Corvidæ* in this region, an idea being prevalent that the *brown-eyed* birds are the young. Sharpe, however, in his catalogue, classes the brown-eyed crow as a raven, having larger nasal bristles and a longer first primary, with the nostrils placed in a groove. The type bird of the species presented by the Linnæan Society to the British Museum has these characteristics. The feathers of this latter species, also, are quite white at the base. In my "Systematic List" I entered it on the authority of a specimen in the British Museum presented by Mr. Ronald Gunn, who was a thoroughly reliable collector, but I have not yet had an opportunity of examining a series of Brown-eyed Crows and satisfying myself as to the validity of the species in Tasmania.

14. STREPERA ARGUTA, *Gould.*

Observed near the settlement (L).

It is probable that both species of Black Magpie are found on the island The Hill Crow-shrike is an early breeder in the South, where I have found full-grown young at the end of November.

15. GRAUCALUS PARVIROSTRIS, *Gould.*

A visitant to Maria Island, departing in March (B).

My son did not observe this species in April; it probably leaves the East Coast early in the autumn, though I have seen it in the Domain at Hobart as late as the first week in May.

16. COLLYRIOCINCLA RECTIROSTRIS, *Jard. and Selby.*

Observed in the scrub about Bernacchi's Creek, near the settlement (L).

17. PACHYCEPHALA GLAUCURA, *Gould.*

Found on the West Coast; a specimen procured in peppermint bush on the hills south of the settlement (L).

18. RHIPIDURA SATURATA, *Sharpe.*

The Tasmanian Fantail was observed in numbers near the settlement, frequenting briar bushes and scrub near the creek with the same tame habits which always characterise it (L).

This interesting genus of fly-catchers has an almost exclusive oceanic distribution and numbers a great many species (53), some of which are peculiar to small islands in the Pacific. The most northerly species are the two "Fantails" of India, one of which is the pretty little Ceylonese bird, *R. Albifrontata,* which extends to the N.W. Himalayas. Sharpe has recently separated the Tasmanian bird from the Australian *R. Albiscapa,* on account of its larger size, darker head and throat-collar, and richer under surface. He gives the wing of two specimens as 2·9 against 2·75 in the Australian bird. An example in my collection in the adolescent stage measures only 2·7. The back is dark olive-brown, with broad rufescent tips to the back feathers, and narrower margins of the same on the hind neck and nape; the tippings of the lesser wing coverts are also fulvous. A series of these birds from the North Coast, King's and Flinders Islands would be valuable, in order to determine the question of the gradation or otherwise of our species into the Australian form.

19. PETRŒCA LEGGII, *Sharpe.*

The Scarlet-breasted Robin was not uncommon along the West Coast, and observed near the settlement (L).

20. Petrœca phœnicia, *Gould.*

This Robin is numerous in the western part of the island (L).

This is the most *saxicoline* of the robins in Tasmania, reminding one forcibly of the wheatear in England, and even the stonechat. In its little, quick flights from stone to stone in the open fields, then flitting off to the post of a fence and quickly alighting therefrom on the ground, where it will snap up an insect or fly and devour it on a neighbouring clod, it shows the habits of a true chat.

21. Petræca rhodinogaster, *Drapiez.*

Seen near the "Fossil Cliffs" (M).

22. Petrœca vittata, *Quoy et Gaimard.*

The Dusky Robin is as common on the island as elsewhere; observed about the settlement and in the open bushland along the coast (L).

23. Geocichla macrorhyncha, *Gould.*

One example procured in the scrubs on the west side (M).

This fine Thrush will, no doubt, be found to be common in the mountain ranges of the island. It is probably as numerous on the slopes of Mount Wellington and in the spurs of the range as anywhere in the eastern half of the island.

Mr. Seebohm, our chief authority on thrushes, has united all those species which have a white underwing bar under the genus, *Geocichla,* the type of which is Kuhl's Ground thrush, *G. interpres,* from Java, Sumatra, and Lombock. The genus is a widely-spread one, but not represented in Europe. In Asia it has an Oriental distribution, ranging from Eastern Siberia through Burmah to India and Ceylon, and thence through the Malay Archipelago, where it is well represented, to Australia, in which region it is the only Thrush found, and there exists in the form of three species—*G. Heinii* (North Australia and Queensland), *G. lunulata* (N.S. Wales to South Australia), and *G. macrorhyncha* (Tasmania). Africa is a stronghold of the genus, eleven species being found in that continent. Our bird is at best a sub-species or insular variety of the continental bird, from which it chiefly differs in the large size of the bill; but even in this organ the dissimilarity lies in its stoutness, for the difference in length is scarcely appreciable. The length from tip to gape, straight, varies in eight specimens in my collection from 1·38 to 1·45, and in three continental specimens of *G. lunulata* it is 1·37 and 1·38. The tinting of the underwing bar is almost as buff in the continental as in the insular species, but in the latter the upper surface is darker and the crescentic dark markings broader, particularly on the upper tail coverts. The lesser wing coverts are more conspicuously tipped with ochraceous white in the continental species, and the wing is slightly shorter than in our bird. The wing measurements in the respective series above alluded to are 5·3—5.4 inches, and 5·1—5·3 inches.

The Tasmanian Ground Thrush is an early breeder. Mr. Chris. Adams of the Lower Piper having found a nest with two eggs in that district on the 4th of August this year. A nest was also found on Mount Wellington this year at the end of July.

24. Ephthianura albifrons, *Jard. and Selby.*

This interesting little bird was observed on marshy ground near Long Point, a small flock were frequenting reedy ground near a lagoon (L). Mr. Morton likewise observed it near near the settlement in the beginning of August.

These valuable observations prove that this pretty little chat, which has hitherto been thought to be migratory to Tasmania, is, to a certain extent, resident here, and that Maria Island is one of its winter localities. It is likewise found in the winter on the eastern shores of the Derwent, for my son observed a small flock feeding on the shores of the inlet at Muddy Plains in the latter part of June, and on the 21st of May met with a flock close to Bellerive township. In the summer they are found in many localities along the Derwent where the ground is marshy and covered with rushes, rank tussocks, and small bushes, in which places it builds. In former years, Mr. Edward Swan informs me that it used to make its appearance at Cornelian Bay and bred where the cemetery is now situated. I found it breeding near South Bridgwater in October last, and observed it plentiful at South Arm Neck in November, and in this secluded locality it is doubtless resident. The probably correct hypothesis is that it moves about the country in the breeding season, and is therefore more noticed then than in the winter, its numbers being also increased in the summer by a partial migration from the mainland.

25. Cinclosoma punctatum, *Lath.*

Observed by Mr. Morton in bush on the West Coast.

This pretty bird is erroneously styled a thrush in the colony, but it differs from that family in the structure of its wing, leg, and bill. It is again called a "dove," a terrible misnomer, when we think of the beautiful ground doves that exist in tropical regions. It is no more unorthodox, however, than christening the magnificent bustard of Australia a *Turkey!* The genus *Cinclosoma* is a Papua-Australian one, consisting of ten species, the most northerly ranging of which finds a home in New Guinea, and another, the handsome chestnut-backed ground thrush is a well-known inhabitant of the Murray districts.

The stoutly scaled tarsus, short rounded wing, with lengthened first primary, graduated tail, and conical-shaped bill, distinguish the genus *Cinclosoma* from the thrushes and denoted to be strictly a *Timaline* bird.

26. Stipiturus malachurus, *Shaw.*

The Emu-wren was seen by Mr. Morton.

This pretty little bird is more widely distributed than the ordinary observer imagines, for its skulking habits lead to its being passed over in many districts which it inhabits. A favourite locality for it is the vicinity of damp fern brakes which intersect the open, sparsely-covered wastes near the sea coast.

27. Sericornis humilis, *Gould.*

The Bush-tit is common about the creeks in the bush, a locality in which it is usually found all over the island (L). Mr. Morton likewise found it about rocks near the sea coast.

The inquisitive nature of this little bird renders it very familiar, and in the unfrequented districts of the West it is so tame that I have had it alight close to my feet and hop about, peering into my face in a charmingly fearless manner. The wing in the male measures 2·4 to 2·5 inches, and in the female 2·2

28. Acanthiza diemenensis, *Gould.*

The Brown-tail is common about the creeks along the West Coast of the island (L).

29. Acanthiza chrysorrhæa, *Quoy. et G.*

The Yellow-tail was very common in all suitable localities on the West Coast (L).

30. Acanthorhynchus tenuirostris, *Jard.*

This handsome Honey-eater is found in the heath-covered wastes near the lagoons on the sea coast (L).

The "Spine-bill" wanders from its ordinary haunts when honey-bearing plants are in flower. It is often to be seen in gardens in the heart of the city, hovering about flowers, and flitting actively from branch to branch, its graceful form clinging to a twig while it adroitly inserts its long bill into the heart of the blossom which affords it its favourite food.

31. Melithreptus melanocephalus, *Gould.*

Abundant not far from the settlement (L).

This species is one of the most gregarious of our honey-eaters. I have seen it in the Domain in large flocks during the autumn, the members of which keep up a constant repetition of their cheerful, chirping notes. It is plentiful in the lake district, and on the Western Mountains, and I have seen it at Lake St. Clair and along the track to the King River, where I met with it in numbers in the Valley of the Collingwood.

32. Melithreptus validirostris, *Gould.*

The Strong-billed Honey-eater is numerous in the bush (L).

33. Ptilotis flavigula, *Gould.*

Common in the gum "bush" of the island (L).

34. Meliornis Australasiana, *Shaw.*

Found in abundance in the island (L).

I noticed this honey-eater in vast numbers in the scrub lining the shores of the lower part of Lake St. Clair. Like most of the smaller birds in the West Country it was very tame, flying about in the young honeysuckles near Boathouse Bay within a few feet of the observer.

35. Meliornis novæ hollandiæ, *Lath.*

This showy Honey-eater was seen in the scrub in the creeks running into the West Coast (L).

This species is far less numerous in the south than the aforementioned; but on the North and on the East Coasts it is more plentiful. Its favourite resort appears to be honeysuckle scrub and ti-tree thickets when there are honey-bearing shrubs in their vicinity. In 1868 I procured an interesting Albino of this bird on Mount Nicholas. The yellow parts of the plumage were slightly more extended than in normal examples, and the only dark part was the head, which was pale earth-brown; the throat and chest stripes were paler still, and the back-feathers grey, edged with white; iris, white; bill, pinkish white; legs and feet, vinous brown.

36. Anthochæra inauris, *Gould.*

The Wattle-bird is abundant (L).

Note.—Though the brush wattle-bird was not observed, it doubtless inhabits the island in company with its congener.

Signor Bernacchi informed my son that the Miner was not found on the island. That the commonest form of honey-eater in Tasmania should be absent from an island only separated from the mainland by seven miles of water is a noteworthy fact in connection with the distribution of this species. Like the magpie it is not found in wild districts covered with virgin forest. I saw nothing of it after leaving the part of the Native Tier on the Ouse and Lake St. Clair Road, nor is it found, according to Dr. Holden, at Circular Head. Its absence from the Bass Straits Islands is also probable. Information on this point is very desirable.

37. PARDALOTUS PUNCTATUS, *Shaw and Nodder.*

The Diamond-bird was observed about the open bush lands of the West Coast (L).

38. ESTRELDA BELLA, *Latham.*

The "Firetail" was seen not far from the settlement (L).

39. ANTHUS AUSTRALIS, *Vig. and Horsf.*

The Tit-lark is found sparingly along the West Coast (L).

This bird is found sparingly on the button-grass plains of the west, in which region I observed it in the Cuvier Valley, the Derwent and Navarre Plains, and the Valley of the Collingwood. It was also met with in the King William Plateau, at an elevation of 4,400 to 4,600 feet. It is also found on the Ben Lomond Plateau, which is still higher. In its alpine proclivities it resembles others of its congeners, notably the Indian and Ceylonese pipit, *A. rufulus,* which is found on the highest "patnas" in the island of Ceylon.

40. ARTAMUS SORDIDUS, *Latham.*

The Wood-swallow is not uncommon in the summer (B).

The latter end of September appears to be the time of the wood swallow's arrival in the south of Tasmania, and its departure takes place at the end of April.

COLUMBÆ.

41. PHAPS CHALCOPTERA, *Latham.*

The Bronze-wing was observed by Mr. Morton on the West Coast, near the homestead.

The Brush Bronze-wing is doubtless found on the island as well as the larger species.

GALLINÆ.

42. SYNOICUS DIEMENENSIS, *Gould.*

The swamp quail is common on the west side of the island (B).

43. SYNOICUS AUSTRALIS, *Latham.*

The Brown Quail of Australia, or the smaller of our two species of "brown quail," is also said by Signor Bernacchi to be found on the island. I have not as yet been able to ascertain properly the distribution of this bird in Tasmania. Most of the quail

I have seen killed in the south of the island up to the present time are of the larger species, known as the Swamp Quail, and they have been in all probability shot in damp, rushy localities; and those I have seen in the Longford district on similar tracts of land have been the same. The smaller Brown Quail is usually found in fern brakes, and grassy, open bush-land.

44. Hypotœnidia pectoralis, *Cuvier.*

A Rail answering to this species is stated by Signor Bernacchi to be found on the lagoons at the "Neck," and Mr. Morton observed it in the same locality.

Very little appears to be known of the distribution of the rails and water crakes in Tasmania, for their skulking habits render them difficult of detection so far as the casual observer is concerned, and it is only those who lay themselves out for systematically collecting birds, who succeed in finding them.

GRALLÆ.

45. Gallinago Australis, *Latham.*

The Australian snipe is found in suitable localities on the island during the season of its visitation to Tasmania (B).

It is a singular fact that the snipe is decreasing in numbers in Tasmania; the country is doubtless not as suited to its habits as in former years, when swamps and favourite marshy feeding grounds were in their primeval state; but there are many tracts of land fit at the present time to hold numbers of snipe, and to which one would think that they would stray on their arrival. Nevertheless they fail to appear in them, and the common lament of the sportsmen is that the snipe are getting scarce.

It is possible that the partial spoilation of their feeding grounds all along the line of their migration on the East Coast of Australia, may tend to divert the "stream" from its original course, and Tasmania, lying at the end of that course, would naturally suffer. The breeding grounds of the species, as at present known, are the islands of Japan, and its migratory course is past the Coast of China and the Phillippine Islands to Australia, and thence down to Tasmania, a distance of 5,000 miles. It is no wonder, therefore, that any change in the features of the country which forms the extreme limit of its wanderings should tend to make it stop short of it, and perhaps content itself by seeking new feeding grounds *en route.*

The snipe procured by Gould at Port Essington, and which he alludes to as being smaller than the Tasmanian bird, with eighteen tail feathers and the four lateral ones on each side attenuated appears to be the Chinese snipe, *S. Megala,* which breeds during the northern summer in S.E. Siberia, and winters in the Malay Archipelago (Celebes and other islands), probably extending to the North Coast of Australia. The above are the characteristics of this snipe, which is smaller than the Australian snipe (wing, 5·6 inches against 6 to 6·7 inches), though very similar to it in plumage, while the latter bird has only two narrow feathers on each side of the tail.

46. Numenius cyanopus, *Vieillot.*

Found on the coast of the island (B).

The Curlew appears to remain in small numbers through the winter in the South of Tasmania, for my son saw an example at Muddy Plains in July last.

47. Ægialitis monacha, *Geoffrey.*

The hooded Dottrel was obtained in Oyster Bay on the Five-Mile Beach (L).

This species is doubtless as common on the island as on the shores of the mainland. The plumage of the young, which is cursorily referred to by Gould, is as follows:—Head and hind-neck, back, and wing coverts brownish-grey, the feathers of the head narrowly margined with whitish, the remainder of the feathers of the upper surface with crescentic margins of brown and a dark shaft mark; wings as in the adult, tail with the outer white feathers tipped black, and the centre black feathers tipped white; the dark longer upper tail coverts tipped with white; the entire under surface with the hind-neck collar, white; bill darkbrown, yellowish at the base; legs and feet paler yellow than in the adult (February specimen).

Gould says that the female has the crown mottled with black and white; but this stage of plumage is not a normal one, as it testifies to a change occurring in the coloration, and I have female specimens carefully sexed in the same dress as the male, and in one of which two eggs in the duct were half formed.

48. Ægialitis Ruficapilla, *Temm.*

This Dottrel was observed on the beach at the Neck (L).

An early breeder. I found young birds on the 7th November at South Arm Neck, so that the eggs must be laid at the end of September. The foregoing species lays in December on the East Coast.

49. Ægialitis bicincta, *Jard. and Selby.*

One specimen procured at the Five-mile Beach (L).

This Dottrel is apparently migratory to this colony. It appears in March, remaining until July, and perhaps later; and at the time of its arrival it is mostly in young plumage, or with the adult bands in an imperfect state, which seems to indicate that there is a change of colouring after breeding. The dress is, however, so variable, that unless a large series of specimens were got together, shot at all times of the year, the changes could not properly be worked out.

The plumage of the young bird in April is as follows;—Head, hind neck, back, and wings, earthy brown, the feathers of the back with narrow rufescent edgings; the scapulars and wing coverts more conspicuously edged than in the adult; forehead whitish, grading into the brown of the head; throat and under surface white, tinged with buff more or less beneath the ear coverts; a more or less incomplete brown band across the upper part of the chest, in some only a brown wash; legs and feet dark olive-green. As time goes on the brown pectoral band becomes darker, and in May blackish feathers, tipped with white, are acquired; at the same time the surface feathers of the lower band begin to appear and may be found lying beneath the white plumage. In June specimens are procurable with the black band showing a want of uniformity on account of the feathers being pale tipped here and there, and the rufous band the same owing to the white tippings. At the end of July, by a change in the feathers the bands become uniform and well defined. During this time the forehead bar and the loral stripe extending beneath the eye and down the neck to the band have been developing and becoming black. An examination of a large number of specimens has led to this diagnosis which, I think, in the main will be found correct, but it is probable that "birds of the year" never get the deep chestnut band in its completely uniform state.

The double-banded doterel frequents inland districts and is common at the Salt Pans on the Mona Vale Estate from March until July, and perhaps later. Wing in adult males 5·0 to 5·2 inches.

50. Hæmatopus longirostris, *Vieillot.*

51. Hæmatopus unicolor, *Wagler.*

Both oyster-catchers met with, the White-breasted at the Neck and near the Settlement, and the Black near the latter place (L).

GAVIÆ.

52. Sterna poliocerca, *Gould.*

A single example seen near Penguin Island (L).

The so-called "Bass Straits" tern is common in the Derwent from August until midsummer. It breeds down the Channel and at the Little Actæon Islands, but it is apparently more abundant in the Straits than in the South, breeding on many of the islands in the former. I have entered this tern in my systematic list as *S. poliocerca*, not with the idea of reversing my opinion given at page 1,027 of the "Birds of Ceylon," where I agreed with Mr. Saunders, our chief authority on these interesting birds, that it was identical with the Indian Ocean crested tern, *S. Bergii*, but in order to retain it *for the present* as a local race or sub-species under Gould's name, *S. poliocereca*. Terns of wide range vary much in size, and the Bass Straits tern is the smallest form of the Crested tern of Indian seas, the gradations in size, however, in specimens from various localities being so regular that the Southern bird is not considered by Mr. Saunders to hold its own as a distinct species. When examining the specimens in his collection I found *S. poliocerca* to range as low as 12·75 in the wing against 15·12 in the largest specimens from the Persian Gulf. Since coming to Tasmania I have procured a fully adult specimen with a wing of 12·0, and I find that the bird is different in its note and habits from the Indian tern, and that its plumage is beautifully suffused with rose colour on the under surface—a feature not observed in specimens of true *S. Bergii*. Should individuals from all parts of Australian seas show the same small size, I am of opinion that *S. poliocerca* may stand as a distinct species.

STEGANOPODES

53. Sula serrator, *Banks.*

Observed and obtained between Spring Bay and the island (L).

It is a matter of conjecture where this gannet breeds. It is in the Derwent nearly all the summer, and is not known to breed anywhere on the south coast.

54. Phalacrocorax leucogaster, *Gould.*

Common all along the coast (L).

This Cormorant breeds abundantly south of Hobart; large colonies nest at Cape Frederick Henry (Bruni Island), and at the Blanche Rock, near Southport.

55. Pelecanus conspicillatus, *Temm.*

Observed occasionally (B).

ANSERES.

56. Cygnus atratus, *Lath.*

Seen in Oyster Bay (L).

S. Bernacchi says the swan breeds in the lagoons, and is not uncommon in the island. Mr. Morton found it nesting in August on a lagoon on the Western side of the island. The nest was composed of a mass of lily leaves and aquatic plants, collected together so as to form a vegetable island in the lagoon. The male bird kept guard a little distance off, while the female was occupied with the duties of incubation.

57. Tadorna tadornoides, *Jard. and Selby.*

Found occasionally on the lagoons (B).

58. Anas superciliosa, *Gmelin.*

Abundant at the mouths of creeks on the West Coast and on the lagoons (L).

59. Spatula rhynchotis, *Lath.*

Observed on the lagoon (M).

60. Anas castanea, *Eyton.*

The teal was also observed on the lagoons near the "Neck" (L).

61. Biziura lobata, *Shaw.*

The musk duck was seen on the lagoons at the Neck (L).

HERODIONES.

62. Ardea Novæ Hollandiæ, *Latham.*

Seen at the lagoons (L).

The White-fronted Heron frequents the foreshores of shallow salt water inlets as well as fresh water lagoons and rivers. The large fresh water mussel is a favourite diet of this bird; it appears to open the bivalve at the hinge, as the shells are found unbroken after the fish has been devoured.

63. Botaurus poicilopterus, *Wagler.*

The bittern is not unfrequently found in the swamps on the West Coast (B).

IMPENNES.

64. Eudyptula minor, *Forster.*

The Little Penguin is abundant,and breeds at Penguin Island off the North Coast (L).

Note.—Eudytula udina, *Gould.* The Fairy Penguin is probably found here as on other parts of the Tasmanian Coast.

DIAMOND DIGGING IN SOUTH AFRICA.

By James Andrew.

Mr. President, — I feel that some apology is necessary for introducing a subject quite foreign to Tasmania, and which I am unable to treat scientifically, but, as few people, except those who have visited the diamond fields of South Africa, can accurately appreciate the most important part the digging industry has played in promoting the welfare of the country, a brief but very imperfect sketch of the mines, and of the method of working them, may prove of interest. Diamonds may yet attract much attention in Australasia as they have been found in four of the five continental colonies and also in New Zealand, and they are now being systematically sought for with profit to the diggers in the northern part of New South Wales. I may add that my paper has been prepared, not from notes as a casual visitor to the fields, but from the experiences of more than two years as a digger and prospector, and as an official intimately connected with diamond mining as there carried out.

That portion of the British possessions in South Africa, generally known as the "Diamond Fields," or Griqualand West, was, at the time of the first discovery there of precious stones, under the rival jurisdiction of two native chiefs, Adam Kok and Nicholas Waterboer, the latter of whom received recognition of his claims to the sovereignty of the territory in the shape of a pension from the Imperial Government, awarded as compensation for the annexation of his country. An additional claim was, however, made by the adjoining republic of the Orange Free State to the area enclosed between their existing western boundary and the Orange and Vaal rivers, on the latter of which, and in its immediate neighbourhood, the first diamond diggings were established. During the stirring times following the discoveries of 1870, the Free State Government exercised such authority as they were able over the various mining camps on the Vaal; attempts which were treated with derision by the hardy and independent diggers. Soon the impossibility of the territory being properly governed by such means, and the absurdity of the Chief Watertoer's efforts in a similar direction over the area claimed by him, led to the hoisting of the British flag in the year 1871, and the proclamation of the Imperial Province of Griqualand West.

For some years the Government of the Free State ventilated their grievances in being thus deprived of a valuable piece of country, and the justice of the claim was admitted, as the sum of £90,000 was awarded by Her Majesty's Government as indemnity, and concessions were arranged as to the direction of certain railways then proposed for construction in the Cape Colony, and since completed, with which it was desired to ultimately connect projected Free State lines.

From 1871 to 1880 Griqualand West remained under Imperial control, and in October of the last-named year the Province was annexed to the Cape colony, a measure which met with much opposition from most of the influential residents on the Fields. The area of the Province is 17,800 square miles, and the population is estimated at about 50,000.

The first diamonds found in South Africa were in alluvial ground on the banks of the Vaal River, and the principal rush of the early days was at Pneil, a mission station of the Berlin Missionary Society. A large population rapidly accumulated at this point, and at various diggings or "rushes" along the course of the river, both above and below the station, for a distance of 70 or 80 miles. Good Hope, Bad Hope, Gong Gong, Waldek's Plant, Cawood's Hope, Niekerk's Rush, and Blue Jacket, Esterhiuzen, Longlands, Delport's Hope, Hebron, etc., all supported a considerable number of diggers, 4,000 claims, each 30ft. square, being at one time worked at Cawood's. As the necessary appliances were comparatively inexpensive, the right and means to search for diamonds were within the reach of almost everyone. At the present time a river digger's outfit usually consists of a few very simple appliances. A "baby," an oblong sieve about 6ft. by 3ft., of very fine mesh, so arranged in a stout frame as to oscillate freely, and inclined to allow the gravel to roll down it, is a necessity. At the upper end of this "baby" is fixed a small sieve coarse enough to pass pebbles of ½in., into which the ground is fed by hand, whilst the worker swings the apparatus backward and forward, and thus removes all sand and separates the larger stones, which are glanced over before being thrown on the *debris* heap in the hope of making a big find. "Babying" is a most noisy and very dusty process.

Many diggers still use the cradle, almost identical with that used in primitive gold mining districts, but after the introduction of the gravitating process, it was generally dispensed with. Some large tubs are required, and, of course, picks, shovels, crowbars, etc., and a mule or bullock cart for the conveyance of water to the claims or of diamondiferous ground to the river, as might be more desirable. Steam machinery has for some years been used for treating alluvial ground in the search for diamonds, but the principle of sieving, sizing, and washing is practically the same as in the process by hand. It was by means of steam power that I carried on the digging operations in which I was interested during my residence on the Vaal River. The gravitating process is of comparatively recent introduction, old style digging providing for no treatment between the "baby" or the "cradle" and the sorting table, much to the advantage of the more experienced men of the present time who work over the *debris* with advantage.

Gravitation consists of the manipulation of the gravel in hand sieves. About two shovelfuls are treated at once, the sieve being worked with a circular and vertical motion in a tub of very dirty water, clean water for some unexplained reason not being suitable. The gravel is kept "alive" during the process, and this has the effect of depositing all the heaviest particles at the bottom, and in the centre of the sieve, which is of very fine mesh. It is usual for the operator to place one or two small diamonds in each sieveful of gravel as test stones. An iron table is used for sorting purposes, and on to this the contents of the sieve are capsized with a practised swing, which does not disturb the relative position of the pebbles. All diamonds, including, of course, the test stones, should now be exposed on the surface, and in the centre of the mould of gravel, any failure in this respect requiring the operation to be repeated. The whole of the contents of the sieve are, however, sorted over, a scraper of hoop or sheet iron being used for the purpose, but it is seldom that all the diamonds are found in this first sorting. The process is almost invariably repeated, often twice. The man gravitating, after being at work for some time, may lose the peculiar knack requisite for the success of the operation ; the test stones are missed, and a rest is necessary, or a fresh hand is obtained before the work can be continued.

In the year 1871 diamonds were found some 25 miles distant from the river, near a shallow pool of water or "vley," known as Dutoit's Pan, and from the early method of dry sorting the ground at this, and the other mines subsequently discovered these, the largest diamond mines in the world, received the name of the "Dry Diggings." Dry in those early days of their history they must assuredly have been. Clouds of dust from innumerable "babies" rose in the air to a great height, and involved everything in dim obscurity. Dust and heat, plagues of flies, and the much dreaded camp fever, scarce and bad water, short supplies of provisions were discomforts and drawbacks the early diggers in this new field had to endure in their search for wealth, but the evidences of reward for the energetic soon brought a large population together, and with population, more substantial dwellings, better supplies of food, etc., soon improved the condition of affairs. The largest and most productive of the four Griqualand mines, Kimberley, or Colesberg Kopje, sometimes even at the present day known as the New Rush, was accidentally discovered when negotiations for the purchase of a farm called "Vooruitzigt," upon which diamonds had been found on the site of the present De Beer's mine were in progress. The owner of this property, a Dutchman named De Beer, received £6,000 for his land, some 6,000 acres, but the purchasers, Messrs. Dunnell, Ebden and Co., a Port Elizabeth firm of merchants, a few years later came into collision with the diggers over the collection of claim licenses, and found it prudent to dispose of their property to the Government for £100,000. As, up to the end of 1885, the yield of diamonds from this mine alone had exceeded 17,500,000 carats, equal to three and a half tons weight of these precious stones, in value about £20,000,000, the State cannot be considered to have made an unsatisfactory purchase. The other large Griqualand dry mines are De Beer's, situated about a mile from Kimberley, and Dutoitspan and Bultfontein, about two miles beyond, thus a circle of three and a half miles in diameter would enclose the group. The two last-named mines are of great extent, but the average value of claims is very much below that of Kimberley. Calculations show that, from the known average yield of the ground in each mine, it may fairly be estimated that 10 tons of diamonds have been raised since they were discovered, of value certainly not less than £45,000,000 to £50,000,000. There is also a dry mine in the Orange Free State at Jagersfontein, which has maintained a small yield for many years, and many other localities have attracted some attention for a time, but without much profit to those working at them.

Diamonds in the early days of the dry diggings were found in what was known as "yellow ground," all of which was removed years ago, and with the characteristics of which I had no opportunity of becoming personally acquainted. Claims of 31ft. square (30ft. Dutch measure), were sub-divided into sections of even so small an area as an eighth, and were worked under this multiplied ownership, much to the advantage of the mining community. At this time the Diamond Fields probably supported a larger population than at any other period, the number of natives employed in the Kimberly mine alone being over 12,000.

The system of working was almost similar to that in vogue on the river, but necessarily performed without water. The ground was sorted on the very brink of the mines, and the *debris* accumulated there in great mounds; afterwards worked again under more careful management to considerable profit. At a depth of some 80ft. to 100ft. a change in the character of the ground led to the belief that the mines would soon be exhausted, some of the claimholders who had sunk deeper than their neighbours having "bottomed" on hard rock. It was ascertained, however, that this rock, or "blue ground" (the name by which it is locally known is "blue") when exposed to the air and moistened at intervals by rain or artificially, decomposed in a similar manner to the more friable yellow ground, and the *debris*, when sorted, was found to contain diamonds. This was the commencement of the most prosperous mining days of the province. Improved appliances were invented for treating the ground after disintegration, powerful steam engines were erected to pump the water out of the mine, and haul the rock as blasted and picked out to the surface, and the industry, owing to the excessive cost of machinery and the high price of skilled labour, soon became too extensive for any but the wealthiest private claimholders to cope with, and amalgamation of many proprietary rights led to the formation of companies, and a systematic method of working and management by which the resources of Griqualand, in this direction, were fully developed. The surface of the country in the neighbourhood of Kimberley is covered with a red sandy soil seldom more than a few inches in depth. Beneath this there is a thin layer of superficial limestone, and then occurs what is known as the upper reef—a yellow shale extending to a depth of 35ft. to 40ft. This is succeeded by a black carbonaceous shale of from 250ft. to 280ft., under which is found unstratified basaltic rock which encircles the whole mine. At De Beers the basalt appears in a layer of about 75ft. in thickness on top of the black shale, and as the latter, where exposed to the action of the weather, decomposes very rapidly the overhanging hard rock, until cut back from the margin, is a continual source of danger to those working in the mine.

Dr. Shaw, of Colesberg, an eminent geologist, has stated that Syenite may be considered the basis of the rocks in the diamond fields district, granite only occurring in isolated boulders, and minus the micaceous portion of the compound. He also states that there is no evidence to show what may be looked upon as the true matrix of the diamond, but considers the production of these precious stones is not due to any rock more recent than greenstone. Elaborate analyses have been made of the "blue" ground which has proved of such wonderful value, but its precise nature still seems doubtful. It is described as a hydrous magnesian conglomerate with silica as a base. Thin veins of calc spar are of frequent occurrence, and vaalite, mica, iron pyrites, and hornblende are found disseminated through the diamond bearing rock, besides fragments and masses of shale, sandstone, and boulders of dolerite. The generally accepted theory is that the "blue" has filled the crater or funnel of an extinct volcano, which now forms the mine, and that it has been upheaved from a vast depth, the diamonds themselves being of earlier date than the upheaval. Coal has been found in the immediate neighbourhood of the Kimberley mine, and remains of plants and of extinct reptiles are frequently to be met with in the deposits of shale.

The area of the mine originally enclosed within the surrounding rock was about 11 acres, but as this reef has been removed, a course necessitated by the increased depth of the workings, the surface area has been extended to about 30 acres. The greatest depth to which the surface working of the mine has extended is 450ft., but underground excavation has had to be resorted to, owing to the continual slipping of the loose slate or reef. In the year 1883, the whole of the diamondiferous ground was covered in this manner to a depth, in parts, of over 100ft., and it was estimated that the cost of clearing the mine would be, at least, £2,000,000. Up to this time, over £1,500,000 had been spent in connection with this difficulty, and several successive contractors had failed in their efforts to cope with it, and as now the Banks refused further assistance to the Mining Board, it was predicted that the mine was ruined. The result was a crisis on the fields, which coupled with a great fall in the price of diamonds, was most disastrous for speculators.

Two methods of underground mining have been adopted, in one case shafts are sunk from the surface, at some distance from the margin of the mine, and tunnels driven through the hard basaltic rock, which is found at a depth of 250ft. to 300ft., into the "blue ground." The "Jones' system" as the alternative method is called, after its inventor, is to sink shafts on the coffer dam principle through the loose reef to the "blue," after which they could easily be extended and the ground excavated. This system, however, seems to have had but a brief period of success, as continual reef movements wreck the shafts, and destroy all means of access to the valuable solid rock. It may be surmised then that the prestige of Kimberley as the most wealthy diamond mine in the world is, for a time at least, eclipsed, as the yield from De Beers has exceeded the amount there raised for the last three or four years. In the days of its greatest prosperity the Kimberley mine contained 420 claims, each of 31ft. square, and 600,000 loads of blue ground were annually raised to the surface and put through the washing machinery; a load being equal to 16 cubic feet. The value of the mine was estimated at £5,000,000. It is difficult for anyone who has not had an opportunity of seeing this wonderful excavation to form an idea of the immense amount of work which has been done in a few years' time. As its name of Colesberg

Kopje implies the locality was originally a hill, and from its site 20,000,000 of tons of diamondiferous ground and the surrounding rock have been removed. Work of almost similar magnitude has been simultaneously carried on at the three other mines, each but little inferior in depth to Kimberley, and two of considerably greater area.

The "blue ground," composed of pebbles and stones of various kinds cemented together by a silicate of alumina or lime, is of varying degrees of hardness in the several mines, and frequently varies very much in quality in different sections of the same mine. It has first to be loosened by blasting, and then, after being broken with large hammers and heavy picks into pieces which can be handled, it is hauled to the surface for future treatment.

The hauling gear is of most ingenious construction. A complete plant, consisting of a double ærial tramway, each division or line being constructed of two stout wire cables on which travels a frame or four-wheeled carriage, bearing a large iron tub, slung on trunnions, of a capacity of about 30 cubic feet. As the sides of the mine are inclined at varying angles, and the tramway may for some distance be either nearly perpendicular or nearly horizontal, the slinging system is a necessity.

From the large hopper receptacles, into which the "blue" is received on the surface, trucks are filled and run on lines of railway or trams to the outskirts of the camp. There being spread over the surface of the ground, exposed to the disintegrating action of light and weather, the "blue" remains until fit for treatment in the washing machinery, the time varying from some two or three weeks, under favourable circumstances, to so long as three months.

The depositing floors are of great extent, a single company often having 5,000 or 6,000 loads under treatment, and land for this purpose was difficult to obtain within a reasonable distance of the mine.

Large lumps of "blue" are frequently broken up with hammers. I believe steam stone crushers have even been used for the purpose, and rollers, clod crushers, and harrows, etc., intended for agricultural pursuits, have been brought into requisition for pulverising the ground. The boundaries of the floors are marked by beacons and by walls built up with refractory lumps of "blue" used with the dual object of vacating valuable floor room and facilitating the desired result by increased exposure. Careful watch has to be kept over the natives employed in spreading and loading the ground on these floors, as many of the finest diamonds are frequently found there, as well as in the primary operations of blasting and picking in the mines. Lumps always separate more readily at the spot where a large stone is embedded than elsewhere. One white man is usually placed in charge of from every five to ten natives, with the sole duty of keeping watch against theft. The fine gravel which results from this disintegration of the "blue" is next treated in circular rotary washing machines, to which it is fed through revolving cylindrical screens of graduated mesh, so as to remove any remaining lumps. Several arms fitted with knives or scrapers rotate in the washing machine, and stir up the diamondiferous ground mixed with water, which enters through an opening in the outer edge of the machine. The lighter stuff comes to the surface, and floats away through an aperture in the inner rim, and the heavier gravel falls to the bottom of the pan. The inner circumference of the pan is usually about 12ft., and the outer about 45ft. The mud, or "tailings," escaping through the centre is raised by elevators, the water coming into use over and over again, and the more solid portion going to waste. When the machine is stopped the residuum is either washed in a "cradle," or treated in a pulsator, a machine constructed to perform the process of gravitation previously described. The final sorting is identical with the method followed on the river diggings, but the stones remaining in the larger meshed sieves of the cradle or pulsator are merely glanced over, as a sorter, however inexperienced, would hardly fail to notice a diamond of such size as they would retain. The resulting *debris* is generally sold by the proprietors to private individuals, and is again carefully gone through by women and children, who are often amply rewarded for their trouble by the small stones which have been missed on the sorting table. After rain diamonds are occasionally found in the streets or in paths which have been repaired with material of this nature. A complete plant for raising and washing diamondiferous ground cannot be put up for less than £25,000.

Diamonds in the rough as found in the Griqualand mines are generally perfectly bright and clear, free from any coating of silica, such as I believe sometimes encrusts stones found in other countries. They are more varied in quality, colour, and form than is generally supposed. A white stone of 10 carats weight (151½ carats=1oz), or upwards, of perfect purity, free from speck or flaw of any description is by no means common ; such stones have, or had, up to the time my acquaintance with the diamond market ceased, suffered no depreciation in value, whilst those of an inferior quality, had within some twelve months, fallen 50 per cent., and as inferior and small stones are what a digger used to depend upon to pay his working expenses, the great and universal depression on the fields in the year 1883 was chiefly due to this quite unexpected fall. Spots in diamonds are of very frequent occurrence, and it is by no means an easy matter to decide as to the amount of depreciation in value they occasion. The stone may be split or the spot cut out, so as to leave the diamond as perfect and of the same size it would have been when cut had no such blemish existed; under other circumstances it may be comparatively valueless. Buyers are naturally averse to admit that a spot may be anything but a serious defect in a stone. At the river diggings water-worn diamonds resembling ground glass in appearance are common, and are frequently difficult to distinguish from other pebbles. For many months I carried about a stone of this description of the size and shape of a small marble, and saved only on acount of its peculiar form, which ultimately proved to be a diamond although of inferior quality. The majority of stones found are in the form of an octahedron, and of modifications of that shape. Many have all the angles almost as sharp and well defined as in cut stones. Some bear peculiar triangular marks on their facets as if they had been built up in layers. Macles or flat triangular stones are also common, but are of little commercial value, and curious combinations of maces are occasionally met with, but they are only interesting as specimens. I have heard of the discovery of one hollow diamond, but do not recollect its size, and Mr. Streeter, in his work on precious stones, mentions a white diamond in which is enclosed a small yellow stone.

Colour, or rather absence of colour, is almost of more importance in determining the value of these precious stones than freedom from specs or flaws. Yellow is the commonest tint, and it is a general, but very mistaken belief, that all Cape diamonds are more or less tinged with this colour. Yellow stones are frequently of great brilliancy and fire, and by some are admired more than the purer gems. They are found of all shades from a pale straw colour to deep orange. The Dutoitspan mine is remarkable for its yield of large yellow stones. Brown and grey diamonds are often of great beauty, and in purer coloured stones the various tints are known as "Cape white," "bye water," "off colour," etc. Blue, green and pink tinted diamonds are not uncommon, but are seldom looked upon with any great amount of favour unless of exceptional quality and brilliancy, and depth of tint, when their rarity and beauty warrant a specially enhanced price being asked. Such a stone was in the possession of a Dutch canteen keeper on the Vaal River, and it was one I had many opportunities of examining. The colour was a tawny orange red or flame colour, quite distinct from the ruby tint of ordinary red diamonds. When cut it weighed about two carats, and the fortunate owner stated he had refused £600 for it, an instance of an exceptional estimated value, as a pure white diamond of equal size would not be worth more than a twentieth of that sum. Some of the diamonds found in the Dry Diggings develop strange and very disappointing peculiarities. A stone when first found may be remarkable for its fire and great brilliancy. After a few hours' exposure to air and light a faint flaw appears, this gradually spreads and radiates, until, perhaps by the following morning, the diamond may be found burst into a hundred fragments. A suspected stone is often parted with at a very low rate, resold almost immediately, if an unsuspicious buyer can be found, who may shortly find himself the possessor of unsaleable chips. Various expedients have been recommended as precautions against this unprofitable dissolution, and it seems generally accepted that protection for some time from air and brilliant light is necessary. Immersion in honey, treacle, or grease is supposed to have a beneficial effect. Fortunately these stones are not common.

Boart is a term locally descriptive of comparatively valueless stones or fragments of black, brown, or grey diamondiferous substance irregularly massed in one specimen ; 2s. 6d. per carat was the ruling rate for "stuff" of this nature on the fields, and it is principally used, ground into powder, for polishing valuable stones.

Many diamonds of note have been raised from the Griqualand mines. The largest of which there is any authentic record is one of 457 carats ; rumours of the discovery of this gem were current in the fields more than four years ago, but accurate accounts were not to be then obtained, as the stone was an "illicit" or stolen one and the receiver was serving a sentence for other irregularities in connection with the contraband purchase of diamonds. It was afterwards bought by a syndicate of diamond merchants, and they estimated it would cut, as a brilliant, to about 220 carats, or in another form to about 300 carats. In size, colour, and purity it was expected to prove the most marvellous stone ever known, and I believe this was the diamond it was proposed to present to Her Majesty in commemoration of her jubilee. Three celebrated stones, the Koh-i-nur, Regent of France, and Orloff diamonds, weigh respectively 106, 136, and 195 carats. There are many of much greater weight, but they are badly cut, blemished, or off colour stones of relatively small value.

Another South African gem of some notoriety is the "Porter Rhodes" diamond. This is a stone of 150 carats weight, of great purity. It was found in the Kimberley mine in 1880, and even in that land of diamonds, over £500 was paid by spectators admitted to see it before it left the fields. Mr. Rhodes refused an offer of £60,000 for his find, but subsequently discovered the difficulty of disposing of so large a stone. He had been a digger for only a very limited time, and his fortune was made in a claim which had been long unremunerative.

The first really valuable diamond from the Cape was the Star of South Africa, which, when found, was 83½ carats, and now weighs 46½ carats, and is valued at £25,000. It is in the possession of the Countess of Dudley. The "Stewart" is another large stone of great beauty. It is of a faint yellow tint, and weighed uncut 288½ carats, or nearly 2oz. The "Schreiner," 308 carats, still remains uncut, and its value unascertained.

It is almost impossible for anyone who has been absent for a length of time from the fields to attempt to give an accurate idea of the price of diamonds of any particular size, except in the case of such small "stuff" as is quoted in the market reports. Averages alone can give an impression of the rates ruling the diamond market. The yield of the Kimberley mine for three years, amounting to 2,500,000 carats, brought 19s. 3d. per carat, whilst during the same period the average price of De Beer's stones was 20s. 6d., and those from Dutoitspan brought 27s. 9d. per carat. The diamonds imported into Kimberley, being principally the finds from Jagersfontein, in the Free State, and parcels returned for sale, brought the highest price of all, viz., 32s., and the grand average was 23s. 2d. per carat for 8,000,000 carats. There is a most disproportionate and arbitrary increase of value in large stones, and they are often most difficult to dispose of. The buyers describe them as speculative, and as they frequently combine to refuse the probably moderate sum asked by the vendor, it is not unusual for such diamonds to be sent to Europe or to India for sale. Of my own finds, the highest price I obtained was for a wonderfully pure, well-shaped stone of 3 carats, viz., £10 per carat, the largest stone was 39 carats, evidently a chip from one of, at least 200 carats, this realised £254, and if free from blemish would have brought 20 times that price.

No ex-resident of Griqualand can consider any description of diamond mining industry complete without, at any rate, brief mention of the chief drawback to the profitable carrying on of the work, under which all suffer alike. The theft and illegal sale of diamonds has had at times almost a paralysing effect on digging, for, previous to the introduction of the system of searching all—natives and even white men—when leaving the mines, it was estimated that 50 per cent. of the total yield of the province was stolen, and disposed of to illicit diamond buyers (I.D.B's.), and even now, in spite of the strictest precautions the detective returns speak of the usual 25 per cent. to be added to the estimated yield for the diamonds illicitly sold.

NOTES ON THE NEW HOBART STORAGE RESERVOIR.

By T. Stephens, M.A., F.G.S.

As the New Storage Reservoir will probably be completed before the next evening meeting of the Royal Society, I submit some remarks upon the geological conditions of the locality, based upon notes made at various times during the progress of the works. In a paper read before the Society on the 11th of September, 1877, on the causes of the failure of the dam of the old reservoir, I mentioned incidentally that another fault, in addition to those then under consideration, crossed the valley of the Sandy Bay Rivulet close to the upper end of the reservoir. In the following year I visited the place in company with the members of the Waterworks Committee to inspect the site selected by the Corporation Engineer for the dam of the proposed new reservoir, on which a good deal of work had already been done, and which proved to be at that part of the valley which I had described as being traversed by a great fault. A cutting had been made into the mudstone rock on both sides of the rivulet, and a shaft sunk to a depth of about 40 feet in its bed, with the object, I believe, of ascertaining whether the character of the rock was such as to serve for a good foundation; but all the information thus obtainable might have been readily gathered from an examination of a few of the sections exposed in road cuttings or otherwise, where an opportunity is afforded of studying a far greater thickness of the beds of the mudstone series.

The two points at which I had noticed signs of a break in the formation were about half-a-mile apart, and the intervening rocks were at that time too much obscured by surface soil and low scrub to enable one to trace its direction with accuracy. The evidence, however, was too strong to be set aside, and after another look at the country, I had no hesitation in informing the Waterworks Committee that the fault previously described must cross the valley near where the shaft was being sunk, and that it would intersect the line of the dam not far from the S.E. end of the open cutting. Whether a secure dam could be constructed under such conditions would depend on the character of the filling of the fissure produced by the break in the rocks, and to test this point I recommended that the cutting should be extended for a short distance in a S.E. direction, by which means the question of security could be set at rest at a trifling expense.

The engineer, however, preferred to try the ground at a lower level, and tunnels were driven from the bottom of the shaft towards the N.W. and S.E. respectively, for 45 feet each way, the mudstone being continuous for that distance. It is, perhaps, just as well that this mode of testing the ground stopped where it did. Had the S.E. drive been continued for about 20 feet it would have broken into the fault, and an additional element of insecurity would have been imported into the affair.

When matters had arrived at this stage the works were suspended. When they were renewed in 1885, under the management of the present Director of Waterworks, the open cutting was extended, and, on cutting down to the rock at the point which I had indicated, a vertical fault crossing obliquely the line of excavation was clearly exposed. The break in the rocks constituting the fault was about three feet wide, with a well defined wall of mudstone on one side, and of soft sandstone on the other, the remaining portion of the cutting being through the latter rock. The fissure, instead of being partly open, or loosely charged with angular fragments of rock, as very commonly happens, proved fortunately to be well and compactly filled with finely comminuted material from the bounding rocks intermixed with vertical bands of black clay. As a foundation for a properly laid puddle wall it might be considered at least equal to that afforded by the mudstone; and though a better selection of a site might easily have been made in the first instance, there was no sufficient ground for incurring the large additional expenditure that would have been entailed by abandoning works on which so much money had been spent. To describe the progress made from this stage with the construction of the embankment and the other extensive works connected with the formation of the reservoir, is for the engineer rather than the geologist, and I believe that a full account of the undertaking will be written by a more competent hand than mine. Having had to criticise somewhat unfavourably the planning and construction of the old Storage Reservoir, I am glad to have an opportunity of testifying to the sedulous care and skilful management with which the physical difficulties of the situation have been met, and which have set at rest all doubts that might otherwise have been entertained as to the permanent success of this important work.

The excavations at the new reservoir have not added anything new to the geological record. The so-called "mudstone" to which reference has been made is, in South-Eastern Tasmania, the highest member of the Upper Palæozoic marine series, of which some representative beds are found in almost every district. The ridge to the N.W. of the old Storage Reservoir consists entirely of this rock. The beds dip somewhat sharply to the east, the whole mass of the ridge having been tilted by a movement independent of those which have affected other portions of the marine beds of the immediate neighbourhood.

Next in order above the mudstone are thick bedded sandstones, which furnish most of the building stone for which Southern Tasmania is famed, but this rock has been entirely removed by denudation from the ridge in question, though it is seen in its normal position to the S.E. of the Sandy Bay Rivulet, dipping towards and partly under the massive diabase which bounds the valley on that side. The lowest beds of the sandstone probably represent the epoch at which the floor of the Upper Palæozoic sea, after being gradually built up from the waste of older rocks during subsidence for a vast period of time, began to emerge, and a considerable part at least of the covering beds was of aerial formation. That these and other sandstones generally classed with them, as well as a long series of shaly beds, and part of the southern and eastern coal measures, are to be seen in places distinctly conformable to the Palæozoic Marine beds, is unquestionable; but conformity does not necessarily imply continuous deposition, and it is probable that a long period of time, and a distinct stratigraphic break, intervened between the formation of the most recent of the marine beds of the Palæozoic series and that of the rocks forming the base of the so-called Mesozoic coal measures. Of this, however, we have at present no distinct record.

A FIRST LIST OF THE BIRDS OF TASMAN'S PENINSULA.

By J. R. McClymont, M.A.

The subjoined list is not the work of a scientific ornithologist, but of one who has spent a good many hours in ambush, an interested observer of the manners and customs of birds. There are a few of those included in the list which are not of common occurrence in the district above designated; these have been collated with specimens in the Museum, or with Gould's descriptions and plates. The field of observation is within a radius of a mile from the settlement at Koonya, unless otherwise stated in a note. The classification is adopted from "A Systematic List of Tasmanian Birds," by Col. W. V. Legge, R.A., F.L.S.

ACCIPITRES.

1. Astur Novæ Hollandiæ, *Gmelin*. White Goshawk. Two or three seen within the last four years.

2. Uroætus audax, *Latham*. Wedge-tailed Eagle.

3. Haliætus leucogaster, *Gmelin*. Grey-backed Sea Eagle. One seen on the Eastern Coast near Tasman's Arch.

4. Hieracidea Orientalis, *Schlegel*. Brown Hawk.

5. Ninox Boobook, *Latham*. Brown Hawk Owl. (Ewing in *Tas. Jour*. i. 53).

6. Ninox maculata, *Vig. and Horsf*. Spotted Hawk Owl. Often heard. One was caught in the kitchen of a house, having flown in.

PSITTACI.

7. Calyptorhynchus xanthonotus, *Gould*. Black Cockatoo. Frequent. Said by the country people to presage rain.

8. Platycercus flaviventris, *Temminck*. Yellow-bellied Parrakeet.

9. Pezoporus formosus, *Latham*. Ground Parrakeet. On the downs of native grass on the N.W. side.

10. Lathamus discolor, *Shaw*. Swift Lorikeet.

PICARIÆ.

11. Cuculus pallidus, *Latham*. Pallid Cuckoo.

12. Cuculus flabelliformis, *Latham*. Fantailed Cuckoo.

12. Podargus cuvieri, *Vig. and Horsf*. More Pork. About the old buildings, from which it is difficult to dislodge them, even with sticks and stones.

PASSERES.

14. Corone Australis, *Gould.* White-eyed Crow.

15. Strepera fuliginosa, *Gould.* Black Magpie.
Seen rarely.

16. Strepera arguta, *Gould.* Hill Magpie.
As many as twenty together occasionally.

17. Graucculus parvirostris, *Gould.* Summer Bird.
Arrives in the latter part of October.

18. Collyriocincla rectirostris, *Jard and Selby.* Whistling Shrike Thrush.

Known as "Whistling Dick," or locally and anthropomorphically, "Black-eyed Susan." Man's nearness to the animal is rudely indicated in these friendly and familiar appellations.

19. Gymnorhina hyperleuca, *Gould.* Magpie.
First domiciled at Saltwater River, this bird has reached Impression Bay. The Sparrow has advanced in the same direction.

20. Cracticus cinereus, *Gould.* Butcher Bird.
Its piping note is heard from time to time.

21. Pachycephala olivacea, *Vig. and Horsf.* Olivaceous Thickhead.

22. Pachycephala glaucura, *Gould.* Grey-tailed Thickhead.
This bird, or *P. gutturalis*, was observed once in the gully behind Koonya.

23. Rhipidura saturata, *Sharpe.* Fantail.
Called by boys "Cranky Fan" from its erratic movements in pursuit of insects.

24. Myiagra nitida. *Gould.* Shining Flycatcher.
Seen once near Taranna.

25. Petræca Leggii, *Sharpe.* Scarlet-breasted Robin.

26. Petræca phœnicea, *Gould.* Flame-breasted Robin.
The female has the under surface grey. See *Gould* i. 283.

27. Petræca rhodinogaster, *Drapier.* Pink-breasted Robin.
The nest is exquisitely adorned with lichen.

28. Petræca vittata, *Quoy et Gaimard.* Dusky Robin.

29. Malurus Gouldi, *Sharpe.* Blue Wren.
The males through the winter in blue plumage are seen. See *Gould* i. 321.

30. Geocichla macrorhyncha, *Gould.* Ground Thrush.

31. Cinclosoma punctatum, *Lath.* Ground Bird.

32. Calamanthus fuliginosus, *Vig. and Horsf.* Rush Warbler.

33. Stipiturus malachurus, *Shaw.* Emu Wren.
Seen many years ago at Eagle Hawk Neck; lately, near Roaring Beach.

34. Sericornis humilis, *Gould.* Sombre Bush Tit.

35. Acanthiza diemenensis, *Gould.* Brown Tail.

36. Acanthorynchus tennirostris, *Lath.* Spine Bill.
Very easily beguiled by an imitation of its whistling notes.

37. Melithreptus validirostris, *Gould.* Strong-billed Honey-eater.

38. Melithreptus melanocephalus, *Gould.* Black-headed Honey-eater.

39. Ptilotis flavigula, *Gould.* Yellow-throated Honey-eater.
The Spring note of this bird is almost as characteristic of the season as the note of the Summer-bird.

40. Meliornis Novæ Hollandiæ, *Lath.* New Holland Honey-eater.

41. Meliornis Australasiana, *Shaw.* Tasmanian Honey-eater.
The peculiar humming and clicking noise made by this bird is, I suppose, produced by the wings and mandibles.

42. Acanthochæra inauris, *Gould.* Wattle Bird.

43. Acanthochæra mellivora, *Lath.* Brush Wattle Bird.

44. Zosterops cærulescens, *Lath.* White Eye.

45. Pardalotus punctatus, *Shaw and Nodder.* Diamond Bird.

46. Pardalotus affinis, *Gould.* Allied Diamond Bird.

47. Hirundo neoxena, *Gould.* Australian Swallow.

48. Estrelda bella, *Lath.* Fire-tailed Finch.

49. Anthus Australis, *Vig. and Horsf.* Australian Pipit.

COLUMBÆ.

50. Phaps chalcoptera, *Latham.* Bronze-wing.

GALLINÆ.

A Quail, but species not determined.

FULICARIÆ.

51. Tribonyx Gouldi, *Sclater.* Native Hen.
One shot near Koonya.

GRALLÆ.

52. Ægialites monacha, *Geoffrey.* Hooded Sand Plover.

53. ÆGIALITES RUFICAPILLA, *Temm.* Red-capped Sand Plover.

Both found on the Beach of Pirates Bay.

54. LOBIVANELLUS LOBATUS, *Latham.* Wattled Plover.

A bird answering to this shot near Safety Cove.

55. HÆMATOPUS LONGIROSTRIS, *Vieill.* White-breasted Oyster Catcher.

56. HÆMATOPUS UNICOLOR, *Wagler.* Sooty Oyster Catcher.

GAVIÆ.

57. STERNA CASPIA, *Pallas.* Caspian Tern.

Shot near Taranna.

58. STERNA POLIOCERCA, *Gould.* Bass's Straits Tern.

59. LARUS PACIFICUS, *Latham.* Pacific Gull.

60. LARUS NOVÆ HOLLANDIÆ, *Stephens.* Little Gull.

STEGANOPODES.

61. SULA SERRATOR, *Banks.* Australian Gannet.

This bird enters the water sidewise, and penetrating it first with one outstretched wing raises a small fountain of foam.

62. PHALACROCORAX CARBO, *Linu.* Common Cormorant.

63. PHALACROCORAX LEUCOGASTER, *Gould.* White-breasted Cormorant.

ANSERES.

64. CYGNUS ATRATUS, *Lath.* Black Swan.

Seen near Price's Flats. Also on lagoon near Lime Bay, where the nest has been found.

65. ANAS SUPERCILIOSA, *Gmelin.* Wild Duck.

On the agoons.

66. ANAS CASTANEA, *Egton.* Teal.

Shot near Koonya.

67. BIZIURA LOBATA, *Shaw.* Musk Duck.

Shot at Impression Bay.

HERODIONES.

68. ARDEA NOVÆ HOLLANDIÆ, *Lath.* White-fronted Heron.

Sometimes seen frequenting cultivated paddocks in winter.

69. BOTAURUS POICILOPTERUS, *Wagler.* Australian Bittern.

Found on the N.W. side.

IMPENNES.

70. EUDYPTULA MINOR, *Forster.* Little Penguin.

The following species probably belong to the district, but not with sufficient certainty to be placed in the above list:— *Strix castanops, Cuculus plagosus, Phaps elegans, Porphyrio cyanocephalus, Gallinago Australis.*

THE HIGHLANDS OF LAKE ST. CLAIR.

By Col. W. V. Legge, R.A., F.G.S.

In the following paper an effort is made to describe the topographical features of Mounts King William and Olympus, and to touch upon the magnificent scenery which surrounds these grand highlands of western Tasmania.

After the traveller crosses the Clarence River, some ten miles from Marlborough and draws near Lake St. Clair, he emerges from the forest upon the button-rush plains on the north of Mount Charles, and first becomes aware of the altered character of the scenery awaiting him as he journeys towards the west. In addition to the bold mural outlines, characteristic of the greenstone districts of the island, and which are here also a marked feature in the landscape, peaked mountains rise up grandly here and there among the adjacent bluffs, and add a new and grand feature to the country. Thus, from the plains near Mount Charles, the peaks of Mount Byron and Mount Hugel come into view, and, mingling with the precipitous bluffs of Mount Olympus and King William, form a view not easily forgotten.

The newly formed track, which it is to be hoped will a no distant date become the main road from Hobart to the West Coast, passes to the north of Mount Charles, a forest-clad tier with an altitude of about 3,300 feet, and on the north side of the flat ground over which the track passes is another range, whichis in reality the southern edge of the higher Lake plateau running westward till stopped by the gorge which contains Lake St. Clair. The small Traveller Lakes lie a little way back on this upland, and discharge their waters by the small and rocky Traveller River into the Derwent, about two miles from the lake. The road crosses the Traveller just beyond Mr. Orr's hut on a substantial bridge, about a mile from the junction of the stream with the river, and in another half mile or so the latter is reached, where a fine wooden bridge gives access to the "Wild West." The elevation of this bridge, and in fact of the whole track from Marlborough to King William, allowing for rise and fall, is about 2,300 feet. Between the Traveller and the Derwent is a small button-rush plain, bounded by the characteristic clumps of small gums, locally called "sapling banks," and studded here and there with those gaunt sentinels, frost killed gums, which so often mar the beauty of the Lake Country. From here, and nowhere is there a better stand-point than the little bridge over the Traveller, a grand view is

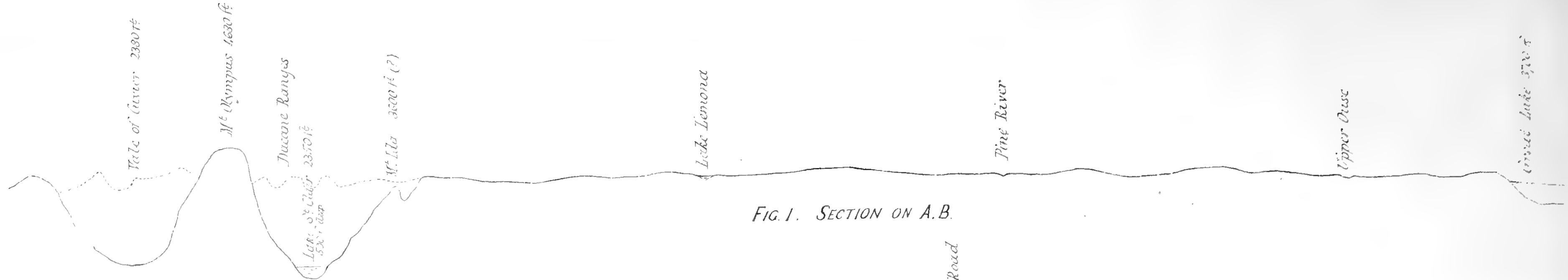


FIG. 1. SECTION ON A.B.

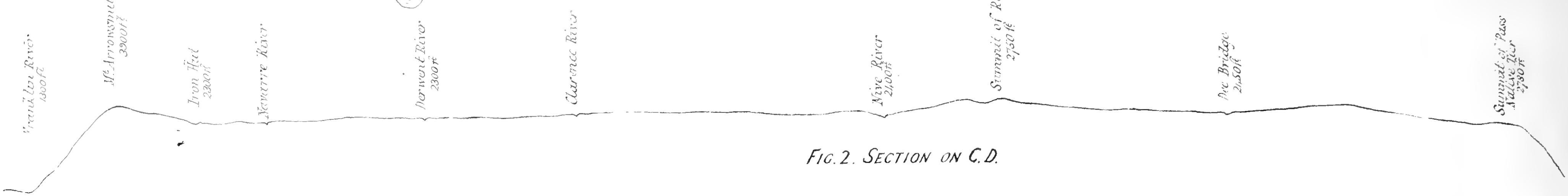


FIG. 2. SECTION ON C.D.

SKETCH MAP AND SECTIONS OF THE SOUTHERN PORTION OF THE UPPER AND LOWER PLATEAUS FORMING THE TABLE LAND OF TASMANIA

General boundaries of the Plateaus, thus –

obtained of Mount Olympus and the jagged Du Cane Ranges, with the sharp peak of Byron in the centre; and then looking due west beyond the Derwent, the whole length of Mount Hugel and its bold ridge, with the smoother outline of Mount Rufus, completes the panorama of the mountains in the immediate vicinity of the Lake. I regret that my lamented friend Mr. Sprent, under whose able leadership we made our trip to the West at the time I write of, did not see this view, for he was looking forward to it with considerable interest. We had, however, trudged the whole way from the hospitable homestead of Bronté in constant driving snow showers, which effectually obscured the country, and though the weather cleared up as we neared the lake, the mountains were still clothed with mist. Every now and then the clouds would lift and suddenly disclose some unknown crag or peak to our eyes, and many were the conjectures among the party as to what this mountain or that could be, for the study of our charts did not assist us much so long as our observations were limited to single mountains standing up here and there among the clouds. In the afternoon the sun shone out and the mountains cleared entirely, but by that time we had crossed the Derwent, and under the guidance of Mr. Orr, of Mount Charles, had reached the shores of the lake, the storm-tossed beauties of which fully occupied our attention. After crossing the Derwent, the country lying between the river and the King William Range is perfectly flat, and consists, for the main part, of two large button-rush plains, the first called the Derwent, and divided from the second, or Navarre Plain, by a belt of bush. A forest-clad ridge starts from the lake about three miles to the north and impinges on these plains, an arm of which runs behind the ridge through to the lake, and by which there is a track from the Navarre Plains to the Boat House. The western face of this ridge is a picturesque precipice about 300 feet high, called the "Bedlam Walls," and of which I am told an effective painting was made by a lady traveller some years ago. On emerging from the bush fringing the west bank of the Derwent, and issuing on to the plains, a grand view is obtained of the King William Mountain, which rises boldly up like a solitary monarch from the surrounding country. From this point of view the three peaks, which form the northern face of the mountain, blend into a continuous basaltic ridge standing out of a series of beautiful forest-clad slopes, which unite at their base with the bush skirting the Navarre Plains. To the south the Derwent Plain stretches away for miles like a yellow sea of grass, fringed on all sides with forest, and backed up by the Mount Hobhouse Range, between which and King William there is a wide gap in the landscape, formed by the level country at the head of Gordon Valley. After reaching the Navarre Plain, the new track diverges towards the south with a view to avoid the damp ground, but in dry weather there is a short cut across the plain to the bridge erected over the Navarre, a pretty little stream which rises in the slopes of Mount Rufus and flows eastward into the Derwent abreast of the Wentworth Hills. A walk of a couple of miles more, with the bold bluffs of King William towering up in front, takes the traveller to the Iron Hut under the mountain, and which has been for the past few years the depôt for provisioning the road party engaged in making the track to the King River Gold-fields.

In this district the gum forest is chiefly stringy bark (*E. obliqua*), and between the Hut and base of the mountain there is a small button-rush plain, traversed by a little stream which runs into the Navarre. The first beech groves met with on this route, except those which clothe the western shores of Lake St. Clair, are in the vicinity of the Iron Hut. About a mile before reaching the hut, a clump of deep green foliage is observed between the track and Mount Rufus, which is soon discovered to be a grove of beeches (*F. Cunninghami*), and thenceforward to the West Coast this tree is more or less prominent. At the foot of Mount King William, and at the farther margin of the little button-rush plain just alluded to, is a splendid beech grove, in which I measured a monarch of the forest which was 27 feet in girth. Perhaps most of the Fellows of this Society have wandered through the beech forests of the West of Tasmania, but there may be some whose acquaintance with this tree is limited to the solitary specimens met with here and there in the dells of Mount Wellington.. To such, I may be permitted to say, that on suddenly entering one of these beautiful woods, ignominiously called "myrtle scrubs," the traveller is translated in an instant to the cool, shady, and romantic forests of Southern or Central Europe. All around stand weird and moss-covered trunks of lofty stature, whose gigantic lichen-clad limbs stretch out among the feathery beech foliage, upon which, as the wind sways the branches overhead, fitful gleams of sunlight play for an instant, and then fall on the massive decaying logs which lie strewn among the ferns. For the most part an absolute stillness pervades these verdant solitudes, as scarcely a bird-note enlivens their depths, and the usual animals of the Australian bush seem to be absent from them.

So far, my remarks on the country through which the West Coast tract runs have been introductory, and relate to our journey to King William from Marlborough on the 18th and 19th of February last. On the morning of the 20th we started for the King River and continued our journey along the new track over Mount Arrowsmith across the beautiful Franklin and Collingwood Rivers, and along the picturesque stream called the Cardigan, to a point ten miles from the King River. The next day Mr. Piguenit and myself, wishing to see more of the beautiful scenery in the vicinity of Lake St. Clair, and taking no interest in the King River mines, returned to King William while the rest of the party continued their journey to the West. A warm wind blew over the endless gorges lying between the Frenchman and Mount Arrowsmith and suddenly turned to rain, which continued more or less all the next day, and it was not until the morning of the 23rd that the weather was clear enough to ascend Mount King William. The range, which I shall presently describe, towers up in the form of three bold rounded bluffs connected by two saddles, immediately behind the Hut.

A shepherd of Mr. King's, who owns sheep on the Navarre Plains, was my guide, and making an early start we ascended a long spur which holds a sloping button-grass plain or field about the middle and runs out to the east of the eastern peak. Passing up along the edge of the plain we entered the low bush and scrub which always surrounds the greenstone cliffs of these mountains, and climbing up through it soon reached the rocky slope forming the northern face of the peak. Selecting this for our attack so as to avoid the precipitous southern face, we shortly gained the summit after a walk of two and a-half hours from the Hut which, however, included a halt of three-quarters of an hour under the precipice for a sketch of Lake George and the Gordon Valley. The altitude of this peak, taken with the aneroid, was 4,100 feet, and that of the second peak, to which we climbed directly afterwards, about 60 feet lower. From this end of the King William Range one of the finest mountain views that can be imagined is obtained. It may be said to be a complete panorama, for although it is intercepted to the southward by the plateau of the mountain itself, yet this is so beautiful that instead of being an obstruction it forms a lovely foreground to the scene. I may therefore digress to give a short description of the scenery.

Looking first to the north, close at hand and just beyond the moor of Mount Arrowsmith, rises up the picturesque Mount Gell, which is backed by the lofty Eldon Ranges, and skirted on the east by the romantically wooded valley of the Upper Franklin, running into the heart of the mountains near the Coal Hill, and holding in its depths the pretty lakes, Dixon and Undine. Flanking this valley on the east are the heights of Mounts Rufus and Hugel, towering up beyond which come the crags of Mounts Olympus and Byron, with a back-ground of lofty peaks, one of which is the Cradle Mountain and another probably Barn Bluff.

Turning to the east, Lake St. Clair is seen embosomed in the forest beneath Olympus, and then follows a long stretch of broken upland until the eye rests on Mount Hobhouse and Wylds Craig, both fine pinnacles from this point of view. Immediately beneath are the wide plains of the Upper Gordon with the secluded Lakes George and Rufus at the foot of the range. Due south, beyond Lake Rufus, is a labyrinth of peaked mountains, some of which belong to the almost unknown Denison and adjacent ranges, and further still to the south in the dim blue distance stands up a lofty pinnacle which may possibly be Mount Wedge. Then, before we look to the West, lies immediately at our feet the grand upland moor or plateau of the range itself, crowned with the heights of King William the Second and Third, which stand out from the hills and vales and rocky knolls and craggy ledges of the moor like huge billows from a stormy sea, while near at hand lies a little mirror-like placid lake as a glistening gem on the mountain-top. Finally, to the westward is reserved for the eye the grandest sight of all; the mighty Frenchman, from whose jagged summits the huge Cap stands up into the sky like a giant sentinel looking to the south over all the mountain wilderness of the Gordon. Further beyond, towards the ocean, are the bold outlines of Mount Lyell and the West Coast Range, which carry the eye northward to the Eldon Range and thus complete the panorama.

To return to the King William range, it may be described as a mountain plateau built up to a height of from 2,000 to 2,500 feet from the plains surrounding it on the north and east, while its western face descends suddenly into a deep, densely clothed gorge, dividing it from the Loddon Hills, and running southwards towards the head waters of the Denison. I cannot help thinking, and Mr. Piguenit agreed with me, that on our recent maps both the Loddon Hills and Loddon River are incorrectly laid down, and that instead of running westward, their direction should be more southerly; in this case the Loddon would arise in the western slopes of the hills of that name, and the waters draining the deep gorge just mentioned would flow south to the Denison. Along the eastern base of the range there is quite a system of small lakes lying ensconsed beneath the precipices, exactly after the manner of the Scotch tarns and Welsh mountain pools. They are kept filled by the melting snow in the winter and spring and the abundant soakage from the plateau in the summer. Beneath the eastern peak of the northern face of the range is situated Lake George, which has the shape of a sea-horse (*Hippocampus*), and with which is grouped three other smaller sheets, two at the tail of the horse, and the third upon the ridge between its back and the next group. This follows at a distance of a mile and a-half, and consists of four lakes, the two largest of which lie in a deep hollow, beneath King William the Second. The larger of the two is Lake Rufus, which is too far to the south in the map; it is a fine sheet some two miles round, I should say, but is not so pretty as the smaller, circular lake, lying higher into the gorge. This lake is without a name, and I bestowed on it that of "Lake Anne." The waters of Lake George and Lake Rufus both drain into the Derwent by the Guelph River, a small stream meandering across the plain, and joining the queen of Tasmanian rivers north of Mount Hobhouse. A slight rise in the plain towards the south forms the water-shed between the Derwent and the Gordon, which latter rises in the next system of lakes, defined by the name of Lake Richmond, and lying close beneath the range, and between King William the Second and Third. I did not explore the plateau far enough to the south to view Lake Richmond, and cannot say whether it is a solitary sheet or not. It is probably fed by a stream descending into it from the plateau above, or it could scarcely furnish enough water for the source of such a stream as the Gordon.

The waters of the upper lake on the plateau drain in the opposite direction towards the west, descending into the deep gorge towards the Denison, and are probably the source of that river. This little lake has a circular form, with low shores, except at one spot, and is about three-quarters of a mile in circumference. It is moderately shallow, and at one end (the north-west) there is a tiny islet, to which access can be gained by stepping on the rocks between it and the mainland. On this isle we broke fast, and erected a little cairn in memory of our visit. The water is inhabited by the small shrimp (*Palæmon sp.*), some of which we caught among the stones. The springs on the moor just beneath the peaks of the northern face of the range supply this lakelet. A small stream is formed there, which, on its way to the water, flows through a pretty pool some 80 yards long, and overhung on one side by a perpendicular rock face.

The sides of the range on the north and west are clothed with gum forest, tolerably open in places, in others thick, with ti-tree scrub, and here and there groves of the handsome *Richea pandanifolia.* This palm grows to a height of 30 feet, and when seen mingled with the surrounding vegetation has quite a tropical appearance.

On the slopes of the mountain above Lake George, the Hakea, a pine-like tree of small dimensions flourishes, and grows as high as the base of the crags at the edge of the plateau. The deep gorge between King William and the Loddon Hills is clothed, for the most part, with beech forest, and here and there I could distinguish isolated pines, probably *Arthrotaxis, Seleginoides*. This valley of the Denison will probably be found to contain valuable beds of timber, which no doubt improve southwards towards the Gordon. The most accessible route by which to reach the valley of the Denison would probably be from the Iron Hut over the King William plateau, and keeping on the top of the range, which affords easy walking, to descend from the south-west edge into the valley. By adopting this route the lie of the valley, with its spurs and gorges, could be well viewed, and a track chosen before descending from the heights. I speak here under correction, not knowing what the alternative route between the Gordon valley and the Denison, round the south end of King William, is like; but even supposing the gap between this and the next unnamed range afforded easy access to the Denison, there would be a wide stretch of forest to traverse before the river was reached, and one would have the disadvantage of keeping entirely to the lower level—often a fatal mistake in bush exploration.

To refer now to the upland of King William, with its curious Alpine vegetation, so different from anything seen in the lowlands of Tasmania, the plateau itself, though a much narrower tract than the great moor of Ben Lomond has, when viewed from the northern peaks, a singularly beautiful aspect. Bold bluffs tower along its eastern edge above the valley and lakes beneath; and on its surface rocky hills, picturesque hollows, studded with shining pools, and rocky knolls, with here and there a precipitous torr, all succeed one another as the eye looks southwards towards the heights of King William the Second and Third, which close in the view. The vegetation differs slightly from that of Ben Lomond moor, in being mingled here and there with dwarf specimens of the grass palm (*R. scoparia*). The curious "yellow bush" (*Orites acicularis*) and the dark-green leaved *Richea Gunnii* are the largest bushes which one meets with on the moor, but round the little lake we saw several specimens of the *Hakea lissorperma*, about the height of a man. In the swampy spots the pretty mountain artichoke (*Celmissia longifolia*) flourishes, and affords good stepping ground on the oozy moor. I did not notice the curious tabular moss (*Abrotanella fosterioides*) in such abundance as on other mountain tops. On Ben Lomond it spreads out like a green table, beautifully patched or mapped out, so to speak, with pale greenish-white tracts on the dark green ground of the larger portion of the plant, and rises up here and there into round, pudding-like masses, reaching a diameter of two feet or more. I have often spoken of this curious moss-like substance to people, and find that it is very little known even among those who are mountain climbers. On King William I found it paving the damp places here and there, in about the same abundance as on Mount Wellington.

The same characteristic vegetation probably obtains along the whole plateau to its southern edge, with no doubt here and there a boulder-strewn tract or "ploughed field," interrupting the green clothing of the surface, and clumps of stunted gums lining the lower edges of the plateau. Above Lake George is a grand perpendicular precipice of columnar greenstone; it shows out well from the plains to the eastward on coming from the Derwent, and I walked across to the edge of the moor to examine it. On arriving within about 40 feet of the edge, my companion suddenly startled me with "Look out, sir," and on looking down we found we were just on the point of stepping into a crevice varying from 18 inches to 3 feet in width, and which was cut down like the gash of a knife for a vast depth into the bowels of the mountain. It was partly overgrown with vegetation and was consequently a most dangerous spot. A momentary survey of the spot revealed the fact that the grand precipice in front of us had parted from the main mass of the mountain, and that the yawning cleft at our feet would some day be the means of sending it into the valley beneath. On stepping across the crevice, after endeavouring to sound its depth by throwing stones into it, we gained the edge of the precipice, and there found that at perhaps no very distant period a mighty downfall of tens of thousands of tons of rock had been precipitated into the valley beneath and had left exposed the perpendicular face, on the brink of which we stood. The cleft that we had just stepped over was the process repeating itself and is, in fact, a characteristic of all basaltic mountain tops.

But little animal life was seen on the plateau; o quadrupeds we saw none, though probably kangaroo, wallaby, and wombat, find their way up to it from the low country. As regards birds, the Tasmanian Honey-eater, *Meliornis Australasiana*, was seen in flocks among the low honey-bearing bushes; the Hill Crow-shrike, *Strepera Arguta*, was also seen flying across the moor, and a few Rock Swallows, *Petrochelidon nigricans* skimmed here and there past us. A pair of white Goshawks, *Astur Novæ Hollandiæ*, soared high above the mountain and disappeared into the Denison Valley, where they were no doubt breeding. My companion caught sight of a small brown snake under the peak upon which the shattered trig. station is built, but I could scarcely gather from his description to which species it belonged.

Before quitting my notice of this locality, a few words must be said about the now tolerably well-known Mount Arrowsmith, which appears to have given its name to the hut used as a provision depôt, which useful edifice is, however, more closely connected with King William than Arrowsmith. When viewed from the top of King William, Arrowsmith is no mountain at all, but merely the raised termination of the lake plateau lying between Mount Gell and King William, and divided from the former by the magnificent myrtle-clad gorge through which the Franklin River issues from Lake Dixon. The plateau rises gradually from the hut up to the Arrowsmith moor, which is broken up into rocky eminences and picturesque schistose torrs, standing up from the button-grass wastes around them; between these the path to the West Coast winds till it reaches the edge of the moor, and then, suddenly turning towards the south-west, drops about 2,000 feet into the valley of the Franklin. At the point where the descent commences a sublime view of the "Frenchman," with the Cap towering up in the centre, is suddenly disclosed. Seen from this point on the highlands I cannot call to mind any mountain of corresponding height which is so grand in the character of its outline as the "Frenchman," and a trip to Mount Arrowsmith from Hobart would be worth taking, were it only to obtain one glance at the magnificent range as seen from that point. I am told that the view of the mountain is excessively grand from the south-west, but from that elevation, when seen from among the valleys, it cannot be so comprehensive as from the highlands to the eastward.

I now come to a closer notice of the beautiful lake and its mountainous surroundings, the notable features of which are Mounts Olympus and Ida.

Lake St. Clair is about eleven miles long, and two wide at its broadest part; its shores are, on the whole, for the most part unindented, the "Lake Basin" at the south end being the only bay of consequence. Its eastern shore is flanked by a long unbroken tier (the edge of the great lake plateau), which descends steeply to the water's edge and is covered beneath its cliffs with gum forest. Near the north of the lake a bold, conical offshoot of this tier occurs, as Mount Ida, which is divided from the main body by a deep gorge, and overlooks on its northern side the pretty little Lake Laura. The densest forest surrounds this lake and prevented Mr. Piguenit from painting it when he penetrated to its shores with Mr. J. R. Scott in 1874. Overlooking Lake Laura, the tier assumes a loftier and bolder character, and running north is broken up into bluffs and peaks forming a rugged wall to the lonely valley of the Narcissus, which extends for 10 miles or so from the head of the lake to the foot of the Du Cane Range. The western side of the valley is closed in by the peaks of Mount Byron, Mount Ossa and a portion of the Du Cane Range, and about the centre of the Lake the lofty crags of Olympus tower above the richly wooded slopes which abut on its shores. The chief beauty of the lake lies in the dark green foliage of the beech forest clothing its western shore, but much of it cannot be seen from the lower end, as under Olympus the water trends to eastward and becomes hidden by the spur of the mountain. The Olympus Range approaches the lake from a north-easterly direction, and slopes abruptly down into the beautiful Cuvier valley which terminates at "Boat House" or Cynthia Bay, and down the centre of which the Cuvier River, a pretty trout stream, flows after issuing from Lake Petrarch at the upper end of the valley. On the opposite side of the vale the heights of Mount Hugel, with a number of smaller subsidiary hills, form a fitting *vis-à-vis* to Olympus, and at the top beyond Petrarch and two smaller lakes, Gould's Sugarloaf and the Coal Hill on the left-hand, and the remarkable peak of Mount Byron on the right complete the view. The beech forest is almost wholly confined to the shores of the lake, for on leaving it to proceed up the vale nothing but gum forest is met with; a few pines of the handsome *Arthrotaxis seleginoides* species are scattered here and there in the bush on the south sides of Olympus, but they are not noticeable until the forest is penetrated, and from what I saw, do not exist in sufficient numbers for even a limited timber supply.

The summit of Mount Olympus is a wall-like formation of basaltic greenstone, rising 2,300 feet above the lake and somewhat less from the Vale of Cuvier, which has a slight elevation above the water. It has the shape of an irregular figure of 8, as the flat rocky tract swells out at each end and is contracted to a narrow ridge in the centre; on the lake side the formation is perpendicular, except at the narrow ridge, which is a boulder-strewn slope, at the foot of which, nearly 1,000 feet below the summit, are two little mountain lakes; overlooking the Vale the sides are perpendicular at each end of the plateau, the south-eastern aspect of which has a very grand appearance, towering to a considerable height above the wooded spurs which abut on the lake. Mr. Piguenit's beautiful painting depicts this view.

The ascent of the mountain may be made either from the north-western shores of the lake, by way of the little mountain lakes, or from the Vale of Cuvier, but the former route cannot be chosen without using the boat, which is at present in too leaky a condition to venture very far in. On the evening before my ascent of the mountain, I launched the boat and crossed the lake in her, but it took two of us to bail her out as the third pulled, or she would have sunk. It is much to be regretted that there is not a good boat on the lake, as it is impossible to get round the densly wooded shores, and even if such were not the case, very little of the scenery could be viewed with advantage. The present craft was very kindly placed upon the lake by Messrs. Piguenit and Scott in 1874, and had she been carefully looked after would have been serviceable for years to come.

Finding the lake route impracticable, I started from camp at the Boat House at seven o'clock on the morning of the 19th of February, taking Mr. Orr with me as a guide, and proceeded along Scott's track, which crosses the Cuvier about a mile from the lake and keeps to the north side of the river as far as Lake Petrarch, whence it ascends the Coal Hill Range, and passes thence into the low country to the West Coast. I understand that this track has not been used for many years. After leaving the Eldon Range it descends into very difficult country, and now that the more southern route, *viâ* Mount Arrowsmith, has been adopted, there will be no further use for it, as regards a direct road to the West Coast. When, however, the Lake country becomes better known, and tourists frequent the district I am speaking of, Scott's track will, no doubt, be useful to pedestrians, in giving access to the grand region to the north of the Eldon Range, and it might be continued down the gorges of the Murchison and the Mackintosh Rivers, which, when Tasmania becomes the tourist-land of Australia, will furnish some of the most beautiful scenery in Australasia. The Vale of Cuvier, into which the track first of all strikes, is an undulating button-grass plain, studded here and there with clumps of young gums, giving it a park-like appearance, the beauty of which is enhanced by the towering walls of Olympus, and the precipitous peak of Mount Byron. The track is marked out along the river with stakes. We found it much overgrown, as it has not been burnt out for four or five years, and the walking was consequently very heavy. At about five miles from the lake we turned across the valley and struck into the forest, making up the slope of the mountain to the foot of the crags at the south end. At the limit of the forest, on coming out into low rocky scrub, we met with the deciduous beech (*F. Gunni)*, which was growing in a bush-like form among the boulders, the altitude being about 3,800 feet, and passing over this rough track we reached the foot of a narrow and very steep slope of immense boulders, up which we clambered with some difficulty, and gained the summit of the mountain about half-past eleven. Included in this time were two halts for sketching and making tea, so that for good walkers the ascent by this route is no very difficult matter. The top of the mountain is a level tract of boulders overgrown with Alpine vegetation, and measures perhaps three-quarters of a mile by one-third, narrowing at its northern end into the ridge before mentioned. About the centre of this little rugged plain is a large crevice descending into the heart of the mountain. Its sides consist of basaltic columns, and at the northern end there is a slope of detritus, down which one could descend to the bottom. At first it gives the impression of having been a rent in the basaltic formation, but the fact of its being so short—about 50 yards—and closed at both ends, would rather lead to the belief that the cleft is the result of a subsidence in the rock formation. The altitude of the mountain taken a little distance from the trig. station, was 4,680 feet. The panorama all round was fine indeed, but to the westward it is simply sublime. Immediately at one's feet the lake lies 2,000 feet below with Mount Ida on its further shore, standing out like a sugarloaf in front of the walled tier, which forms the edge of the wild and rugged upland, stretching across to the sources of the Pine River. At the foot of Mount Ida, Lake Laura nestles in the forest, overlooked by the precipices of the upland, which further north break up into an indescribable jumble of peaks and bluffs standing up at the head of the Valley of the Narcissus; to the west, the view is more extensive. Directly beneath in the Vale of Cuvier is Lake Petrarch, painted by Mr. Piguenit in 1874, and beyond are the Coal Hill, Sugarloaf, and Hugel Mountains, forming a foreground to the Western Wilds, which are bounded towards the horizon by the lofty mountains, known as the "West Coast Range," and near the centre of the mining industry in that part of the Island.

The features of the upland between Lake St. Clair and the sources of the Pine and Mersey rivers are not sketched in in our maps; it is full of lakes and bold rocky hills with flat summits, and fully merits the term "rugged" which I have applied to it. Probably no one has ever crossed it, and if this is so there is presumably no good land there; but for the sake of acquiring a knowledge of its topographical features it is well worth while to explore it. About a mile from the edge of the highland and to the south of Ida, is a fine sheet of water, which is perhaps connected with the Traveller Lakes lying a little to the south. It was not marked on the map, and I named it Lake

Sappho; furthur west are other sheets of water, which are probably Lake Lemona and Lake Ina. The lakelets at the foot of the crags upon which we stood, and which might be named the "Pools of Olympus," are exactly similar to the Cumberland and Welsh tarns, which are to be found beneath the summits of nearly all the British mountains; they are almost circular, with their immediate surroundings bare and flat. In the Old Country these tarns are usually full of trout and many a good day's sport is to had "whipping" round the edges with a long "cast" and a taking fly!

The country to the north-west of Lake St. Clair could be explored by going to the head of the lake in a boat and following up the Narcissus River, the source of the Derwent, to the foot of the Du Cane Range, which might then be ascended and a topographical sketch of the country to the north of the range made. I do not know whether the tract between the Canning and the Rugged Mountain has been explored, but it could be done from this side and the settlements at the head of the Mersey reached, if the explorers did not wish to cross the Forth to the Vale of Belvoir, taking the Cradle Mountain *en route.*

I must not forget to mention that there is a little lake under the northern side of Mount Hugel, about three miles from the Cuvier River, and this I named Lake Hermione. On our return we found the button-grass in the valley, and though it was drizzling at the time a huge fire sprung up at night and burnt all the following day, so that the next pedestrians who ascend Olympus will have better walking than we had.

From the observations made in this paper it will be seen that the western limits of what might be termed the lower lake plateau, and which is bounded on the south by the Native Tier and other continuous slopes, are Mount Arrowsmith and the descent down into the valley of Rasselas from the head waters of the Gordon, these tracts being looked upon as ramifications of the plateau beyond the Derwent. The valleys of the Cuvier and the Narcissus are also further ramifications of this lower plateau, and the high mountains to the north-west of these valleys are the limits of the upland in that direction. Then the higher lake plateau, which contains the Great Lake and the system of smaller waters at the head of the Pine River, and thence westward to Lake St. Clair, ends in the high ridges overlooking the eastern shores of that lake and the valley of the Narcissus. I subjoin an ideal section of these uplands, which may assist in illustrating my meaning, if examined in conjunction with the maps accompanying them.

In conclusion, it may not be out of place to speak of the advisability of an annual improvement to the West Coast track, so that some day in the future it may become the trunk road to the other side of the island. This is unquestionably the route which a road should take from the metropolis to the West Coast, and following the system adopted by the Romans, who were the greatest colonisers of past ages, there should be a road from the centre of government to the confines of its jurisdiction on the West Coast. By making a main road from Hobart to the West Coast an artery is formed along which the life-blood of civilisation and commerce will eventually flow to the numerous roads, tracks, and settlements, mining or otherwise, which must be the outcome in future years of the construction of that road. It is all very well to talk of Macquarie Harbour being the shipping port of the West Coast mines, and that all that is required is a good road thence to the mineral country; this is looking at the subject from only one point of view, and it is not opening up the country, which I take to mean connecting the important parts thereof with the centre of importance and power: the metropolis. By the latter alternative, means are afforded for a special postal communication and for carrying on mineral, topographical and scientific exploration to the north and south of the main road, and thus thoroughly opening up the country; whereas by resting content with an occasional sea voyage of hundreds of miles, as the only means of communication with the coast, the inhabitants thereof are practically isolated from the world.

The route *viâ* Marlborough and Arrowsmith offers no difficulties as a winter postal route: I think I can correctly assert that the post boys of Connemara and the north of Scotland have more hardships from the weather to encounter than any who will have to ride over Mount Arrowsmith while that track remains the only route to the King River. Depôts, or "Rest Houses," as they are called in India, should be established at the Derwent and Collingwood Bridges, which places form a convenient division of the distance between Marlborough and the King River. A few hundred pounds spent upon the road from Marlborough to King William would make it a fair cart track, driveable for the tourist in the summer, and an assistance to the miner throughout the year, who is able now to walk from the Dee Bridge to the King River in three days. The track over Arrowsmith requires to be properly cut out over the button-rush portions and staked for winter travelling when the Mount is covered with snow. Once over Arrowsmith no one could wish for a better bridle track than now exists thence to the King River.

ON THE BREEDING OF SOME SEA BIRDS ON THE ACTÆON AND ADJACENT ISLETS.

By Col. W. V. Legge, R.A., F.Z.S.

On the 31st October and the 28th November last year I visited the Actæons, touching on the first occasion at Southport Island, and, on the second, at the Blanche Rock, of shipwreck notoriety. The object of my visit was to gain information on the breeding of our sea birds on these out-of-the-way islets, and the following notes purport to give an account of the nesting of the few species which were found on them. A few words descriptive of the islets may not be out of place.

Southport Island is a low, grass-covered tract, lying about half-a-mile off, and in line with the southern head of Southport. It is, taking a rough estimate, about 500 yards long by 200 broad, of an oval shape, with a tolerably regular coast-line, and rising on its southern side to an altitude of about 60 feet. This side is tolerably steep, and, in fact, almost precipitous at the western end, where there is a little reft or cove indenting the steep face to a depth of about 15 yards, its sides at the top clothed with bushes (out of which I roused a fine immature Sea Eagle, *H. leucogaster*), and at the bottom a pebbly floor, up which the water rushes as the swell rolls in to land. The northern side slopes down to a boulder-strewn shore, which becomes more rocky at the eastern point of the island. Long grass and brackens, mixed with occasional Barilla bushes, clothe the surface of the island, and snakes are said to be unpleasantly abundant on it.

To the south of the island, and standing out of deep water, is the Blanche Rock, a pinnacle of about 40 feet in height, and of very unpleasant notoriety in having been the means of sending the good ship Blanche to the bottom many years ago. This rock, like other isolated points not far from the land, is frequented by numbers of Cormorants, *P. leucogaster*, which breed there in company with a few small Gulls, *L. Novæ Hollandiæ*, and an occasional Pacific Gull, *L. Pacificus.*

The Actæon Islands lie four miles to the south of Southport Island, and about two from the mainland; they are divided into two groups, the southern one one and a-half miles from the northern, and called in the map the Sterile Islands, although they are locally known as the Little Actæons. There is one isle in each group, the rest being mere rocks and of small extent. The Great Actæon consists of three pear-shaped islets, joined by narrow isthmuses, or raised pebbly beaches, and were probably, at no distant date, separated from one another. The most northerly of the three is by far the largest, measuring about 600 yards long by 300 broad, with an altitude of about 60 feet. On the east the sides are steep, but composed of deep black, guano-like mould, clothed with rank vegetation and Barilla bush. Here the Penguins and Mutton Birds, *Puffinus brevicaudus*, breed, burrowing to a considerable depth in the soft earth, beneath the surface of which masses of tussock-grass are to be found, not yet decayed. This arises from the constant excavations made by the birds, at the mouths of which quantities of soil are thrown out year after year, resulting in the covering up of the tussocks. The two smaller islets are very low, scarcely rising above the top of the shingly beaches, and in the centre of one there is a depression. They are densely clothed with Barilla bushes, brackens, and rank vegetation of much variety, the droppings of the birds leading, of course, to this luxuriant growth.

I was unable on both trips to visit the Little Actæon Islands, owing to the heavy swell that prevailed; this is the better locality of the two for the breeding of sea-birds and was the spot where the eggs of the Sea Eagle, *H. leucogaster*, were found by Mr. Graves some years ago. The islet is very low and appears to be more shingly than the Great Actæon with somewhat less overgrowth.

The height of the breeding season in most years appears to be about the 30th of November. At that time both species of Gull and the short-tailed Petrel are breeding in the greatest numbers; though the Terns, *S. Poliocerca*, and Black Oyster-catchers, *H. unicolor*, probably nest a little later.

The following species are known to breed, or to have bred, on the islets above-mentioned :—

HALIÆTUS LEUCOGASTER, *Gmelin.*

A nest of the grey-backed Sea Eagle was found on the Little Actæon three years ago at the end of November. The nest was a large structure of sticks and sea-weed placed on the ground. A similar position is chosen by this Eagle in the islands in the Straits where there are no trees. I have seen its nest on the Scamander River at the top of a high gum, and in the tropics it invariably builds on trees both inland near "tanks" and on the sea-coast. My observations of the eggs in Ceylon testify to the shape being variable, some being very round while others are long ovals or pointed at one end. The colour is dirty white, and by my measurements are 3·17 to 2·77 inches in length by 2·18 to 2·02 inches in breadth. I have taken several nests of this species and always found it somewhat cowardly in its behaviour, never attempting to attack the intruder, though it will swoop down at him, delivering its hard clanking note.

Euphemia Chrysogastra, *Latham.*

It is probable that the orange-billed Grass Parrakeet breeds on the Actæon Islands, it is always there in more or less numbers during November and December. I flushed it frequently from among the long grass and bushes, but could not find its nest. Gould was equally unsuccessful many years ago when he found it in abundance on the Island It probably nests in holes in the ground, a very abnormal. habit if it does breed there, and this fact makes it very desirable that its nesting-place should be found.

Acanthorhynchus tenuirostris, *Lath.*

I saw several "Spinebills" on the Great Actæons, and I have no doubt that this honey-eater breeds there.

Anthus Australis, *Vig. and Horsf.*

The Titlark was observed on Southport and Actæon Islands and would have been breeding at that season of the year. The nest of this species, like that of all the Pipets, is a neatly formed cup-shaped structure, firmly built into a depression in the ground. It is made of grass stalks, and dry blades, and is thinly but carefully lined with hair and very fine grass, the interior measuring 3 inches across. The eggs vary from two to four (I have found a bird incubating the lesser number), and are of a greyish-white ground when fresh.

Hæmatopus unicolor, *Wagler.*

The Sooty Oyster-catcher was nesting on Great Actæon on the 28th November, but I could not find its eggs. Several pairs frequented the island, which were breeding, this being easily seen by their manner, but they baffled my search for their nests. The eggs of this species are among the handsomest that are found on the Australian Coasts, the markings excelling that of other eggs in richness and beauty. The ground colour is generally rich creamy, or yellowish stony, and the markings consist of large blots and clouds of sepia black, running, in some eggs, into a hieroglyphic form either at the large end or all over the shell, over light sepia and almost grey clouds, spots, and markings. In shape they are much like the eggs of the *Laridæ*, as are all Oyster-catchers; they are very shapely ovals, narrowed at the small end, but not in any way pointed. They measure from 2·23 to 2·55 inches in length, and from 1·6 to 1·7 inches in width.

Sterna poliocerca, *Gould.*

This handsome Tern breeds at the Little Actæon, where its eggs have been taken by Mr. Hinsby, our well-known collector.

He informs me that the nests were slight depressions among shingle, overgrown with herbage, just above high water mark, a few herbs and strips of seaweed being the only lining in the bottom. The eggs were two in number. The ground colour varies from pale yellowish stone to stony white, and the markings, which are very handsome, are hieroglyphic in character, consisting of zigzag and otherwise irregular linear blotches, slightly confluent in parts, and laid on over light inky grey or lilac streaks and spottings. They measure from 2·24 to 2·3 inches in length, by 1·52 to 1·55 inches in breadth.

In Mr. Hume's exhaustive account of the Indian Ocean representative of this Tern (*S. Bergii*, Lichtenstein), contained in Vol. iv. "Stray Feathers," pp. 473-4, he describes the eggs obtained at its great breeding haunt, the Island of Astolah, off the Mekran Coast, as extraordinarily variable, and possessing great richness in colouring. The ground colour varies from "white, greenish and pinkish white, to pale buff, pale yellowish, and again pure pale pinkish stone colour to the richest and warmest salmon pink." The markings which are deep burnt sienna and pale inky purple are either in the form of large blotches, and spots predominant at the large end or of "entirely hieroglyphic lines." Twenty-five eggs vary from 2·3 to 2·71in., and in breadth from 1·63 to 1·78in.

LARUS NOVÆ HOLLANDIÆ, *Stephens.*

On the 31st October I found this species breeding at the south point of the Great Actæon. About 50 pairs were nesting, according to the habit of this Gull, close together. During the early part of the next month many more must have bred, making a large "colony," as an immense number of eggs were taken by the inhabitants of Recherche, who make an annual raid upon the unfortunate birds. The nests I found at the end of October were all fresh, so that the height of the breeding season would be about the 10th of November. They were situated under the rank herbage and thistles growing at the edge of the pebble beach, none of them being more than four yards from the margin of the vegetation. Little hollows between the rolled pebbles lined with herbage ormed the nests, which were placed as near one another as a couple of feet. No nests contained more than two eggs at this time, the third not having been laid. In colouring there are three types of eggs of this gull, viz.:—yellowish, chocolate, pale earth brown, olive grey, and stone grey, the former usually possessing the heaviest markings.

An egg of the latter type before me is evenly clouded throughout the surface with two shades of rich deep sepia, over larger primary clouds of inky grey in two shades; some of the clouds are longitudinal, and others transverse. Eggs of the light type are blotched and speckled with two or three shades of umber brown (thickly at the larger end) over softened primary markings of bluish grey in two shades. In some examples the umber markings are pale and small, and the bluish grey much washed off at the edges. In a few the umber markings take a hieroglyphic form, chiefly round the larger end, and these are the handsomest eggs. In shape the eggs of this Gull vary somewhat, and are either stumpy ovals with a broad end, pyriform ovals, or ovals regularly shaped at each end. They measure as follows:—length, from 2·02 to 2·18 inches; breadth from 1·45 to 1·59 inches.

While examining the nests, I found the birds less anxious as to their safety than some species; they flew round with querulous cries for a little while, and then settled down on the rocks close at hand with comparative unconcern.

LARUS PACIFICUS, *Latham.*

This Gull is a later breeder than the little species. On the 31st October there were no nests on the Islands; but on the 20th of November I learned that large numbers of eggs had been taken by the Recherche people. On the 28th, I only found two nests, as the birds had evidently been driven away from the Islands, owing to the wholesale taking of their eggs. The nests were constructed in the centre of the wild celery plant, which was growing among the smaller rounded boulders near the top of the rocky shore. The centre of the plant was trampled down into a hollow and a few tufts of grass placed in the depression, forming a nest 10 inches wide by 5 inches deep. The eggs of this species are very large and vary considerably in size and shape; they are usually broad ovals, more or less stumpy at the small end, but some have a pointed or pyriform shape. I do not observe much variation in the ground colour, which is olive grey or pale stone grey or whitish stone colour. The markings are generally small and sparingly distributed over the surface without regard to either end, and are of a pale umber brown, or light sepia in some, over brownish blue spots, blots and specks, these again overlying primary pale spots of blue grey. Occasionaly eggs are found with large handsome clouds of reddish sepia, overlying faint blotches of bluish grey. A series of five vary in length from 3·0 to 2·69 inches and in breadth from 2·1 to 2·2 inches.

PUFFINUS BREVICAUDUS, *Brandt.*

The "Mutton Bird" is said by the inhabitants of Southport to come to the Actæon Islands in vast flocks about the 24th of November, and to commence breeding at once. On the first occasion I visited the Islands no birds were seen anywhere about the Islands; and on the second (28th November) had I not accidently discovered a "Mutton Bird" in what I took for a Penguin's nest, I should have left with the impression that there were none on the Island, as not a sign could be seen of any examples flying round it. At the north end, where the earth bank above the rocks is steep, and riddled with nest holes, I detected the bird in question at the end of a hole, and pulling her out, found an egg in the nest. I subsequently unearthed half-a-dozen birds from holes round the same part of the island, so that it may be inferred that a small colony were breeding there, although the probabilities were that no very great number of birds would visit the island at that late period. The holes were in some instances 6 feet deep, and in one I found both a Penguin and a Petrel, so that the latter must have appropriated the Penguin's habitation, which probably, however, was originally made by the Petrel. When molested in their holes they fight savagely, but do not utter any noise until driven out of their nest, when they utter a low querulous cry. In some nests there was a little grass, in others the egg was deposited on the bare ground. The egg of this Petrel is enormous for the size of the bird, and is a well known article of food among the Straits Islanders and people living on the coast near the bird "colonies." It is white with a chalky excrescence in some examples, though this is not rough like that of a Cormorant's egg. Examples in my collection measure from 2·76 to 2·95 inches in length by 1·78 to 1·86 inches in breadth. A bird I took from the nest proved to be a male, showing that both sexes assist in the duties of incubation. The time of coming on shore to breed is, I am told, the same at the Friar Islands and those at the mouth of Port Davey, where this Petrel breeds in great numbers, in company with the Broad-billed Prion (*Prion vittatus*).

PHALACROCORAX LEUCOGASTER, *Gould.*

The White-breasted Cormorant was nesting in as large a number as the space would admit of on the top of the Blanche Rock. There were about 30 or 40 pairs there, in company with a few little Gulls, which not unfrequently nest in such situations. The nests of the Cormorants were situated in hollows and crevices in the rock, a few strips of seaweed and portions of marine plants forming the receptacle for the eggs. These are three to four in number, elongated ovals in shape, some almost the same at both ends, others slightly pointed at one end. The primary colour is very pale seagreen, but large portions of the shell are covered with a chalky white layer, in some examples rough and in others smooth. Fifteen examples vary from 2·23 to 2·5 inches in length and 1·53 to 1·56 in breadth. A typical egg measures 2·48 inches by 1·5 inches. These eggs were taken by Mr. Joseph Graves on the 20th, it being too rough on the occasion of my visit on the 28th to land on the rock.

EUDYPTULA MINOR, *Forster.*

This Penguin was found breeding on Southport Island and on the Great Actæon on the occasion of both my visits. They excavate a hole in the ground of varying depth from three to six feet, and form a largish cavity at the end for the eggs; in some places have two. Among the dense, matted herbage, in the centre of the Actæon Islands I found the nest under cover of a thick roof of vegetation, with an entrance to it formed under the same, like a tunnel. Here I found the birds carrying on an extraordinary "corroboree" of growls and hoarse crowings, the performers being outside their nests, while the young were hidden beneath the herbage, the comical situation appearing to be that the birds were groaning over the tedious duties of maternity, while their spouses were busy far away at sea in pursuing their prey. Two eggs are laid, one, probably the first, being nearly always soiled with earth, or blood-stained. They are pointed ovals in shape, some more tapering than others; the texture is usually smooth, but there are chalky excrescences in some. A series of about a dozen measure from 2·18 to 2·39 inches in length, and from 1·54 to 1·69 inches in breadth.

These Penguins run with considerable speed, particularly when pursued, for half-a-dozen yards, and then fall forward, lifting themselves up again with their wings, and again making another rush onward. They proceed under water with great speed, literally flying with their rudimentary wings, their course consisting of a series of zigzag darts, which must prove highly effectual in the capture of their prey.

The fisherman have, I am sorry to say, a cruel antipathy to these defenceless birds, and delight in taking them from their nests and worrying them with their dogs. They fight dexterously against their tormentors, and I have seen one keep two terriers off when attacked in a pool of water. Last year a party of men visited the Actæons on the 20th of November, whether from Recherche or Southport is a matter of uncertainty, and with inconceivable barbarity set the islands on fire, roasting alive the unfortunate Penguins, which were breeding in large numbers on the north end of the Great Actæon, and when I visited the island the week following I found the ground strewn with roasted carcases of the birds. This is such wanton cruelty that it should be put down by the Territorial Police. The barbarians who commit these atrocities appear not to have the sense to perceive that there are plenty of fish in the sea for Penguins as well as for human food, and that the destruction of the unfortunate birds can make no appreciable difference to the fish supply. It is only where numbers of the larger species of Cormorants frequent *inland* water that much damage is done to fish.

OBSERVATIONS WITH RESPECT TO THE NATURE AND CLASSIFICATION OF THE TERTIARY ROCKS OF AUSTRALASIA.

By R. M. Johnston, F.L.S.

General Features of the Tertiary System.

Overlying the prevailing sandstones, limestones, shales, and coal beds of the Mesozoic Period are to be found vast accumulations of clays, sands, gravel, marls, calcareous grits, limestones, gypsum, and lignites, of either marine or fresh-water origin. These accumulations, as a rule, do not present the same features as those of the older rocks, inasmuch as the process of consolidation and metamorphism, excepting in rare instances, is far less complete. The rocks generally are loose and incoherent, and their exposed surfaces are less able to resist the weathering and denuding influences of air and water.

It is also manifest, from a study of these accumulations in various countries, that for the most part they were deposited within limited and comparatively shallow basins, whether as sediments of fresh-water lakes, river beds, estuaries, or seas. The frequent changes exhibited in the order and composition of their beds also indicate that they were often subjected to sudden changes of level, permitting the same limited areas to be successively and alternately invaded by the organisms of sea and land within a comparatively short period of time. These changes in some countries, as in France, America, Australia, and Tasmania, are further greatly complicated by widespread eruptions of basalts and associated tuffs, both of which are often interstratified in thin regular sheets over wide areas with the more common aqueous accumulations of sand, clay, lignite, marl, and pebble drifts. In Australia, Tasmania, and also in Scotland (leaf-beds of Mull) these basalts and their tuffs are most intimately associated with leaf-beds. In Tasmania, notably at Breadalbane, there is abundant evidence of the destruction sub-aerially of perfect forests of conifers and angiosperms, by vast outbursts of scoriæ and volcanic dust, such as that remarkable outburst which has recently buried and destroyed a rich vegetation in the vicinity of Mount Tarawera in New Zealand.

Although from the evolutionist's point of view it would be unreasonable to look for a break or hiatus in the continuity of physical and organic processes connected with the succession of rocks and organic life as regards the whole globe, still it must be borne in mind, in respect of any one region, that breaks of a very remarkable character do occur; and although evidences are becoming more and more abundant that the local break involves merely a shift of the conditions to other regions where the threads of continuity are maintained, yet such is the obscurity caused by our ignorance of the direction, extent, and exact sequence of these local shifts, and such are the complications brought about by the commingling of migratory forms from different sources in the successive provinces invaded, that we are still involved in much confusion respecting the true sequence of the rocks and organisms of different regions.

This confusion is intensified by the general tendency among geologists, in widely separated provinces, and, indeed, in opposite hemispheres, to aim at fixing parallel limits too closely,—not only with the great systematic divisions of Europe, where the sequence and boundaries of rock systems were first closely studied, but also with a definite number of minor subdivisions which strictly can only be of local value. Whereas, if due regard be paid to questions concerning unbroken continuity of laws or forces in operation[a], and the inevitable constant successive interweaving of organisms in different regions from many independent centres of origin, forming new groups of association, we should be led to expect that the slow spread of

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[a] "As all the living forms of life are the lineal descendants of those which lived long before the Cambrian epoch, we may feel certain that the ordinary succession by generation has never been broken, and that no cataclysm has desolated the whole world." (Darwin—*Origin of Species*, 6th ed., 1875, p. 428.)

"Upon any theory of 'evolution,' at any rate, it is certain that there can be no total break in the great series of the stratified deposits, but that there must have been a complete continuity of life, and a more or less complete continuity of deposition from the Laurentian period to the present day. There was, and could have been, no such continuity in any one given area, but the chain could never have been snapped at one point and taken up at a wholly different one. The links must have been forged in different places, but the chain, nevertheless, remained unbroken." (Dr. H. A. Nicholson—*Manual of Palæontology*, 2nd ed., 1879, pp. 49-50.)

persistent terrestrial forms of life to the antipodes of their origin would probably in most cases occupy a vast period of time; and consequently the typical forms of a given horizon in one hemisphere should rather be sought in a succeeding horizon in the opposite hemisphere, and *vice versâ* ; and the equivalents of a given subdivision in one geographical province are more likely to be indicated by the local breaks of far distant regions rather than by any local division represented, with which alliances are too frequently sought on the strength of the association of two or three typical genera which they may happen to possess in common.

The danger of this common tendency has already been fully discussed under classification and nomenclature of the Mesozoic period.[a] The great difficulty of correlating widely separated provinces, by reference to the association of typical organisms of any one distant region, is in no way concerned with *absolute contemporaneity*, for that might be reconciled by the theory of *homotaxis*, as defined by Professor Huxley.

The conception of the commingling of types from *widely separated independent centres of origin*—a most probable one—frustrates any attempt by the usual references to fix the sequence and exact relationship of the rocks of widely separated countries.

Towards the close of the Mesozoic period, and during the Tertiary period, physical, climatic, and organic changes of a remarkable character took place, both in the northern and southern hemispheres. Dr. Geikie states that some of the most colossal disturbances of the terrestrial crust of which any record remains took place within the Tertiary period; and adds: "Not only was the floor of the cretaceous sea upraised into lowlands, with lagoons, estuaries, and lakes, but throughout the heart of the Old World, from the Pyrenees to Japan, the bed of the early Tertiary or nummulitic sea was upheaved into a succession of giant mountains, some portions of that sea floor now standing at a height of at least 16,500 feet above the sea." In the southern hemisphere there is no evidence of Tertiary marine beds having been found at a greater altitude than 2000 feet above the existing sea level, but the almost continuous mass of marine formations in Australasia, from Cape York to Tasmania, testify of the won-

[a] Proc. Roy. Soc. of Tas., 1886, (pp. 164-169; 181-182).

derful physical changes that have taken place in this region within the periods. In Wallace's Island Life, pp. 460-467, a most graphic account is given of these changes with respect to their influence upon the spread of organic life. The conclusions arrived at by Mr. Wallace and Professor Hutton, based upon these terrestrial changes, throw much light upon the problems connected with the origin and spread of existing forms of life throughout Australasia, and the writer cannot do better than reproduce an abstract of Mr. Wallace's views in his own words; thus, p. 462: "If we imagine the greater part of North Australia to have been submerged beneath the ocean, from which it rose in the middle or latter part of the Tertiary period, offering an extensive area ready to be covered by such suitable forms of vegetation as could first reach it, something like the present condition of things would inevitably arise . . . The existence in North and North-east Australia of enormous areas covered with Cretaceous and other Secondary deposits, as well as extensive Tertiary formations, lends support to the view that during very long epochs temperate Australia was cut off from close connection with the tropical and northern lands by a wide extent of sea; and this isolation is exactly what was required in order to bring about the wonderful amount of specialisation and the high development manifested by the typical Australian flora . . ." From a study of the South-eastern and South-western Australian flora he also infers that the "facts clearly point to the conclusion that South-western Australia is the remnant of the more extensive and more isolated portion of the continent in which the peculiar Australian flora was principally developed. The existence there of a very large area of granite—800 miles in length by nearly 500 in maximum width—indicate such extension; for this granitic mass was certainly buried under piles of stratified rock, since denuded, and then formed the nucleus of the old Western Australian continent. But while this rich and peculiar flora was in process of formation, the eastern portion (the Cordillera) of the continent must either have been widely separated from the western, or had, perhaps, not yet risen from the ocean. If we examine the geological map of Australia . . . we shall see good reason to conclude that the eastern and western divisions of the country first existed as separate islands, and only became united at a comparatively recent epoch. This is indicated by an enormous stretch of Cretaceous and Tertiary formation extending from the Gulf of Carpentaria completely across the continent to the mouth of the Murray River[1]. During the Cretaceous period, therefore, and probably throughout a considerable portion of the Tertiary epoch, there must have been a wide arm of the sea occupying this area, dividing the great mass of land on the west—the true seat and origin of the typical Australian flora—from a long but narrow belt of land on the east, indicated by the continuous mass of Secondary and Palæozoic formations already referred to, which extend uninterruptedly from Tasmania to Cape York. Whether this formed one continuous land, or was broken up into islands, cannot be positively determined; but the fact that no marine Tertiary beds occur in the whole of this area ([2]) renders it probable that it was almost, if not quite continuous, and that it not improbably extended across to what is now New Guinea."

. . . The eastern and the western islands . . . would then differ considerably in their vegetation and animal life. The western and more ancient land already possessed in its main features the peculiar Australian flora, and also the ancestral forms of its strange marsupial fauna, both of which it had probably received at some earlier epoch by a temporary union with the Asiatic continent over what is now the Java Sea. Eastern Australia, on the other hand, possessed only the rudiments of its existing mixed flora, derived from three distinct sources.

"Some important fragments of the typical Australian vegetation had reached it across the marine strait, and had spread widely, owing to the soil, climate, and general conditions being exactly suited to it; from the north and north-east a tropical vegetation of Polynesian type had occupied suitable areas in the north; while the extension of the Tasmanian peninsula, accompanied probably, as now, with lofty mountains, favoured the immigration of south

[1] The discovery at Table Cape and elsewhere of the marine beds of Eocene age, similar to those of the Murray, indicate the extension of this old Tertiary sea to Northern Tasmania. (R. M. J.)

[2] The Heathy Valley limestones of Tertiary age on Flinders' Island, and other marine deposits on several of the connecting islands in the eastern portion of Bass' Strait, indicate the probable occurrence of one or two minor straits, as at present. (R. M. J.)

temperate forms from whatever Antarctic lands or islands then existed. The marsupial fauna had not yet entered this eastern land, which was, however, occupied in the north by some ancestral struthious birds, which had reached it by way of New Guinea through some very ancient continental extension, and of which the emu, the cassowaries, the extinct Dromornis of Queensland, and the moas and kiwis of New Zealand, are the modified descendants."

From this interesting sketch of the earlier condition of Australasia much may be learned respecting the vast extent of the terrestrial changes which have taken place since the close of the Mesozoic period. It is also obvious that the changes in the alternation of sea and land in the northern hemisphere, and the character of the typical organisms which occupied the areas determined by these changes, must present striking differences as compared with contemporaneous changes in the southern hemisphere; and that, while on the broad lines of epochs or systems there may be many points of agreement, it would scarcely be wise to expect that the subdivisions of the period should offer any approach to agreement either with respect to their extent or number; and, as regards the terrestrial life of these subdivisions, we must also be prepared to expect wide differences, although agreeing in some of the broader distinctions which in a general way mark the Mesozoic and Tertiary epochs.

The nature and composition of the formations have already been referred to. As regards the life of the period, the most distinguishing features observed in contrast with the preceding one are the introduction of types of life which characterise the existing period. We find that the reign of the lycopods, cycads, and yew-like conifers has given way to that of the beech, oak, elm, willow, cinnamon, banksia, eucalyptus, and other angiosperms. This transition, it is true, was not abrupt, for the dawn of the new types had already made an appearance in many countries towards the close of the Mesozoic period (Cretaceous). The ammonites, belemnites, inocerami, scaphites, and other characteristic types of the Mesozoic rocks, disappear or sink into insignificance, and their places are taken by molluscs closely resembling existing forms, and belonging in most cases to identical genera. Towards the close of the period a great part of the species are found to be identical with existing forms. The great dominant reptiles and batrachians, which gave such a singular character to the Secondary period by their numbers and variety, have mostly disappeared from the scene, and their places are occupied by the placental and aplacental mammalian types, most of which prevail to the present day. The placental forms, however, are almost entirely unrepresented in the Australasian region, but there instead the aplacental or pouched animals of the kangaroo and wombat type have attained their highest state of development in size, number, and differentiation. Such being the case, it is clear that, whatever agreement there may be found to exist within the Tertiary period, the subdivisions of the epoch in opposite hemispheres cannot offer a very close correspondence with each other, and the associated forms of life typical of a given formation in one hemisphere would be of little assistance in approximating the boundaries or relationships of any of the subdivisions of the other hemisphere.

Classification.

The only general standard for determining the respective subdivisions of the epoch is the local order of succession of distinct formations, aided, as regards the life of the period, by relationship with existing types as indicated by the percentage of forms which are in common.

This latter method has been adopted with success by European geologists, so far as it is applied locally. For purposes of classification the shell-bearing molluscs are generally selected as the most useful and convenient class of organisms, because they are so abundant and so perfectly preserved in all countries, both in land, freshwater, and marine deposits; and are, moreover, from their diversity of specific form, with numerous varieties produced by change of habitat, so useful in indicating the changing conditions of their environments.

It is true the persistency of certain forms and the variability of others cause perplexity at times; but, upon the whole, the evidences of the conditions under which they lived and of their succession offer greater facilities for the proper classification of rocks than are presented by any other class of organisms.

This is the reason why Lyell based his original classification of the European Tertiary strata—Eocene, Miocene, and Pliocene—mainly upon the evidence of the testaceous mollusca.

By relation to existing species he arranged the known European beds into three principal groups, named on the basis of the percentage of living forms to be found in them.

Thus, the order of the three divisions was classed as follows, beginning with the oldest :—

	Contained Percentage of Species still existing.
Eocene *(dawn of* (recent) *life)*	1 to 3½
Miocene *(less* (proportion of recent) *life)*	17 to 30
Pliocene *(more* (proportion of recent) *life)*	36 to 98

In the first edition of the Principles of Geology, Lyell recognised four distinct groups by the same method; thus :—

	Contained Percentage of Species still existing.
Eocene	3½
Miocene	17
Older Pliocene (Pliocene)	35 to 50
Newer Pliocene (Pleistocene)	90 to 95

The two latter groups are now for the most part linked together under the name Pliocene, and a fresh subdivision, absorbing a portion of the Lower Miocene and Upper Eocene, has been adopted very generally in Europe, termed " *Oligocene.*"

The percentages given, however, are not to be taken too rigidly, for Lyell has himself stated that since the time when the original classification was made (1830) "the number of known shells, both recent and fossil, has largely increased, and their identification has been more accurately determined. Hence some modifications have been required in the classifications founded on less perfect materials."

Generally, then, it may be well to consider that the *Eocene* includes those formations in which living species represent an extremely small proportion of the testaceæ; *Miocene*, those in which the extinct species exceed those having living representatives; and *Pliocene*, those in which the extinct species bear a smaller proportion than the associated species having living representatives. The manifest objection to the use of such terms for the classification of subdivisions of the Tertiary period throughout the world is, that it *fixes* the number of subdivisions; and as it is very improbable that characteristic groups in different countries, especially in opposite hemispheres, will be found on stratigraphic and organic grounds to maintain anything approaching a natural division into three, or even four or more groups, the terms are often a hindrance.

For example, in Australia and Tasmania the marine deposits, though very extensive, do not reappear again and again throughout the epoch, and there are no means, therefore, of determining with satisfaction the exact position of the extensive leaf-bed and lignite formations[a] such as might be obtained if the latter were intercalated with successive marine deposits showing marked differences of percentage of species having living representatives, as in Europe. In this region, the adoption of the European classification would be most unsuitable and very deceptive. It is apparent, therefore, that for Australasia a broader distinction between the older and younger Tertiary deposits is absolutely necessary; and as the terms *Palæogene* and *Neogene* have already been recognised as indicating the older and younger Tertiaries respectively, they have been adopted by the author as most suitable for the classification of these rocks in Australia and Tasmania.

This arrangement is all the more necessary when we come to consider that the introduction of the fourth group, "Oligocene," between the Eocene and Miocene, is by many geologists deemed to be doubtful and arbitrary even as applied to English rocks, although fairly justifiable for some of the formations in France, Germany, and in other European countries. It is also advisable to make the broader classification for other reasons, for there is still much that is uncertain in the groupings of English and other European countries.

Mr. Starkie Gardiner has repeatedly drawn attention to the unsatisfactory classification of the vegetable deposits of Europe, and has given many weighty reasons for revis-

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[a] The attempt to determine the exact age of these deposits by the aid of successive flows or sheets of eruptive basalt, as in Victoria, is far from satisfactory, and affords no reliable guidance to the relationship of various beds in independent basins.

ing the classification which, on doubtful data, groups many of them as *Miocene.*

In commenting upon the development of Dicotyledons, Mr. Gardiner states: "Floras from Spitzbergen in the north to Australia in the south have been classed as Miocene from a very slender fancied resemblance to those of Switzerland, and a great series of strata have been assigned without sufficient reason to that age, not only in Central Europe, but in such distant lands as Greece, Madeira, Borneo and Sumatra, Sachalin and Alaska, and, in fact, wherever other evidence of age was absent." He also clearly enforces views, already advanced in this work, that, in utilising the floras of different countries "for comparison, the differences of latitude and longitude must be taken into account. Nor have we a right to suppose that all the plants preserved from an immense number of localities grew at the same elevation above the sea, while they may also have lived on very different stations and under relatively dry or moist climates." The danger of determining the ages of fossil floras in remote parts of the world by comparing and estimating the percentages common to those of Europe is also very great; for, as Mr. Gardiner remarks: "Not only have we to keep in mind the similarity that dicotyledonous leaves belonging to different genera bear to each other, a likeness increased by the process of fossilization where the matrices are similar, but the fragmentary condition of the specimens usually brought from distant countries . . ." And additional caution is urged by this careful observer by citing the following illustration:—"Were we to take an armful of fallen leaves at random from each country, such as Siberia, Japan, Sumatra, Australia, New Zealand, Madeira, Scotland, France, Greece, and the United States, and compare them together after the manner of palæontologists, is it likely that we should find grounds for supposing that they all belonged to floras growing synchronously?" Such reasoning is most wholesome at the present time, and amply justifies the course adopted by the author in respect of the broader subdivision suggested for Tasmania. Mr. Gardiner, however, states that his remarks are not intended to discredit those who have laboriously worked at the task of deciphering fossil floras, but "simply meant to warn hose who have to make use of the facts arrived at, that conclusions and the inductions drawn from them are not based upon foundations as assured as those of other branches of geology and palæontology."

The following table not only helps us to understand the different opinions of authorities at different times with respect to the classification of well known typical formations of England, but it is an index of the uncertainty of fixing many hard-and-fast subdivisions which would prove suitable for widely separated localities.

Historical Classification of

	Forbes, 1856.	*Jukes,* 1862.
Forest-bed Group	PLIOCENE	PLIOCENE
Chillesford Beds	PLIOCENE	PLIOCENE
Norwich Crag	PLIOCENE	PLIOCENE
Red Crag	PLIOCENE	PLIOCENE
White Crag	PLIOCENE	PLIOCENE
Mull and Antrim Leaf-beds ?	MIOCENE	MIOCENE
Hempstead Beds	EOCENE Upper	EOCENE Upper
Bembridge Beds	EOCENE Upper	EOCENE Upper
Osborne or St. Helen's Beds	EOCENE Upper	EOCENE Middle
Upper Headon Beds	EOCENE Upper	EOCENE Middle
Middle Lower ditto	EOCENE Upper	EOCENE Middle
Upper Bagshot Sands	EOCENE Middle	EOCENE Middle
Barton Beds	EOCENE Middle	EOCENE Middle
Bracklesham or Middle Bagshot	EOCENE Middle	EOCENE Middle
Lower Bagshot	EOCENE Middle	EOCENE Middle
Part of Lower Bagshot	EOCENE Middle	EOCENE Middle
London Clay	EOCENE Lower	EOCENE Lower
Oldhaven Beds	EOCENE Lower	EOCENE Lower
Woolwich and Reading Beds	EOCENE Lower	EOCENE Lower
Thanet Sands	EOCENE Lower	EOCENE Lower

the British Tertiary Beds.

Von Koenen, 1863.	*Page,* 1876.	*Lyell,* 1876.	*Judd,* 1880.	*Geol. Mag. Gardiner,* 1882.	*Geikie,* 1883.	*Phillips and Etheridge,* 1885.
PLIOCENE	PLIOCENE	PLIOCENE (Lwr. | Upper)	PLIOCENE	PLIOCENE	PLIOCENE	PLIOCENE
MIOCENE	MIOCENE	MIOCENE (Lower | Upper)	MIOCENE	MIOCENE	MIOCENE	MIOCENE
OLIGOCENE (Lower | Middle | Upper)	EOCENE	EOCENE (Lower | Middle | Upper)	OLIGOCENE (Lower | Middle | Upper)	OLIGOCENE (Lower | Middle | Upper)	OLIGOCENE	OLIGOCENE
EOCENE (Lower | Middle | Upper)			EOCENE (Lower | Middle)	EOCENE (Lower | Middle | Upper)	EOCENE (Lower | Middle | Upper)	EOCENE (Lower | Middle | Upper)

The following comparative table has also been prepared by the author to show the varying characteristics of the subdivisions of the period in countries widely separated from each other, together with local modes of classification.

AUSTRALASIA.

Australia and Tasmania.—The preceding comparative table gives a fair abstract of the general features, composition, life, and classification of the rocks of the epoch in each of the Colonies of Australasia where the formations of the period are most extensively developed. In a general way it may be stated that, excluding the later raised sea beaches, the Marine Tertiary formations nearly all belong to *Palæogene* age, and are mainly confined to the southern parts of Australia and the northern parts of Tasmania, extending and occupying the greater part of the low-lying country along the course of the River Murray and the southern coast line of Australia. The Rev. J. Tenison-Woods, in a paper read before the Royal Society of Tasmania (Proc. Roy. Soc. Tas., March, 1873), describes them as commencing on the west side of the Great Australian Bight, and are but little interrupted until the high land of Cape Otway is reached. The only interruptions are granite outcrops about Fowler's Bay, Port Lincoln, &c., and the axis of the Flinders' Range, which terminates at Cape Jervis. Upon the flanks of all these, up to a certain height, the Tertiary rocks rest. In some places, such as the Australian Bight, the beds are nearly 400 feet in thickness, and these give almost at one glance a conspectus of the whole of our Tertiary (marine) formations. Between Warnambool and Cape Otway there are equally perfect series, but not superimposed; and the eastern limits of the floor of this old Tertiary sea are found in the vicinity of the spur of the Dividing Range, which abuts upon the sea at Wilson's Promontory, including the formations close to the sea in Gippsland. The more remarkable localities between Cape Otway and the eastern limit embrace formations on the eastern and western shores of Port Phillip, including Geelong, Mount Maria, Muddy Creek, Cape Schanck, &c. The cliffs on the coast near Spring Creek, 16 miles south of Geelong, expose a thickness of about 300 feet of strata. The most southerly limits of this old sea floor are found in northern Tasmania in isolated patches between Cape Grim in the extreme north-west and Flinders' Island in the north-east. The patches in Tasmania, however, though of limited extent, are of considerable thickness, and are extremely rich in fossils. The localities where they are best known occur at (1) a point a little to the south of Cape Grim, extending to Welcome River; (2) Table Cape; (3) Heathy Valley, Flinders' Island.

No marine Tertiaries are known to exist northward towards the Gulf of Carpentaria between the older formations of Western Australia and the Eastern Cordillera; and Mr. Tenison-Woods and other authorities state that the Tertiaries thin out in the direction of the northern and eastern tributaries of the Murray (Riverina District). The ancient mesial gulf dividing the old land of Western Australia from the Eastern Cordillera is in the northern portion occupied mainly by marine formations of Cretaceous age.

The lacustrine formations, also of *Palæogene* age—consisting of clays, marls, sands, lignites, leaf-beds, and pebble drifts—occur in limited basins at various altitudes throughout the eastern and southern part of Australia, and very extensively throughout Tasmania, where some of them are found probably over 1000 feet in thickness. It is estimated that the lacustrine formation known as the Launceston Tertiary Basin, in northern Tasmania, alone covered an area of not less than 600 square miles.

Volcanic Activity.

One of the most remarkable features of the Tertiary period throughout Australia and Tasmania marking the close of the Palæogene epoch is the eruption of extensive sheets, flows, and accumulations of feldspar basalts, with their associated tuffs. It is evident that great volcanic activity prevailed generally at this time, especially in the neighbourhood of ancient lakes, estuaries, and river systems. Considerable areas in such places are covered by repeated flows or sheets of basalt or scoriæ—overwhelming forests, and filling ancient valleys, lakes, estuaries, and river beds. Great waste and erosion have occurred since the period of volcanic activity, and the existing beds of watercourses now generally found at a much lower level are often cut deeply through the sedimentary basins formed by lakes during the Tertiary period.

In the main valleys occur raised alluvial flats, and on the higher slopes ancient gravel terraces; the latter frequently overlying the basalts or basaltic tuffs. Where these formations (Neogene) overlie the older granites, porphyries, metamorphic rocks or slates, they are often mined in search of auriferous and stanniferous drifts, which are generally found occupying the "leads" of the ancient watercourses. The outbursts of volcanic matter are not confined to the lower plains and valleys, for many extensive patches are found in Tasmania, in the great inland plateau, at a height of from 3000 to 4000 feet above sea level, notably at Lake St. Clair, Great Lake, Lake Sorell, and Marlborough. The western elevated plateau of Tasmania, in the neighbourhood of Magnet Range, Mount Bischoff, and Hampshire Hills, is covered to a great extent by a considerable thickness of basalt, and in the localities named this rock is found at altitudes varying between 1800 and 2500 feet above sea level.

Even in these higher levels the existence of extensive underlying beds of lignite and ligneous clays with associated leaf-beds, indicate that the outbursts occurred in regions occupied by fresh-water lakes.

Climate.

Palæogene Period.—Professor Duncan is of opinion that the evidence of the flora of the period resembles that of tropical rather than extra-tropical Australia; and that the Echinodermata of the period afford similar evidence. In addition, the marine beds at Table Cape, Tasmania—rich in reef-building corals—have recently afforded evidence of contemporaneous relationship with a flora, some of the species of which (*Sapotacites oligoneuris*, &c.) are identical with those abounding in lacustrine deposits throughout the island. Of the Tasmanian reef-building corals Professor Duncan writes: "Evidently the reefs round Tasmania, now long extinct, existed amidst all the physical conditions peculiar to coral growth on a large scale. Pure sea water, in rapid movement, and having a temperature of not less than 74° Fahrenheit, was as necessary to them as it is to those far away to the north and the north-east at the present day. The coral-isotherm would have to be 15° of latitude south of its present position in order that the reef should flourish south of Cape Howe."

We must not forget, however, that the Rev. J. Tenison-

Woods, who was the first person who made a thorough investigation of our Tertiary marine beds, has come to regard the evidences of the fauna in a different light. He infers that "our Lower Tertiary fauna is not a tropical, or even a sub-tropical one." "All that we can say," he continues, "is that certain species which are found still living now inhabit the tropics, while others remain where they are, and generally very many of the genera are now to be found in a warmer climate. It is very remarkable to find specimens of reef-building corals, but we can hardly assert under what conditions they lived, since they are so very different from the reef-builders of the present day. I suppose it is hardly attempted to account for the reef-building corals which we find in the British coral rag (oolitic), for instance, by climatal conditions alone. He further adds: "It seems to me that we are too imperfectly acquainted with the circumstances which govern the migration of species at present to be able to apply even generally any reasoning to such facts as those before us. Climate alone will not account for them." The difficulty of arriving at correct conclusions is not lessened by confining attention to the flora; for the general prevalence of the oak, birch, elm, alder, and beech in the Tertiary lacustrine deposits, and their almost total disappearance in Australia at the close of the Palæogene period, are matters not easily disposed of by references to any one single cause. From the knowledge of the distribution of such types at the present day, we would be justified in inferring a very temperate clime, in Tasmania at least, during the earlier or middle part of the Tertiary period. And this inference is borne out to some extent by the fact that one of the survivals—the genus *Fagus*—is now only to be found in moist situations in alpine and sub-alpine heights in Tasmania, whilst the genus *Eucalyptus*, found rarely in the Tertiary deposits of Tasmania, now generally predominates over all other trees in the drier and warmer parts from the sea level to sub-alpine heights. Whatever influences were at work, therefore, towards the close of the Middle Tertiary period, it is evident in Australia that they operated in favour of the spread of the *Proteaceæ* and *Myrtaceæ*, and against the deciduous types of trees such as the oaks, elms, beeches, and alders formerly prevailing; and it is equally true that effects the reverse of this were in operation in France, Switzerland, and Great Britain, where the *Proteaceæ*, formerly so abundant, have now become extinct.

Neogene Period.—Mr. Wilkinson is of opinion that the great drift deposits left at different levels upon the sides of the valleys as they were deepened towards the close of the *Neogene* period indicate a much greater rainfall than at present, and this greater rainfall is inferred to be due to the greater extent of glaciation of portions of the northern and southern hemispheres. Whatever grounds there may be for this view, it is clear, from the absence of huge ice-borne erratics and other evidences on the lower levels, we are not justified in assuming a very serious and general refrigeration of the climate in the Australasian region.

That a considerable change of climate, however, had its beginning at this time is most probable, as evidenced by the sudden disappearance of the characteristic flora of the older or *Palæogene* epoch; and especially by the striking contrast which its unstratified irregular drift deposits (almost barren of all traces of life) present, as compared with the more regularly stratified members, replete with life remains, of the *Palæogene* epoch.

New Zealand.—In the preceding comparative table it may be seen that the great physical changes in New Zealand during the Tertiary period do not correspond with those of Australia and Tasmania. Unlike the latter, the several divisions in New Zealand are well marked by successive marine formations, and these again are in most cases easily distinguished by the different assemblages of molluscs contained in them, and by the striking differences as regards the percentages which obtain in respect of those of the species having living representatives. This is at once apparent from the following abstract of the subdivision as arranged by Professor Hutton:—

Classification of Tertiary Formations in New Zealand.

	Contained Percentage of Species still existing.
Wanganúi System (Pliocene)	70 to 90
Pareora System (Miocene)	20 to 45
Oamarú System (Oligocene)	9 to 10

It is obvious, therefore, that with such marked characteristics in the assemblages of the mollusca, the New Zealand rocks do not present to the classifier such difficulties as those referred to with respect to the members of the system in Australia and Tasmania,—where, with the exception, perhaps, of a limited patch of marine beds of later age at Flemington, Victoria, the whole of the marine formations are confined to an extensive though continuous series of formations, which, if we trust to the percentage method, must be restricted to the earliest Tertiary period (probably Eocene).

None of the various bands or groups in Australia and Tasmania contain more than from about 1 to 5 per cent. of species of molluscs having living representatives. It is significant, too, that as the molluscs of these beds are more thoroughly investigated the tendency is to reduce even this very small percentage. Whatever advantage there may be locally in distinguishing certain zones within the Australian and Tasmanian series, it seems, therefore, almost certain, according to the percentage method, that they should be classed as Eocene rather than Oligocene or Miocene, to which periods some of the divisions have been referred by some authorities.

With such advantages as those referred to, the New Zealand geologists have greater facilities for determining the position of their numerous lacustrine formations containing lignites, coals, and other vegetable drifts.

From the fact that some of the marine formations of the Paréora system are now found at an altitude of over 2000 feet above sea level, it is evident that New Zealand has been subjected to even greater physical changes than Australia and Tasmania since the early Tertiary period. The greater extent of glaciation in the Neogene epoch in New Zealand is also evidently isochronous with the supposed colder epoch in Australia and Tasmania, and it is generally regarded by the geologists of New Zealand as mainly due to the very much greater elevation of the land at that time.

Life of the Period in Australia and Tasmania.

The following tables show the probable distribution, in time, of the genera of plants and molluscs occurring in Australia and Tasmania during the Tertiary period, embracing also a fairly complete list of the various species of fossils described up to the present time. The tables, by their arrangement, readily indicate the distribution in the various Colonies where the Tertiary formations are principally developed.

In addition to the generic and specific lists of fossils, a summary has been prepared under the head of *Classes*, showing in alphabetical order the names of authors to whom we are indebted for the greater part of the original specific descriptions and determinations. It will be seen from this summary that the principal palæontological work has been accomplished by the following persons; viz.—

Plantæ—Baron von Ettingshausen, Baron F. von Mueller, and R. M. Johnston.

Rhizopoda—D'Orbigny, and Professors Rupert Jones and Brady.

Actinozoa—Dr. Duncan and Rev. J. E. Tenison-Woods.

Echinodermata—Dr. Duncan, Lamarck, and Professor M'Coy.

Polyzoa—Professor Busk and Rev. J. E. Tenison-Woods.

Mollusca—Professor Tate, Rev. J. E. Tenison-Woods, R. M. Johnston, and Professor M'Coy.

Pisces and Mammalia—Professors Agassiz and M'Coy.

Of the 908 species enumerated, Professor Tate has described 224 species, or nearly 25 per cent.; Rev. J. E. Tenison-Woods described 165 species; and the author describes or figures 116 species. The three together describe 505 species, or over 52 per cent. of the whole.

TABLE SHOWING T... URED BY

Authors of Sve...

...lia.

Ulmaceæ ..
Myricaceæ .
Juglandaceæ
Betulaceæ .
Platanaceæ.
Cupuliferæ .
Salicineæ ..
Moreæ ....
Artocarpeæ
Laurineæ ...

Tertiary Fossils.

TABLE SHOWING THE NUMBER OF SPECIES UNDER EACH CLASS, DESCRIBED, DETERMINED, OR FIGURED BY VARIOUS AUTHORS.

Authors of Species enumerated.	*Plantæ.*	*Rhizopoda.*	*Actinozoa.*	*Echinodermata.*	*Annelida.*	*Crustacea.*	*Polyzoa.*	*Brachiopoda.*	*Pelecypoda.*	*Scaphapoda.*	*Pteropoda.*	*Gasteropoda.*	*Cephalapoda.*	*Pisces.*	*Mammalia.*	TOTAL.
Adams and Reeve	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Agassiz	..	..	..	..	..	..	..	..	..	..	..	..	..	7	..	7
Alth	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1
Brocchi	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Bosquet	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1
Busk	..	..	..	..	..	..	33	..	..	..	..	..	..	..	..	33
Carter	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Davidson	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1
Darwin	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1
Defr	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	2
Deshayes	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1
D'Orbigny	..	24	..	..	..	..	1	..	1	..	..	..	..	..	..	26
Duncan	..	..	31	12	..	..	..	..	..	..	..	..	..	..	..	43
Edwards and Haimes	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	3
Etheridge (R.)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
——— (R., jun.)	..	..	..	1	..	..	1	2	3	..	..	..	..	..	..	7
Ettingshausen	61	..	..	..	..	..	..	..	..	..	..	..	..	..	..	61
Fichte and Molle	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	3
Gray	..	..	..	2	..	..	..	..	1	..	..	..	..	..	..	3
Hassal	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	2
Hagenow	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Harris	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Hutton	..	..	..	..	..	..	..	1	3	..	..	2	..	..	..	6
Johnston (R. M.)	74	..	..	1	..	1	..	..	6	..	..	34	..	..	..	116
Jones and Pedder	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Lamarck	..	4	..	1	..	..	..	..	1	..	..	..	..	..	..	6
Laube	..	..	..	9	..	..	..	..	..	..	..	..	..	..	..	9
Linnæus	..	1	..	..	..	..	1	..	2	..	..	..	..	..	..	4
M'Coy	3	1	..	6	1	..	1	1	11	..	..	22	..	4	4	54
M'Gillivray	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Montagu	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	2
Mueller (Baron F. von)	31	..	..	..	..	..	..	..	..	..	..	..	..	..	..	31
Phillips	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Quoy and Gaimard	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Reuss	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	2
Sanger	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Sowerby (J.)	..	..	..	..	..	..	..	1	1	..	..	2	..	..	..	4
Sowerby (G. B.)	..	..	..	..	..	..	..	..	1	..	..	2	1	..	..	4
Stoliczka	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Sturt	..	..	..	..	..	..	4	..	6	..	..	..	..	..	..	10
Sequenza	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Tate (Professor Ralph)	..	..	..	1	..	..	..	23	168	6	5	20	1	..	..	224
Woods (Tenison)	..	..	22	3	..	..	13	5	21	..	..	101	..	..	..	165
Woods and Duncan	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	2
Woods and Tate	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Walker and Jacob	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Wright	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Zittel	..	..	..	..	..	..	..	..	4	1	..	..	..	..	..	5
Undetermined	4	6	5	1	..	..	6	..	10	..	..	14	..	..	4	50
TOTAL	173	50	63	39	1	6	65	34	243	8	5	197	2	11	10	908

PROBABLE RANGE, IN TIME, OF THE CHARACTERISTIC GENERA OF PLANTS OCCURRING IN THE ROCKS OF THE TERTIARY PERIOD IN AUSTRALIA AND TASMANIA.

		PALÆOZOIC.			MESOZOIC.			CAINOZOIC.			
								TERTIARY.			POST TER.
Families.	*Genera.*	*Cam. to Dev.*	*Carb.*	*Per.*	*Tr.*	*Jr.*	*Gr.*	*E.*	*M.*	*P.*	
Myristicaceæ	Myristica						—	—	—	—	—
Magnoliaceæ	Magnolia						—	—	—		
	Liriodendron								—	—	—
	Illicites								—	—	—
Pittosporaceæ	Pittosporum						—	—	—	—	—
Myrtaceæ	Eucalyptus						—	—	—?	—	—
Aceraceæ	Acer								—	—	
Sapindaceæ	Sapindus								—		
	Pentacoila								—		
	Penteune								—		
	Phymatocaryon								—		
	Tricolocaryon								—		
Tillaceæ	Tilia								—	—	—
	Elæocarpus								—		
Rhamneæ	Rhamnus								—	—	—
	Pomaderrites								—		
Calycifloræ	Acrocoila								—		
Papilionaceæ	Dalbergia								—		
Celastrineæ	Celastrophyllum								—		
Olacineæ	Eisothecaryon								—		
Sterculiaceæ	Bombax								—		
Capparideæ ?	Liversidgea								—		
	Dieune								—		
	Ochtodocaryon								—		
	Plesiocapparis								—		
Menispermaceæ	Rhytidocaryon								—		
Saxifragaceæ	Ceratopetalum						—	—	—		
Sapotaceæ	Sapotacites								—		
Cæsalpineæ	Cassia								—	—	—
	Leguminocites						—		—	—	—
Verbenaceæ	Premna								—		
	Trematocaryon								—		
Boragineæ	Cordia								—	—	—
Apocynaceæ	Apocynophyllum								—	—	—
	Tabernæmontana								—	—	—
	Echitonium								—	—	—
Rubiaceæ	Coprosma								—	—	—
Proteaceæ	Lomatia								—	—	—
	Knightia								—		
	Banksia								—		
	Conchocaryon								—	—	—
	Celyphina								—		
	Conchotheca								—		
	Dryandroides						—	—	—	—	—
Laurineæ	Cinnamomum						—	—	—	—	—
	Laurus								—	—	—
	Daphnogene								—		
Artocarpeæ	Artocarpidium								—	—	—
Moreæ	Ficonium								—	—	—
	Ficus						—	—	—	—	—
Salicineæ	Salix						—	—	—	—	—
Cupuliferæ	Fagus						—	—	—	—	—
	Quercus						—	—	—	—	—
	Castanopsis								—	—	—
Platanaceæ	Platanus						—	—	—?	—	—
Betulaceæ	Betula								—	—	—
	Alnus								—	—	—
Juglandaceæ	Juglans						—	—	—	—	—
Myricaceæ	Myrica								—		
Ulmaceæ	Ulmus								—	—	—
	Microrhagion								—		

CKS OF AUSTRALASIA,

TIC GENERA OF PLANTS OCCURRING IN THE ROCKS OF THE AUSTRALIA AND TASMANIA.

PALÆOZOIC.		MESOZOIC.			CAINOZOIC.			
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Families.	…NOZOIC.		
	…RY.		POST TER.
		P.	
Coniferæ..........		—	—
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Pleu	—	—
Daph	—	—
Mang	—	—
Conu	—	—
Cypr	—	—
Trivi	—	—
Cassi	—	—
Cassi	—	—
Nati	—	—
Troc	—	—
Crep	—	—
Solar	—	—
Adec	—	
Scal	—	—
Cros	—	—
Turr	—	—
Torc		
Verr	—	—
Tena	—	—
Euli	—	—
Leio	—	—

Families.	Genera.	PALÆOZOIC.			MESOZOIC.			CAINOZOIC.			
								TERTIARY.			POST TER.
		Dev.	Carb.	Per.	Tr.	Jr.	Cr.	E.	M.	P.	
Coniferæ	Spondylostrobus								—	—	—
	Larix								—	—	—
	Araucaria					—	—	—	—	—	—
	Sequoia						—	—	—	—	—
	Taxites			—	—	—	—	—	—	—	—
Filices	Pteris								—	—	—
	Trichomanes								—	—	—
	Lomaria								—	—	—
	Aspidium								—	—	—

Probable Range, in Time, of the Characteristic Genera of Molluscs occurring in the Rocks of the Tertiary Period in Australia and Tasmania.

	PALÆOZOIC.				MESOZOIC.			CAINOZOIC.			
								TERTIARY.			POST TER.
	Ca.	Sil.	Dev.	Carb. Per.	Tr.	Jr.	Cr.	Eo.	Mio.	Plio.	
Brachiopoda.											
Terebratula					—	—	—	—	—	—	—
Waldheimia				—	—	—	—	—	—	—	—
Terebratulina						—	—	—			—
Terebratella					—	—	—	—			
Magasella								—			
Thecidium					—	—	—	—			
Rhynchonella		—	—	—	—	—	—	—	—	—	
Pelecypoda.											
Aspergillum								—	—	—	—
Solecurtus								—	—	—	—
Saxicava						—	—	—	—	—	—
Panopæa							—	—	—	—	—
Corbula							—	—	—	—	—
Zenatiopsis								—	—	—	—
Myodora							—	—	—	—	—
Psammobia							—	—	—	—	—
Tellina							—	—	—	—	—
Chione							—	—	—	—	—
Cytherea							—	—	—	—	—
Dosinia								—	—	—	—
Gouldia											
Cardium		—	—	—	—	—	—	—	—	—	—
Chama							—	—	—	—	—
Chamostrea											
Lucina		—	—	—	—	—	—	—	—	—	—
Diplodonta					—		—	—	—	—	—
Sacchia								—			
Lepton								—			
Kellia								—	—	—	—
Crassatella								—	—	—	—
Montacuta								—			
Cardita								—	—	—	—
Mytilicardia								—	—	—	—
Unio					—	—	—	—	—	—	—
Anodonta								—	—	—	—
Trigonia			—	—	—	—	—	—	—	—	—
Nucula		—	—	—	—	—	—	—	—	—	—
Leda		—	—	—	—	—	—	—	—	—	—
Arca		—	—	—	—	—	—	—	—	—	—
Barbatia								—	—	—	—
Cucullæa		—	—	—	—	—	—	—	—	—	—

	PALÆOZOIC.				MESOZOIC.			CAINOZOIC.			
								TERTIARY.			POST TER.
	Ca.	Sil.	Dev.	Carb. Per.	Tr.	Jr.	Cr.	Eo.	Mio.	Plio.	
Pelecypoda—continued.											
Pectunculus								—	—	—	—
Limarca								—	—	—	
Limopsis					—	—	—	—	—	—	—
Modiolaria								—	—		
Septifer						—	—	—	—		
Vulsella							—	—	—	—	—
Pinna								—	—	—	—
Spondylus				—	—	—	—	—	—	—	—
Modiola		—			—	—	—	—	—	—	—
Lima				—	—	—	—	—	—	—	—
Limea						—	—	—			
Pecten			—	—	—	—	—	—	—	—	—
Hinnites					—	—	—	—	—	—	—
Placunanomia				—				—	—		
Ostrea					—	—	—	—	—	—	—
Gryphea						—	—	—	—		
Dimya								—	—		
Pteropoda.											
Styliola								—	—		
Vaginella								—	—		
Spirialis								—	—	—	
Gasteropoda.											
Helix							—	—	—	—	—
Vitrina								—	—	—	—
Bulimus								—	—	—	—
Murex								—	—	—	—
Typhis								—	—	—	—
Ricinula								—	—	—	—
Tritonium								—	—	—	—
Fusus							—	—	—	—	—
Latirus											
Buccinum								—	—	—	—
Cominella								—	—	—	—
Nassa								—	—	—	—
Voluta							—	—	—	—	—
Mitra							—	—	—	—	—
Thala								—			
Erato								—	—	—	—
Marginella							—?	—	—	—	—
Ancillaria								—	—	—	—
Columbella								—	—	—	—
Cancellaria								—	—	—	—
Terebra								—	—	—	—
Pleurotoma							—	—	—	—	—
Daphnella								—	—	—	—
Mangelia								—	—	—	—
Conus							—	—	—	—	—
Cypræa							—	—	—	—	—
Trivia								—	—	—	—
Cassis								—	—	—	—
Cassidaria							—	—	—	—	—
Natica		—	—	—	—	—	—	—	—	—	—
Trochita								—	—	—	—
Crepidula							—	—	—	—	—
Solarium								—	—	—	—
Adeorbis								—	—	—	
Scalaria				—	—	—	—	—	—	—	—
Crossea								—	—	—	—
Turritella				—	—	—	—	—	—	—	—
Torcula								—	—		
Vermetus			—	—	—	—	—	—	—	—	—
Tenagodus								—	—	—	—
Eulima				—	—	—	—	—	—	—	—
Leiostraca								—	—	—	—

	MESOZOIC.			CAINOZOIC.			
				TERTIARY.			POST TER.
Carb. Per.	*Tr.*	*Jr.*	*Cr.*	*Eo.*	*Mio.*	*Plio.*	
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„ Werribee		
„ Sprentii.		
„ sp. ind. .		
Daphnogene, sp		
Proteaceæ.		
Lomatia prælon	—	
Knightia Dalto		
Banksia, sp. ind.		
„ sp. ind		
Conchocaryon S		
Celyphina Macc		
Conchotheca (?)		
„ turg		
Dryandroides J		
Rubiaceæ.		
Coprosma præcu		
Apocynaceæ.		
Apocynophyllum	—	
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Tabernæmontan	—	
Echitonium obs		

C.	
io.	POST TER.

	PALÆOZOIC.				MESOZOIC.			CAINOZOIC.			
								TERTIARY.			POST TER.
	Ca.	*Sil.*	*Dev.*	*Carb. Per.*	*Tr.*	*Jr.*	*Cr.*	*Eo.*	*Mio.*	*Plio.*	
Gasteropoda—continued.											
Turbonilla							—	—	—	—	—
Odostomia								—	—	—	—
Pyramidella							—	—	—	—	—
Cerithium				—	—	—	—	—	—	—	—
Cerithiopsis								—	—		
Potamides								—	—	—	—
Rissoina								—	—	—	—
Rissoa								—	—	—	—
Liotia						—	—	—	—	—	—
Turbo		—	—	—	—	—	—	—	—	—	—
Imperator					—	—	—	—	—	—	—
Calcar								—	—	—	—
Delphinula						—	—	—	—	—	—
Trochus			—	—	—	—	—	—	—	—	—
Gibbula											
Zizyphinus								—	—	—	—
Thalotia								—	—	—	—
Euchelus								—	—	—	—
Margarita								—	—	—	—
Haliotis							—	—	—	—	—
Fissurellidæ				—	—	—	—	—	—	—	—
Emarginula				—	—	—	—	—	—	—	—
Actæon					—	—	—	—	—	—	—
Ringicula								—	—	—	—
Cylichna						—	—	—	—	—	—
Scaphopoda.											
Dentalium								—	—	—	—
Entalis								—	—		
Cadulus			—	—	—	—	—	—	—	—	—

List of the Species occurring in the Rocks of the System in Australasia.

		Tasmania.		South Australia.		Victoria.		New South Wales.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
PLANTÆ.									
Filices.									
Pteris Humei	*Ettingshausen.*							—	
„ Belli	*R. M. Johnston.*	—							
Lomaria primaeva	„	—							
Trichomanides Tasmanica	„	—							
Coniferæ.									
Spondylostrobus Smythii	*F. von Mueller.*	—				—		—	
Aracauria Johnstoni	„	—							
Taxites Thureaui	*R. M. Johnston.*	—							
Cycadites microphylla	„	—							
Monocotyledon.									
Microrhagion Liversidgei	*Ettingshausen.*							—	
Myricaceæ.									
Myrica Eyeri	„	—							
Betulaceæ.									
Betula Daltoniana	„							—	
„ Derwentensis	„	—							
„ Launcestonensis	*R. M. Johnston.*	—							
Almaceæ.									
Alnus Muelleri	*Ettingshausen.*	—						—	
Ulmus Tasmanicus	*R. M. Johnston.*	—							
Cupuliferæ.									
Quercus Hookeri	*Ettingshausen.*							—	
„ praephilippinensis	„							—	
„ drymejoides	„							—	
„ Darwinii	„							—	
„ Tasmanii	„	—							
„ sp. ind.		—							
„ Bischoffensis	*R. M. Johnston.*	—							
Fagus Wilkinsoni	*Ettingshausen.*							—	
„ Risdoniana	„	—							
Castanopsis Benthami	„							—	
Salicineæ.									
Salix Cormickii	„	—							
Moreæ.									
Ficonium Solandri	„							—	
Artocarpeæ.									
Artocarpidium Stuartii	„							—	
Laurineæ.									
Cinnamomum polymorphoides	*M'Coy.*	—						—	
„ Leichardtii	*Ettingshausen.*							—	
„ Woodwardii	„	—							
„ Hobartianum	„	—							
Laurus Australiensis	„							—	
„ Werribeensis	*M'Coy.*					—			
„ Sprentii	*R. M. Johnston.*	—							
„ sp. ind.	„					—			
Daphnogene, sp. ind.	„					—			
Proteaceæ.									
Lomatia praelongifolia	*Ettingshausen.*	—						—	
Knightia Daltoniana	„								
Banksia, sp. ind.						—			
„ sp. ind.		—							
Conchocaryon Smithii	*F. von Mueller.*					—			
Celyphina Maccoyi	„					—			
Conchotheca (?) rotundata	„					—			
„ turgida	„	—				—			
Dryandroides Johnstonii	*Ettingshausen.*	—							
Rubiaceæ.									
Coprosma praecuspidifolia	„	—							
Apocynaceæ.									
Apocynophyllum Etheridgei	„							—	
„ travertinum	„	—							
„ microphyllum	„	—							
Tabernæmontana primigenia	„							—	
Echitonium obscurum	„	—							

OF AUSTRALASIA,

ROCKS OF THE SYSTEM IN AUSTRALASIA.

	TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
	Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
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		Tasmania.		South Australia.		Victoria.		New South Wales.	
		Pal.	Neo.	Pal.	Neo.	Pal.	Neo.	Pal.	Neo.
Boragineæ.									
Cordia Tasmanica	*Ettingshausen.*	—							
Verbenaceæ.									
Premna Drummondii	,,	—							
Trematocaryon Maclellani	*F. von Mueller*					—			
Sapotaceæ.									
Sapotacites oligoneuris	*Ettingshausen.*	—							
,, achrasoides	,,	—							
Saxifragaceæ.									
Ceratopetalum Woodii	,,	—							
,, præarbutifolium	,,	—							
Menispermaceæ.									
Rhytidocaryon Wilkinsoni	*F. von Mueller*							—	
Magnoliaceæ.									
Magnolia Brownii	*Ettingshausen.*							—	
,, Torresii	,,							—	
Illicites astrocarpa	*F. von Mueller*							—	
Capparideæ.									
Liversidgea oxyspora	,,							—	
Dieune pluriovulata	,,					—			
Ochtodocaryon Wilkinsonii	,,							—	
Plesiocapparis leptocelyphis	,,	—						—	
,, prisca	,,					—			
Sterculiaceæ.									
Bombax Sturtii	*Ettingshausen.*							—	
,, Mitchellii	,,							—	
Tiliaceæ.									
Elæocarpus Bassii	,,	—							
Olacineæ.									
Eisothecaryon semiseptatum	,,							—	
Sapindaceæ.									
Sapindus Tasmanicus	,,	—							
Pentacoila Gulgongensis	*F. von Mueller.*							—	
Penteune brachyclinis	,,					—			
,, Clarkei	,,					—			
,, trachyclinis	,,					—			
,, Allporti	,,	—							
Phymatocaryon angulare	,,					—			
,, bivalve	,,					—			
,, Mackayi	,,					—			
Tricolocaryon Barnardii	,,							—	
Pittosporaceæ.									
Pittosporum priscum	*Ettingshausen.*							—	
Celastrineæ.									
Celastrophyllum Cunninghami	,,							—	
Rhamneæ.									
Pomaderris Banksii	,,							—	
Calyciflora.									
Acrocoila anadonta	*F. von Mueller*							—	
Myrtaceæ.									
Eucalyptus Delftii	*Ettingshausen.*							—	
,, obliqua?	*Herit.*					—			
,, Pluti	*M'Coy.*					—			
,, Kayseri	*R. M. Johnston.*	—							
,, Milligani	,,	—							
Papilionaceæ.									
Dalbergia Diemenii	*Ettingshausen.*							—	
Cæsalpineæ.									
Cassia Cookii	,,							—	
,, Flindersii	,,	—							
Leguminosites Kennedyi	,,							—	
Incerta sedis.									
Odontocaryon Macgregorii	*F. von Mueller*					—			
Platycoila Sullivani	,,	—				—			
Pleiacron elachocarvum	,,							—	
Rhytidotheca Lynchii	,,					—			
,, pleioclinis	,,	—				—			
Wilkinsonia bilaminata	,,					—			

		Tasmania.		South Australia.		Victoria.		New South Wales.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Cæsalpineæ—continued.									
Xylocaryon Lockii	*F. von Mueller.*	—				—			
Carpolithes gærtneroides	*Ettingshausen.*	—							
,, Risdonianus	,,	—							
,, sp. indet. Fig. 7	(*Johnston.*) *Proc. Roy. Soc. Tasmania*, 1874.	—							
,, ,, ,, 11		—							
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,, ,, ,, 38 39	*Ibid*, 1881.	—							
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Phyllites populiformis	*Ettingshausen.*	—							
,, ficiformis	,,	—							
,, juglandiformis	,,	—							
,, ligustroides	,,	—							
,, pyriformis	,,	—							
,, phaseolites	,,	—							
,, sophoræformis	,,	—							
,, mimosæformis	,,	—							
,, sp. ind. Fig. 2	(*Johnston.*) *Proc. Roy. Soc. Tasmania*, 1873.	—							
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,, ,, ,, 7	*Ibid*, 1874. (*Johnston.*)	—							
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,, ,, ,, 3	*Ibid*, 1881. Estuary of the Derwent. (*Johnston.*)	—							
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,, ,, Pl. I. Fig. 5	*Ibid*, 1885. Leaf-beds under basalt at Waratah. (*Johnston.*)	—							
,, ,, Pl. I. ,, 6		—							
,, ,, Pl. I. ,, 7		—							
,, ,, Pl. II. ,, 2		—							
,, ,, Pl. II. ,, 3		—							
,, ,, Fig. 1	*Ibid*, 1886.	—							
,, ,, ,, 2	*Ibid.* Leaf impressions, including *Sapotacites oligoneuris* (Ett.), occurring in the *Turritella* sandstone beds at Table Cape, Tasmania, among which the marine shells *T. Warburtonii* and *Panopeæ Agnewi* are especially characteristic. (Johnston.)	—							
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OF AUSTRALASIA,

	TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
	Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
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	IA.	NEW SOUTH WALES
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Dendrophyllia		
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Paracyathus (		
Eupsammia (		
Cyathosmilia l		
„ t		
Bistylia adher		
Cladocora con		
Pleiastræa St.		
„ sp.		
Montlivaltia di		
Trematrochus		
ECHINODERMAT		
Arachnoides A		
„ el		
„ L		
Catopygus eleg		
Cidaris, sp. ind		
Echinanthus te		
Echinarachinus		
Echinobrissus A		
Echinolampas		
„ C		
„ c		

		Tasmania.		South Australia.		Victoria.		New South Wales.	
		Pal.	Neo.	Pal.	Neo.	Pal.	Neo.	Pal.	Neo.
Fossil wood. *Pine*, sp. indet. Fig. 16–18	Proc. Roy. Soc.	—							
„ *Banksia* „ „ 10–13	Tasmania, 1874.	—							
„ *Exogen* „ „ 19–20	(Johnston.)	—							
„ „ „ „ 14–15		—							
ANIMALIA.									
Rhizopoda.									
Foraminfera.									
Amphistegina vulgaris	*D'Orb.*			—					
Biloculina contraria	„								
„ depressa	„								
„ elongata	„								
„ ringens	*Lamarck.*								
„ sp. indet.		—							
Cassidulina oblonga*	*Reuss.*	—							
Cornuspira foliacea	*Phillipi.*								
„ involvens	*Reuss.*								
Cristellaria rotulata	*Lamarck.*								
Discorbina Berthcloti	*D'Orb.*	—							
„ turbo	„					—			
Glandulina lævigata	„								
Globigerina bulloides	„								
Hauerina compressa	„								
Lituola Soldanii	*Jones & Parker.*								
Nummulina Raymondi	*Defr.*								
„ sp. indet.		—							
Operculina Arabica	*Carter.*								
„ complanata	*Defr.*								
Orbitolites complanatus	*Lamarck.*								
Orbulina universa	*D'Orb.*								
„ sp. indet.		—							
Planorbulina Haidingerii	„								
„ lobatula	„								
„ reticulata	*Czjzek.*								
„ rotula	*D'Orb.*								
„ Ungeriana	„								
Planularia crepidula	*Fichtel & Moll.*								
Polymorphina lactea	*Walker & Jacob.*								
„ sp. indet.		—							
Polystomella craticula	*Fichtel & Moll.*								
„ macella	„								
Nonionina sp. indet.		—							
Pulvinulina pulchella	*D'Orb.*			—		—			
„ repanda, var. elegans	„			—					
Quinqueloculina agglutinans	„			—					
„ secans	„			—					
„ seminulum	*Linn.*			—		—			
„ subrotunda	*Montagu.*			—					
„ sp. indet.		—							
Rotalia Beccarii var.	*Linn.*								
„ var. Soldanii	*D'Orb.*			—					
Spiroloculina canaliculata	„			—					
Textularia agglutinans	„	—		—					
„ pygmæa	„	—		—					
„ sagittula	„			—		—			
Triloculina oblonga	*Montagu.*			—					
„ tricarinata	*D'Orb.*			—					
„ trigonula	*Lamarck.*			—		—			
Spongida.									
Tethia Newberyi	*M'Coy.*					—			
Actinozoa.									
Amphihelia zic-zac	*Ten.-Woods.*			—					
„ incrustans	*Duncan.*			—		—			
„ striata	*T. Woods.*					—			
Conocyathus cyclostratus	„					—			
„ fenestratus	„					—			
Trochocyathus meridionalis	*Duncan.*					—			

		TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Trochocyathus Victoriæ	*Duncan.*					—			
„ heterocostatus	*T Woods.*			—		—			
Deltocyathus viola	*Ten.-Woods & Duncan.*	—		—		—			
„ italicus	*M. Ed. & Haine.*					—			
„ excisus	*Duncan.*	—		—		—			
„ alatus	*Ten.-Woods.*			—		—			
„ Aldingensis	„			—					
„ Tateanus	„			—					
Spenotrochus variolaris	„					—			
„ Australis	*Duncan.*			—		—			
„ emaciatus	„					—			
Controchus M'Coyi	„	—				—			
„ typus	*Sequenza.*			—		—			
Antillia lens	*Duncan.*	—		—		—			
Smilotrochus vacuus	*Ten.-Woods.*					—			
Flabellum candeanum	*M. Ed. & Haine.*			—		—			
„ distinctum	„			—		—			
„ Victoriæ	*Duncan.*	—		—		—			
„ Gambieriense	„	—		—		—			
„ Duncani	*Ten.-Woods.*	—							
Placotrochus elongatus	*Duncan.*	—				—			
„ deltoideus	„	—		—		—			
„ elegans	*Ten.-Woods.*								
Heliastrea Tasmaniensis	*Duncan.*	—							
Thamnastræa sera	„	—							
„ Tasmaniensis	„	—							
Palæoseris Woodsii	„	—				—			
Cycloseris tenuis	„					—			
Conosmilia elegans	„					—			
„ lituola	„					—			
„ anomala	„					—			
„ striata	„					—			
„ bicycla	*Ten.-Woods.*					—			
„ contorta	„			—					
Balanophyllia campanulata	*Duncan.*					—			
„ semiunda	„					—			
„ armata	„					—			
„ tubuliformis	„					—			
„ fragilis	„					—			
„ Australiensis	„	—		—		—			
„ Selwyni	„					—			
„ cylindrica (variety)	„					—			
„ Ulrichi	„					—			
Dendrophyllia epithecata	„	—							
„ Duncani	*Ten.-Woods.*	—							
Paracyathus (several varieties indet.)									
Eupsammia („ „ „)						—			
Cyathosmilia laticostata	*Ten.-Woods.*			—					
„ tenuicostata	„			—					
Bistylia adherens	„			—					
Cladocora contortilis	„			—					
Pleiastræa St. Vincenti	„			—					
„ sp. indet.	„			—					
Montlivaltia discus	„					—			
Trematrochus fenestratus	„					—			
ECHINODERMATA.									
Arachnoides Australis	*Laube.*			—		—			
„ elongatus	*Duncan.*			—					
„ Loveni	„					—			
Catopygus elegans	*Laube.*			—					
Cidaris, sp. indet.				—					
Echinanthus testudinarius	*Gray.*					— ?			
Echinarachinus parma	*Lamarck.*			— ?		— ?			
Echinobrissus Australiæ	*Duncan.*					—			
Echinolampas Australis	*Ten.-Woods.*			—					
„ Corioensis	*M'Coy.*					—			
„ ovulum	*Laube.*			—					

OF AUSTRALASIA,

	TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
	Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
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Gryphæa tarda* ....
Dimya sigillata ....
„ Tate
„ fimb
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„ Cori
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„ suffl
Terebratulina sco
„ Da
„ len
„ tria
Terebratella Tepp
„ pent
„ furcu
„ Woo
Magasella compt
„ Woods
„ Teniso
„ deform
Thecidium Austr

		Tasmania.		South Australia.		Victoria.		New South Wales.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Echinolampas Gambierensis	*Ten.-Woods.*			—					
Echinus Woodsii	*Laube.*			—					
Eupatagus Forbesii	*M'Coy.*					—			
,, Laubei	*Duncan.*					—			
,, rotundus	,,			—					
,, Wrightii	*Laube.*			—					
,, Murrayensis	,,			—					
Hemiaster Archeri	*Ten.-Woods.*			—					
Holaster Australiæ	*Duncan.*			—		—			
Leiocidaris Australiæ	,,			—		—			
Lovenia Forbesii	*Woods & Duncan.*	—		—		—			
,, ,, var. minor	*Duncan.*	—				—			
,, ,, ,, Woodsii	*Etheridge, jun.*	—		—		—			
Maretia anomala	*Duncan.*					—			
Megalaster compressus	,,			—					
Micraster brevistella	*Laube.*	—		—					
Monostychia Etheridgei (Micraster Eth.)	*R. M. Johnston.*	—							
Paradoxechinus novus	*Laube.*			—					
Psammechinus Woodsii	,,			—					
Pygorhynchus Vassali	*Wright.*					—			
Rhynchopygus dysasteroides	*Duncan.*					—			
Salenia tertiara	*Tate.*			—					
Schizaster ventricosus	*Gray.*			—					
Scutella Tamboensis	*M'Coy.*					—			
Temnechinus lineatus	*Duncan.*					—			
Pericosmus gigas	*M'Coy.*					—			
,, Nelsoni	,,					—			
,, compressus	,,					—			
ANNELIDA.									
Ditrupa Wormbetiensis	*M'Coy.*					—			
CRUSTACEA.									
Bairdia ovata	*Bosquet.*			—					
Cythere Normani	*G. S. Brady.*			—					
Macrocypris acuminata	*Alth.*			—					
Paracypris decora	*G. S. Brady.*			—					
Cypris Alburyana	*R. M. Johnston.*	—							
Balanus amphitrite	*Darwin.*	—							
POLYZOA.									
Caberea lata	*Busk.*			—					
Canda angulata	,,			—					
Cellepora costata	,,			—					
,, echinata	*Sturt.*			—					
,, escharoides	,,			—					
,, Gambierensis	*Busk.*	—		—		—			
,, hemisphærica	,,	—		—					
,, nummularia	,,	—		—		—			
,, spongiosa	,,	—		—					
,, tubulosa	,,			—					
Cœleschera Australis (MS.)	,,			—					
Crisia eburnea	*Linnæus.*			—					
Eschara arcuata (MS.)	*Busk.*			—					
,, bimarginata (MS.)	,,			—					
,, Buskii	*Ten.-Woods.*			—					
,, Clarkeii	,,					—			
,, elevata	,,			—					
,, hastigera (MS.)	*Busk.*			—					
,, inornata (MS.)	,,			—					
,, Liversidgei	*Ten.-Woods.*			—					
,, oculata (MS.)	*Busk.*			—					
,, papillata (MS.)	,,			—					
,, piriformis	*Sturt.*			—					
,, porrecta	*Ten.-Woods.*			—					
,, rustica	,,			—					
,, simplex (MS.)	*Busk.*			—					
,, Tatei	*Ten.-Woods.*			—					
,, verrucosa	,,			—					
,, two species indet.				—					
,, cavernosa	*Ten.-Woods.*			—					

		Tasmania.		South Australia.		Victoria.		New South Wales.	
		Pal.	Neo.	Pal.	Neo.	Pal.	Neo.	Pal.	Neo.
Hornera Gambierensis	*Busk.*			—					
,, regulosa	,,			—					
Idmonea ligulata (MS.)	,,			—					
,, Milneana	*D'Orb.*			—					
Lepralia doliiformis (MS.)	*Busk.*			—					
,, Stawellensis	*M'Coy.*					—			
,, subcarinata (MS.)	*Busk.*			—					
,, submarginata (MS.)	,,			—					
,, one or two sp. indet.		—							
Lunulites, sp. ind.						—			
Melicerta angustiloba	*Busk.*			—		—			
Membranipora appressa (MS.)	,,			—					
,, bidens	*Hagenow.*			—					
,, cyclops	*Busk.*			—		—			
,, stenostoma	,,			—					
Onchopora pustulosa	,,			—					
,, vertebralis	*Stoliczka.*					—			
Psileschara pustulosa (MS.)	*Busk.*			—					
,, subsulcata (MS.)	,,			—					
Pustulipora corrugata	*Ten.-Woods.*			—					
,, distans	*Busk.*			—					
,, ungulata	*Ten.-Woods.*			—					
,, ramosa	,,	—							
Retepora Maccoyana	*Etheridge, jun.*					—			
,, monilifera	*M'Gillivray.*			—					
,, vibicata	*Sturt.*			—					
,, sp. ind.		—							
Salicornaria gracilis	*Busk.*			—					
,, Parkeri (MS.)	,,			—					
,, sinuosa	*Hassall.*	—		—		—			
,, tenuirostris	,,			—					
Scutularia prima (MS.)	*Busk.*			—					
Buskia typica	*Ten.-Woods.*	—							
Tubulipora Gambierensis	,,			—					
BRACHIOPODA.									
Terebratula vitreoides	*Ten.-Woods.*	—		—		—			
,, Aldingæ*	*Tate.*			—					
,, subcarnea	,,			—					
,, bulbosa	,,			—					
Waldheimia Garribaldiana	*Davidson.*	—		—		—			
,, furcata	*Tate.*	—		—					
,, divaricata	,,			—					
,, Tateana	*Ten.-Woods.*	—		—		—			
,, fimbriata	*Tate.*			—					
,, Johnstoniana	,,	—		—					
,, insolita*	,,			—		—			
,, grandis	*Ten.-Woods.*	—		—		—			
,, Crouchii	,,			—					
,, M'Leani	*Tate.*			—					
,, Vincentiana	,,			—					
,, Taylori	*Etheridge.*	—		?					
,, Corioensis	*M'Coy.*	—		—		—			
,, pectoralis	*Tate.*	?		—					
,, sufflata	,,			—					
Terebratulina scoulari*	,,	—		—		—			
,, Davidsoni	*Etheridge.*	—		—		—			
,, lenticularis	*Tate.*	—		—		—			
,, triangularis	,,	?		—					
Terebratella Tepperi	,,	—		—					
,, pentagonalis	,,			—					
,, furculifera*	,,			—					
,, Woodsii	,,	—							
Magasella compta	*Sowerby.*			—		—			
,, Woodsiana*	*Tate.*			—		—			
,, Tenisoni	*Ten.-Woods.*			—					
,, deformis	*Tate.*			—					
Thecidium Australe	,,					—			

TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
Pal.	Neo.	Pal.	Neo.	Pal.	Neo.	Pal.	Neo.
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Gryphæa tarifa ...		
Dimya sigillata ...		
Mytilicardia alata		
" compl		
" platyc		
" curta		
Carditella multilat		
" rugosa		
" radiata		
" polita..		
" lamellat		
Cardita trigonalis		
" pecten ..		
" compacta		
" Murrayan		
" scabrosa .		
" gracilicost		
" latissima.		
" spinulosa		
" polynema		
" delicatula		
" Tasmanica		
" solida....		
" calvea ...		
Unio Wilkinsoni..	—	
" Johnstoni ..		

NEW SOUTH

		Tasmania.		South Australia.		Victoria.		New South Wales.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Rhynchonella squamosa*	*Hutton.*	—							
,, Baileyana	*Tate.*					—			
Pelecypoda.									
Barnea tiara	,,					—			
Jouannetia cuneata	,,			—					
Teredo Heaphyi	*Zittel.*			—					
,, sp. indet.						—			
Aspergillum (Humphreyia) liratum	*Tate.*			—					
,, ,, sp. ind.		—							
Solen sordidus	*Tate.*					—			
Solecurtus Legrandi	*T.-Woods and Tate.*	—							
,, Dennanti	*Tate.*					—			
,, ellipticus	,,			—					
Saxicava arctica	*Linn.*								
Panopaea Agnewi	*T.-Woods.*	—							
,, orbita*	*Hutton.*			—		—			
Capistrocardia fragilis	*Tate.*			—					
Neæra subrostrata	,,					—			
,, Adelaidensis	,,			—					
,, latesulcata	,,			—					
Corbula Gallica	*Sturt.*			—					
,, ephamilla	*Tate.*	—		—		—			
,, pixidata	*Sturt.*			—					
Corbis lamellosa	,,			—					
Zenatiopsis angustata	*Tate.*	—							
Myodora æquilateralis	*R. M. Johnston.*	—				—			
,, Australis	,,	—				—			
,, prælonga	*Tate.*					—			
,, angustior	,,					—			
,, tenuilirata	,,			—		—			
,, corrugata	,,			—		—			
,, lamellata	,,			—		—			
Psammobia æqualis	,,	—		—		—			
,, Hamiltonensis	,,	—				—			
Tellina lata †	*Quoy and Gaimard.*				—				
,, albinelloides	*Tate.*					—			
,, porrecta	,,			—					
,, Masoni	,,					—			
,, cainozoica	*Ten.-Woods.*	—							
,, æquilatera	*Tate.*			—		—			
,, Stirlingi	,,					—			
,, Krausei	*M'Coy.*					—			
Strigilla Australis	*Tate.*					—			
Donax Dixoni	,,					—			
,, depressa	,,				—?				
Semele Krauseana	,,			—		—			
,, vesiculosa	,,					—			
Mactra axiniformis	,,					—			
,, Hamiltonensis	,,					—			
,, Howchiniana	,,			—		—			
Anapa variabilis	,,				—?				
Chione Allporti	*Ten.-Woods.*	—							
,, multilamellata	*Tate.*			—					
,, hormophora	,,	—							
,, dimorphophylla	,,	—		—		—			
,, cainozoica	*Ten.-Woods.*	—		—		—			
,, subroborata	*Tate.*						—?		
,, propinqua	*Ten.-Woods.*	—				—			
,, dictua	*Tate.*				—?				
,, Corioensis	,,						—?		
,, sp. ind.		—		—					
Venus lævigata	*Sturt.*			—					
,, obliqua	,,								
Cytheræa paucirugata	*Tate.*					—			
,, Murrayana	,,			—					
,, tenuis	,,			—					
,, eburnea	,,	—		—		—			

		TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Cythera submultistriata	*Tate.*			—		—			
„ sp. ind.		—							
Dosinia Johnstoni	„	—				—			
„ Grayii*	*Zittel.*			—					
„ imparistriata	*Tate.*			—					
Meroe gibberula	„					—			
Venerupis paupertina	„			—		—			
Cardium pseudomagnum	„			—		—			
„ septuagenarium	„	—							
„ moniletectum	„			—					
„ Victoriæ	„					—			
„ cuculloides	„					—			
„ antisemigranulatum	„					—			
„ hemimeris	„			—		—			
Protocardium antisemigranulatum	*M'Coy.*					—			
Verticordia pectinata	*Tate.*					—			
„ rhomboidea	„			—					
Chama lamellifera	*Ten.-Woods.*	—		—		—			
Chamostrea albida (*C. crassa*—Tate)	*Lamarck.*	—				—			
Lucina leucomomorpha	*Tate.*					—			
„ projecta	„					—			
„ aræa	„			—					
„ affinis	„			—					
„ nuciformis	„								
„ araneosa	„					—			
„ despectans	„					—			
„ quadrisulcata	*D'Orb.*								
„ fabuloides	*Tate.*			—					
„ planatella	„	—							
Loripes simulans	„			—					
Cryptodon mactræformis	„					—			
Diplodonta subquadrata	„	—		—		—			
Sacchia suborbicularis	„			—					
Leptum crassum	„			—					
Lepton planisulcum	„			—					
Kellia micans	„					—			
Montacuta sericea	„			—		—			
Crassatella oblonga	*Ten.-Woods.*	—		—		—			
„ astartiformis	*Tate.*	—		—		—			
„ corrugata	„			—					
„ abbreviata	„			—					
„ Dennanti	„					—			
„ aphrodina	*Ten.-Woods.*								
Mytilicardia alata	*Tate.*			—					
„ compta	„			—		—			
„ platycostata	*R. M. Johnston.*	—							
„ curta	*Tate.*			—					
Carditella multilamella	„					—			
„ rugosa	„			—					
„ radiata	„			—					
„ polita	„			—			—		
„ lamellata	„	—		—					
Cardita trigonalis	„	—		—					
„ pecten	„			—		—			
„ compacta	„					—			
„ Murrayana	„			—					
„ scabrosa	„			—		—			
„ gracilicostata	*Ten.-Woods.*	—							
„ latissima	*Tate.*			—					
„ spinulosa	„					—			
„ polynema	„					—			
„ delicatula	„			—		—			
„ Tasmanica	„	—							
„ solida	„					—			
„ calvea	„					—			
Unio Wilkinsoni	*Etheridge, jun.*								
„ Johnstoni	„	—						—	

F AUSTRALASIA,

Tasmania.		South Australia.		Victoria.		New South Wales.	
Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
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Gryphæa tarda*	
Limya sigillata	
„ dissimilis ...	
SCAPHAPODA.	
Entalis Mantelli (D Woods)........	
„ subfissura ..	
„ acriculum ..	
Dentalium aratum ..	
„ bifrons ..	
„ lacteum .	
Cadulus mucronatus.	
„ acuminatus .	
PTEROPODA.	
Styliola Rangiana ..	
„ bicarinata ..	
„ annulata....	
Vaginella eligmostom	
Spiralis tertiara	
GASTEROPODA.	
Helix Geilstonensis..	
„ Huxleyana	
„ Sinclairoides...	
„ Simsoniana....	

TORIA.	NEW SOUTH WALES.

		TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Anodonta (Unio ?) Tamarensis	*Etheridge, jun.*	—							
Trigonia semiundulata †	*M'Coy.*	—		—		—			
,, tubulifera	*Tate.*					—			
,, acuticostata* ?	*M'Coy.*			—		—			
,, Howitti	,,					—			
Nucula tumida	*Ten.-Woods.*	—		—		—			
,, Atkinsoni (*Portlandia*)	*R. M. Johnston.*	—		—		—			
,, semistriata	*Tate.*			—					
,, Morundiana	,,			—		—			
,, fenestralis	,,	—							
,, Marthæ	*M'Coy.*					—			
Leda obolella	*Tate.*			—		—			
,, planiusulca	,,			—					
,, Huttoni	*Ten.-Woods.*	—		—		—			
,, acinaciformis	*Tate.*					—			
,, apiculata	,,			—		—			
,, leptorycha	,,			—					
,, vagans (lucida—*T.-Woods*)	,,			—		—			
,, prælonga	,,	—				—			
,, Woodsii	,,			—		—			
,, crebrecostata	*Ten.-Woods.*	—							
,, inconspicua	,,			—					
Arca pseudonavicularis	*Tate.*	—		—					
,, equidens	,,			—					
Barbatia dissimilis	,,			—					
,, crustata	,,			—					
,, celleporacea	,,	—				—			
,, limatella	,,			—					
,, consutilis	,,					—			
,, simulans	,,			—		—			
,, pumila	,,					—			
Macrodon cainozoicus	,,			—		—			
Cucullea Corioensis	*M'Coy.*	—		—		—			
,, Adelaidensis	*Tate.*			—					
Pectunculus cainozoicus (*Cucullea*)	*Ten.-Woods.*	—		—					
,, M'Coyii	*R. M. Johnston.*	—		—		—			
,, subtrigonalis	*Tate.*			—		—			
,, convexus	,,			—		—			
,, lenticularis	,,			—					
Limarca angustifrons	,,			—					
Limopsis insolita*	*G. B. Sowerby.*			—					
,, aurita*†	*Brocchi.*	—		—		—			
,, Belcherii†	*Adams & Reeve.*	—		—		—			
Modiolaria singularis	*Tate.*					—			
,, arcacea	,,			—					
,, semigranosa	,,			—					
,, Corioensis	,,					—			
Crenella globularis	,,	—		—		—			
Avicula nasuta	,,			—					
Meleagrina crassicardia	,,			—		—			
Vulsella lævigata	,,			—					
Perna, sp. indet.* (*Tate*)				—					
Pinna semicostata	*Tate.*				— ?				
,, sp. indet. (*Tate*)				—					
Spondylus pseudoradula	*M'Coy.*	— ?		—		—			
,, gæderopoides	,,	—				—			
,, spinulosus (MS.)	,,	— ?				—			
Modiola Adelaidensis	*Tate.*			—					
,, sp. indet. (*Tate*)				—					
,, sp. indet. (*Tate*)				—					
Lithodomus, sp. indet. (*Tate*)				—					
Mytilus sub-Menkeanus	*Tate.*			—					
,, Hamiltonensis	,,					—			
,, linguatulus	,,					—			
,, depauperatus	,,					—			
Septifer fenestratus	,,					—			
Lima Bassii	*Ten.-Woods.*	—		—		—			

		TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Lima squamosa (MS.)	*Ten.-Woods.*	—							
„ polyactina	*Tate.*			—					
„ linguliformis	„					—			
„ Jeffreysiana (*Lima subauriculata*)	„	—		—		—			
„ polynema	„			—					
Limea transenna	„			—		—			
„ minuta (*Cucullea*)	*R. M. Johnston.*	—							
„ alticosta	*Tate.*			—					
Pecten consobrinus	„				— ?				
„ subbifrons	„				— ?				
„ palmipes	„				— ?				
„ Murrayanus	„			—		—			
„ dichotomalis	„					—			
„ antiaustralis	„				— ?				
„ Eyrei	„			—					
„ Flindersi	„			—					
„ Peroni	„			—					
„ Sturtianus	„			—		—			
„ Aldingensis	„			—					
„ Yahlensis	*Ten.-Woods.*			—		—			
„ Foulcheri	„	—		—		—			
„ spondyloides	*Tate.*				— ?				
„ Gambierensis	*Ten.-Woods.*			—					
„ polymorphoides*	*Zittel.*	—		—		—			
„ Hockstotteri*	„			—					
„ subconvexus	*Tate.*					—			
„ incertus	*Ten.-Woods.*			—					
„ Darwini	*Sow.*			—					
„ lucens	*Tate.*	—		—					
„ Zitteli* (Amusium Atkinsoni—*Johnston*)	*Hutton.*	—		—		—			
„ deformis	*Tate.*					—			
Vola laticostata	*Ten.-Woods.*	—							
Humilos Corioensis	*M'Coy.*			—		—			
Anomia cymbula	*Tate.*			—					
Placunanomia sella	„	—		—					
„ Ione	*Gray.*								
Ostrea hyotis†	*Linn.*			—					
„ arenicola	*Tate.*			—					
„ manubriata	„					—			
„ sp. indet.		—							
„ hippopus	*Tate.*			—					
„ elongata	*Sturt.*			—					
Gryphaea tarda*	*Hutton.*			—					
Dimya sigillata	*Tate.*			—					
„ dissimilis	„			—		—			
SCAPHAPODA.									
Entalis Mantelli (Dentalium Kickxii—*T.-Woods*)	*Zittel.*	—		—		—			
„ subfissura	*Tate.*			—		—			
„ acriculum	„					—			
Dentalium aratum	„			—		—			
„ bifrons	„					—			
„ lacteum	*Deshayes.*	—				—			
Cadulus mucronatus	*Tate.*					—			
„ acuminatus	„				— ?				
PTEROPODA.									
Styliola Rangiana	*Tate.*					—			
„ bicarinata	„					—			
„ annulata	„			—					
Vaginella eligmostoma	„					—			
Spiralis tertiara	„					—			
GASTEROPODA.									
Helix Geilstonensis	*R. M. Johnston.*	—							
„ Huxleyana	„	—							
„ Sinclairoides	„	—							
„ Simsoniana	„	—	— ?						

USTRALASIA,

TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
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,, umbilic		
Pileopsis navicello		
Solarium acutum		
,, Wannone		
Torinia gibbuloide		
Adeorbis lævis ..		
,, aster ..		
,, acuticari		
Scalaria, sp. indet.		
Crossea labiata ?†		
Turritella Sturtii		
,, Tasman		
,, Warbur		
,, sp. inde		
,, tristira		
,, transen		
,, platyspi		
,, sp. inde		
Torcula Murrayan		
Vermetus conoheli		
,, sp. inde		
Tenagodus occlusu		
Eulima acutispira		
Leiostraca Johnsto		

RIA.	NEW SOUTH WALES.

		TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Helix Tasmaniensis	*G. B. Sowerby.*	—							
Vitrina Barnardii	*R. M. Johnston.*	—							
Bulimus Gunnii	*Sowerby.*	—							
Murex Eyeri	*Ten.-Woods.*	—							
„ Legrandi	*R. M. Johnston.*	—							
„ minutus	„	—							
„ asper	*Ten.-Woods.*			—					
„ sp. indet.				—					
Typhis M'Coyi	*Ten.-Woods.*	—		—		—			
Ricinula purpuroides	*R. M. Johnston.*	—							
Tritonium Abboti	*Ten.-Woods.*	—		—					
„ minimum	„	—							
„ Tasmanicus	*R. M. Johnston.*	—							
Ranella Prattii	*Ten.-Woods.*			—		—			
Fusus gracillimus	„	—							
„ Johnstonii	„	—							
„ Meredithii	„	—							
„ pagadoides	*M'Coy.*	—				—			
„ Tateana	*Ten.-Woods.*	—							
„ vitreoides	*R. M. Johnston.*	—							
„ transenna	*Ten.-Woods.*	—							
„ Roblini	„	—				—			
„ funiculatus	„					—			
Buccinum fragile	„	—							
Pisania tenuicostata	„					—			
Cominella cancellata	„	—				—			
„ lyræcostata	„	—							
Nassa Tatei	„					—			
Voluta Agnewi	*R. M. Johnston.*	—							
„ Allporti	„	—							
„ M'Coyi	*Ten.-Woods.*	—							
„ lirata	*R. M. Johnston.*	—							
„ pellita	„	—							
„ Stephensi	„	—							
„ stolida	„	—							
„ Tateana	„	—							
„ antiscalaris	*M'Coy.*	—		—		—			
„ anticingulata	„					—			
„ Hannafordi	„	—		—		—			
„ strophodon	„	—		—		—			
„ macroptera	„	—				—			
„ Weldii	*Ten.-Woods.*	—							
Mitra anticoronata	*R. M. Johnston.*	—							
„ sp. indet. (*T.-Woods*)				—					
„ sp. indet. „				—					
Thala marginata	*Ten.-Woods.*	—							
Marginella Aldingæ	*Tate.*			—					
„ muscaroides	„			—		—			
„ Hordeacea	„			—					
„ Wentworthi	*Ten.-Woods.*	—		—		—			
„ cassidiformis	*Tate.*					—			
„ strombiformis	*Ten.-Woods.*	—							
„ micula	*Tate.*					—			
„ inermis	„					—			
„ Winteri	„					—			
„ propinqua	„			—		—			
„ Woodsi	„					—			
„ septemplicata	„					—			
Erato ? octoplicata	*Ten.-Woods.*	—							
„ Australis	*Tate.*			—					
„ minor	„					—			
Ancillaria herbera	*Hutton.*			—					
„ mucronata	*Sowerby.*	—		—		—			
„ semilævis	*Ten.-Woods.*			—		—			
Columbella Oxleyi	„	—							
„ cainozoica	„	—							
Cancellaria Etheridgei	*R. M. Johnston.*	—							

		TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Cancellaria varicifera	*Ten.-Woods.*								
Terebra simplex	,,	—				—			
,, additoides	,,	—		—					
Pleurotoma Johnstonii	,,	—							
,, paracantha	,,	—							
,, pullalascens	,,	—							
,, Murndaliana	,,					—			
,, sandleroides	,,	—							
,, Samueli	,,					—			
,, one or two species indet.		—							
Daphnella collumbelloides	*Ten.-Woods.*	—							
,, gracillima	,,	—		—		—			
,, tenuisculpta	,,	—							
Mangelia gracilirata	,,	—							
,, bidens	,,			—		—			
Conus Trailli	,,			—					
,, sp. indet.				—					
,, Ralphii	*Ten.-Woods.*					—			
,, sp. indet.						—			
Cypræa Archeri	*Ten.-Woods.*	—							
,, eximia	*G. B. Sowerby.*	—				—			
,, gastroplax	*M'Coy.*					—			
,, gigas	,,			—		—			
,, oviformis	*Ten.-Woods.*			—					
,, platypyga	*M'Coy.*	—				—			
,, platyrhyncha	,,	—				—			
,, consobrina	,,			—		—			
,, contusa	,,					—			
,, leptorhyncha	,,			—		—			
Trivia avellanoides	,,	—		—		—			
Cassis sufflatus	*Ten.-Woods.*	—				—			
,, textilis	*Tate.*			—					
Cassidaria reticulospira	*M'Coy.*	—				—			
Natica ovata	*Hutton.*	—							
,, polita	*Ten.-Woods.*	—		—					
,, vixumbilicata	,,	—							
,, Wintlei	,,	—							
,, Hamiltonensis	,,			—		—			
,, sp. indet.				—					
,, sp. indet.				—					
Trochita calyptræformis	*Ten.-Woods.*	—							
,, turbinata	,,					—			
Crepidula Hainsworthii	*R. M. Johnston.*	—							
,, umbilicata	,,	—							
Pileopsis navicelloides	,,	—							
Solarium acutum	*Ten.-Woods.*			—		—			
,, Wannonensis	,,					—			
Torinia gibbuloides	,,	—							
Adeorbis lævis	*R. M. Johnston.*	—							
,, aster	*Ten.-Woods.*					—			
,, acuticarinata	,,					—			
Scalaria, sp. indet.		—							
Crossea labiata ?†	*Ten.-Woods.*	—		—					
Turritella Sturtii	,,	—							
,, Tasmanica	,,	—							
,, Warburtonii	,,	—		—					
,, sp. indet.				—					
,, tristira	*Tate.*	—							
,, transenna	*Ten.-Woods.*					—			
,, platyspira	,,					—			
,, sp. indet.		—							
Torcula Murrayana	*Tate.*	—		—		—			
Vermetus conohelix	*Ten.-Woods.*	—							
,, sp. indet.		—							
Tenagodus occlusus	*Ten.-Woods.*	—							
Eulima acutispira	,,			—					
Leiostraca Johnstonii	*Tate.*	—							

AUSTRALASIA,

TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
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	Species.
Plantæ	73
Rhizopoda	50
Actinozoa	63
Echinodermata	39
Annelida	1
Crustacea	6
Polyzoa	65
Brachiopoda	34
Pelecypoda	43
Scaphapoda	8
Pteropoda	5
Gasteropoda	97
Cephalopoda	2
Pisces	8
Mammalia—	
Marsupialia	8
Cetacea	5
Carnivora	1
	08

		TASMANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
		Pal.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
Niso psila	*Ten.-Woods.*			—					
Turbonilla liræcostata	,,	—							
,, pagoda	,,			—					
Odostomia liræcostata	*R. M. Johnston.*	—							
Pyramidella Roberti	*Ten.-Woods.*	—							
,, sulcata	*R. M. Johnston.*	—							
,, polita	,,	—							
Cerithium Flemingtonensis	*M'Coy.*						—		
,, cribrarioides	*Ten.-Woods.*			—		—			
,, apheles	,,					—			
Cerithiopsis Johnstoni (MS.)	,,	—							
Triforis Wilkinsoni	,,			—		—			
,, sulcata	,,			—		—			
,, planata	,,			—					
Potamides pyramidale	*Tate.*	—							
,, semicostatum	,,	—							
Rissora Stevensiana	*Ten.-Woods.*	—							
,, dubia	*R. M. Johnston.*	—							
Rissoina Johnstoni	*Ten.-Woods.*	—							
,, Tateana	,,	—		—					
,, varicifera	,,	—							
,, concatenata	,,	—							
Liotia lamellosa	,,	—				—			
,, Roblini	*R. M. Johnston.*	—		—					
Cyclostrema acuticarinata	*Ten.-Woods.*			—					
Turbo Wynyardensis (MS.)	*R. M. Johnston.*	—							
,, Etheridgei	*Ten.-Woods.*	—							
Imperator Tasmanica (MS.)	*R. M. Johnston.*	—							
Calcar ornatissimum	*Ten.-Woods.*	—							
,, Flindersi	,,	—							
Delphinula? tetragonostoma	,,	—							
Trochus Josephi	,,	—							
,, sp. indet.		—							
Minolia strigata	*Ten.-Woods.*			—		—			
Gibbula æquisulcata	,,	—							
,, Clarkei	,,	—							
,, crassigranosa	,,	—							
Zizyphinus atomus	*R. M. Johnston.*	—							
,, Tasmanicus	,,	—							
,, Bloxlandii	*Ten.-Woods.*	—							
Thalotia alternata	,,	—							
,, exiqua	,,					—			
Euchelus Woodsii	*R. M. Johnston.*	—							
Margarita Keckwickii	*Ten.-Woods.*	—							
Pleurotomaria Australis (MS.)	*M'Coy.*					—			
,, tertiara	,,					—			
Huliotis Flemingtonensis (MS.)	,,						—		
,, Mooraboolensis	,,						—		
,, nævosoides	,,						—		
,, ovinoides	,,						—		
Fissurellidæ malleata	*Tate.*	—		—					
Emarginula transenna	*Ten.-Woods.*	—		—					
Actæon scrobiculatus	,,	—							
Ringicula lactea	*R. M. Johnston.*	—							
Tornatina involuta	*Ten.-Woods.*						—		
Cylichna Woodsii (*C. arachis*—Woods)	*Tate.*	—							
,, exiqua	*Ten.-Woods.*			—					
Bulla scrobiculata	,,			—					
CEPHALOPODA.									
Aturia (zic-zac) Australis	*J. Sowerby.*	—		—		—			
Belemnites senescens	*Tate.*			—		—			
PISCES.									
Carcharodon angistidens	*Agassiz.*	—				—			
,, megalodon	,,					—			
Lamna contortidens	,,					—			
,, denticulata	,,					—			
,, elegans	,,	—		—					

		Tasmania.		South Australia.		Victoria.		New South Wales.	
		Pal.	Neo.	Pal.	Neo.	Pal.	Neo.	Pal.	Neo.
Otodus Desori	*Agassiz.*			—		—			
Oxyrhina trigonodon	,,	—				—			
,, Woodsii	*M'Coy.*			—					
MAMMALIA.									
Marsupialia.									
Phalangista, sp. indet.						—			
Bettongia cuniculoides	*M'Coy.*					—			
Nototherium, sp. indet.						—			
Phalascomys pliocenus	*M'Coy.*								
,, sp. indet.		—							
Hypsiprymnus, sp. indet.		—							
Halmaturus, sp. indet.		—							
Sarcophilus ursinus	*Harris.*					—			
Cetacea.									
Squalodon Wilkinsoni	*M'Coy.*					—			
Zeugolodon Hardwoodii	*Sanger.*			—					
Cetotolites Leggei	*M'Coy.*					—			
,, Pricei	,,					—			
,, Nelsoni	,,					—			
Carnivora.									
Arctocephalus Williamsi	*M'Coy.*					—			

The foregoing comparative tables contain upon the whole a fairly comprehensive list of the Tertiary fossils described up to the present time. No doubt the number of species of *Gasteropods* will be greatly expanded when Professor Tate's examination of them are completed. It is not expected, however, that the general character of the life of the period will be much affected by further additions, and the following summary will, therefore, be of some value to those who may desire to enter upon comparative work.

SUMMARY OF GENERA AND SPECIES ENUMERATED IN PRECEDING TABLES.

Classes, &c.	*Tasmania.*	*South Australia.*	*Victoria.*	*N. S. Wales.*	*Australia and Tasmania*	
	No. Species.	No. Species.	No. Species.	No. Species.	No. Genera.	No. Species.
Plantæ	115	—	26	40	68	173
Rhizopoda	10	40	12	—	26	50
Actinozoa	16	24	41	—	25	63
Echinodermata	5	23	21	—	25	39
Annelida	—	—	1	—	1	1
Crustacea	2	4	—	—	6	6
Polyzoa	9	54	10	—	20	65
Brachiopoda	16	30	13	—	7	34
Pelecypoda	63	157	122	1	79	243
Scaphapoda	2	4	7	—	3	8
Pteropoda	—	1	4	—	3	5
Gasteropoda	127	54	66	—	77	197
Cephalopoda	1	2	1	—	2	2
Pisces	3	3	6	—	4	8
Mammalia—						
Marsupialia	4	—	4	?	7	8
Cetacea	—	1	4	—	3	5
Carnivora	—	—	1	—	1	1
	373	397	339	41	357	908

MANIA.		SOUTH AUSTRALIA.		VICTORIA.		NEW SOUTH WALES.	
.	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*	*Pal.*	*Neo.*
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ation of them are completed. It is not
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ATED IN PRECEDING TABLES.

Victoria.	*N. S. Wales.*	*Australia and Tasmania*	

arison of *es.*

NEW ZE | UTH W | TASMANIA.

tangiformis, Muel *s, Cypris.* Brachiopoda—*Terebratula, Waldheimia,*
ozoa—*Isis da* figured *Rhynchonella.* Lamellibranchiata—*Arca, Asper-*
ea, Cytherea, Cardium, Cardita, Chama, Chione,
marked with *r Gunn* *llea, Dosinia, Diplodonta, Gouldia, Lima, Limea,*
æogene age i usen a *ucina, Myodora, Mytilicardia, Panopæa, Placun-*
eds at Drury ected b *lus, Psammobia, Solecurtus, Spondylus, Tellina,*
of plants; v *psis.* Gasteropoda—*Terebra, Pleurotoma, Daphnella,*
lites. . Dicot *x, Typhis, Fusus, Cominella, Ricinula, Ringicula,*
okeri, *Columbella, Voluta, Marginella, Erato, Tritonium,*
arwinii *illa, Odostomia, Leiostraca, Cerithiopsis, Rissoa,*
Ficonii *lla, Tenagodus, Vermetus, Potamides, Trochita,*
amomu *mperator, Euchelus, Thalotia, Zizyphinus, Trochus,*
ustrali *a, Liotia, Delphinula, Adeorbis, Trivia, Cypræa,*
m Eth *Pyramidella, Fissurellidæ, Emarginula, Pileopsis,*
nolia B *ia, Dentalium, &c.* Cephalopoda—*Aturia.* Rhizo-
Mitchell *na, Quinqueloculina, Discorbina, Nummulina, Mar-*
Cunnin *a, Alveolina, Polymorphina, Cassidulina, Nonionina,*
Delftii,
nosites ble Cape)—*Voluta anticingulata, Voluta Tateana,*
von Et *lla Wentworthii, Cassis sufflatus, Calcar Flindersi,*
Archeri, C. platypyga, Natica Wintlei, Ancillaria
arburtonii, Daphnella gracillima, Typhis M'Coyi,
Corbula ephamilla, Crassatella aphrodina, Dosinia
Myodora Australis, Panopæa Agnewi, Waldheimia
a, Lovenia Forbesi, Cellepora Gambierensis, Placo-

r, Mount Bischoff.
line of *Macquarie Harbour,* from Long Bay to Kelly's
ging terraces from 40 to 70 feet in height, covered by
sloping to the shore—composed generally in descending
of sand and clay, alternating with thick irregular coarse
he ancient neighbouring rocks; (2) Carbonaceous and
sandstones, regularly and horizontally stratified and
layers of lignite, all being replete with the remains of a
lauraceous types are particularly conspicuous. The
-*Cinnamomum polymorphoides* (M'Coy), *Eucalyptus*
tacites oligoneuris (Ettings.)

he *Magnet Range* there exists, immediately underlying
to 300 feet of white, brown, blue, and blackish clays,
, and whitish sandstones, and with lignites replete with
ng which the following are very characteristic; viz.—
), *Eucalyptus Kayseri* (Johnston), *Quercus Bischoff-*
Tasmanicus (Johnston), *Taxites Thureaui* (Johnston),

TERTIARY PERIOD.

Comparison of the General Characteristics of the Rocks of the Tertiary Period as developed in different Countries.

Arranged by R. M. Johnston, F.L.S.

GREAT BRITAIN.

PLIOCENE.

Forest-bed Group (10 to 70 feet thick).—Silts, clays, with layers of peat and loam, partly estuarine and partly lacustrine, the latter containing numerous seeds, cones, stumps, and fragments of drift wood, blocks of peat, bones of mammals, &c.; the estuarine beds composed of fine sands, with clay and flint pebbles, containing *Leda myalis, Trophon antiquum, Nucula Cobboldiæ, Tellina*. The lacustrine or freshwater beds contain cones of Scotch fir and spruce, leaves of the white waterlily, yellow pond lily, hornwort, blackthorn, bog bean, oak, and hazel; also species of freshwater and land shells; viz.—*Pisidium amnicum, Unio pectorum, Paludina fontanus, Limnæ stagnalis, Succinea putris, Helix arbustorum*, &c. Fifty species of mammals, two reptiles, four amphibians, and seventeen birds are also recorded from the group, nearly all belonging to existing species.

The group is best developed on the north-east of Norfolk, although it nowhere exceeds a few feet in thickness.

Chillesford Beds (1 to 16 feet thick).—Thin local deposit, chiefly in Suffolk, composed of shelly sands and gravels, with *Mya truncata, Mactra ovalis, Nucula Cobboldiæ, Cyprina islandica, Astarte borealis, Tellina obliqua*, &c. Geikie states that about two-thirds of the characteristic species still live in Arctic waters.

Norwich Crag (5 to 10 feet thick).—This deposit is stated by Geikie to consist of a few feet of shelly sand and gravel, containing 139 species of shells, of which 93 per cent. are still living. A large number of bones, chiefly of extinct species of elephant, have been obtained, comprising *Mastodon arvernensis, Elephas meridionalis, E. antiquus, Hippopotamus major, Rhinoceros leptorhinus, Trogontherium Cuvieri*, also remains of horse, deer, otter, and beaver.

Red Crag (25 feet thick).—Thin local formation, consisting of dark-red or brown ferruginous shelly sand. Of its molluscs 92 per cent. are supposed to be still living. Characteristic genera are—*Voluta, Nassa, Purpura, Pecten, Pectunculus, Mactra, Tellina, Cardium, Mytilus, Cyprina*—*Mastodon, Elephas, Rhinoceros, Tapirus, Sus, Equus, Hipparion, Hyæna, Felis, Cervus, Halitherium*. Some of these may have been derived from Miocene deposits.

White Crag (40 to 60 feet thick)—Suffolk, Coralline or Bryozoan Crag.—Shelly sands and marls, containing about 316 species of shells, and about 140 species of coral-like polyzoa. About 84 per cent. of the shells are still living. Characteristic forms are *Terebratula grandis, Lingula Dumortieri, Pecten opercularis, Pholadomya histerna, Astarte Omalii, Pyrula reticulata, Voluta Lamberti*, &c.

MIOCENE.

Great Britain is supposed to have been occupied by a land surface only during the Miocene period, which was connected with the European Continent. The leaf-beds of Bovey, Tracey, Mull, and Antrim are by some authorities doubtfully referred to this period. The latter have yielded Ferns, Vines, Fig, Cinnamon, *Proteaceæ*, &c. Sequoia Couttsiæ nearly allied to the huge Sequoia (Wellingtonia) of California, is especially abundant.

OLIGOCENE.

Hempstead Beds.—(1) Corbula beds (marine), consisting of brown and greenish nodular clays and shelly beds.
(2) Upper freshwater and estuary marls.
(3) Middle and freshwater estuary marls.
(4) Lower freshwater and estuary marls.

Characteristic Genera:

Corbula, Cerithium, Cyrena, Rissoa, Panopæa, Melania, Paludina, Unio, Chara, Gyrogonites, &c.

Bembridge Beds.—Marls and limestones, with *Cerithium mutabile, Cyrena pulchra, Ostrea vectensis*, also *Melania, Limnæa, Helix, Planorbis, Cyclotus, Bulimus*, &c.

Osborne or St. Helen's Beds.—Clays, marls, sands, and limestones, with *Chara Lyellii, Cyrena obovata, Melanopsis carinata, Planorbis, Paludina*, &c.

Headon Beds.—Marine, brackish, and freshwater beds, consisting of clays and thick beds of limestone. Conspicuous among the freshwater beds is the forms *Planorbis euomphalus, P. rotundatus, P. lens*; in brackish water beds, *Potamides plana* and *P. cinctus*; and in the marine bands, *Cytherea incrassata*.

EOCENE.

Upper Eocene (Barton Clay and Upper Bagshot Sands).—Attaining a thickness of 300 feet in the Isle of Wight. Over 200 species of Molluscs are known. The characteristic species are—*Voluta luctatrix, V. ambigua, V. athleta, Conus scabriculus, C. dormitor, Pleurotoma rostrata, Fusus pyrus, Ostrea gigantea, Vulsella deperdita, Pecten reconditus, Lima compta, L. soror, Avicula media, Modiola sulcata, Arca appendiculata, Pectunculus deletus, Cardita sulcata, Crassatella sulcata, Chama squamosa, Nummulites planulata*.

Middle Eocene (Middle and part of Lower Bagshot Beds, London Basin).—The lower division consists of yellow siliceous unfossiliferous sands, with irregular clayey beds, about 100 to 150 feet thick; the upper division about 50 or 60 feet thick, made up of sands and clays, with bones of turtle and sharks, with a few molluscs (*Cardita, Corbula, Ostrea*, &c.) In the Hampshire Basin the series is over 100 feet thick, composed of clays, sands, marls, and lignites, with *Belosepia, Cypræa, Marginella, Voluta, Mitra, Conus, Pleurotoma, Murex, Fusus, Turritella, Ostrea, Pecten, Lima, Spondylus, Avicula, Pinna, Modiola, Arca, Limopsis, Nucula, Leda, Cardita, Crassatella, Chama, Nummulites, Alveolina*, &c. The clays contain remains of *Proteaceæ*, fig, cinnamon, fan-palm (*Sabal*), oak, yew, cypress, laurel, lime, senna, &c.

Lower Eocene.—This division is represented by clays, loams, sands, and pebble beds of the (1) Part of Lower Bagshot Beds, (2) London Clay, (3) Oldhaven Beds, (4) Woolwich and Reading Beds, (5) Thanet Sands, with *Ficus, Grevillea, Laurus, Cinnamomum, Coniferæ, Astarte, Cyprina, Ostrea, Cucullæa, Pholadomya, Corbula, Fusus, Natica, Cerithium, Melania, Melanopsis, Paludina, Lamna*. Bones of turtles, crocodiles, and birds have been found, also bones of mammalia, including *Coryphodon*.

NORTH AMERICA.

PLIOCENE.

[Sumph]... *Period.*—Represented in North and South Carolina by soft ... loam, clay, or sand, which lie in depressions of the older ... and Cretaceous formations. They contain forty to sixty ... of living species of shells. The following are stated by ... be specially characteristic:—*Pecten* (Amusium) *Mortoni, ...hemicyclica, Arca* (Barbatia) *lens, A. lienosa, Scansia ... Cyprea Carolinensis, C. pediculus, Conus adversarius, ...ria rhomboidea, Busycon incile*, &c., also *Myclopteros ...* In the Loup Fork Beds on the Niobara, Upper Missouri ... White River group is overlaid by freshwater beds, and ... in their upper parts the remains of numerous extinct ..., including Camels, Rhinoceroses, Elephants, Horses, &c., ... land and fresh-water shells, which are probably of recent ... The following are especially remarkable:—Birds—*Aquila ...us, Grus Haydeni, Graculus Idahensis*. Mammals—*Felis ...tus, Canis, Leptarctus primus, Elephas imperator, Mastodon ...us, Rhinoceros crassus*; also *Procamelus, Homocamelus, ...meryx, Merycodus, Cervus, Hipparion parvulum, H. occi... Protohippus, Merychippus, Equus excelsus, Castor tortus, ...castor, Hystrix*, &c. *Equus excelsus* is stated to be quite as ... the modern horse.

MIOCENE.

[Yorkto...] ...*Period.*—At Yorktown, Atlantic Border, this division is ...nted by marine clays and sands, among which the following ...teristic forms occur:—Molluscs—*Crepidula costata, Yoldia ..., Callista Sayana, Pecten decennarius, P. Virginianus, ... Virginianum, Venus tridacnoides, V. capax, Chama ..., Axinea tumulus, Anomia Ruffini, Ostrea Virginiana, ...mercenaria, V. cancellata, Mactra lateralis, Pecten concen..., Lunatia heros, Oliva literata, Nassa trivittata*. Fishes—...*rodon megalodon, Galeocerdo latidens, Hemipristis serra, ...ina hastalis*. Mammals—*Balæna prisca, B. palæatlantica, ...inus Conradi, Phoca Wymani*, &c., *Elotherium Leidyanus, ...yus antiquus, Rhinoceros matutinus, Anchippodus riparius, ...odon validus*.

... White River Group.—Extensive beds occur in the Upper Missouri ..., along the White River, belonging to the period, estimated to ... thickness of 1000 feet or more. They are all of freshwater ... These beds contain the remains of mammals, among which ...*Titanotherium Proutii, Hyaracodon Nebrascensis, Oreodon ..., O. Culbertsoni*, also *Dipranodon, Amphycion, Dinictis, ...therium Bairdii, Agriochærus antiquus, A. major, Pæbrotherium Wilsoni, Leptouchenia, Protomeryx, Merycodus, Rhinoceros, ...codon, Lophiodon, Mastodon, Chæroptmaus, Leptochærus, ...otamus, Elotherium, Chalicomys, Ischyromys, Palæolagus*, ... In the same group in Colorado occurs *Brontotherium* ... nearly as large as an elephant, *B. ingens*, still larger, and ...*rium crassum*, two-thirds as large as a rhinoceros. Extensive ... of the same horizon of freshwater origin also occur in the ... River Valley (1500 to 2000 feet thick), also on the James ...

EOCENE.

Alabam... ...*Period* includes the formations—
(1) The Claiborne and Vicksburg groups, occurring along the Gulf ... and Atlantic Border.
(2) ...ahsatch, Green River, Bridger, and Uintah groups, situated ... over the Rocky Mountain slopes, where the beds are of freshwater origin.

... freshwater beds consist of clays and lignites, and the marine ... of marls, limestones, buhrstones, clay sandstone, and loose sand. The Wahsatch group (Coryphodon beds) and Green River group are of great extent, each stated as being over 5000 feet thick.

Characteristic Genera.

Protozoans—*Orbitoides*. Radiates—*Flabellum, Oculina, Scutella, Clypeaster*. Molluscs—*Ostrea, Pecten, Lima, Crassatella, Astarte, ...a, Cardium, Corbula, Callista, Mactra, Leda, Psammobia, Pano..., Cypræa, Marginella, Conus, Voluta, Mitra, Pleurotoma, Natica, Turbinella, Triton, Dentalium*. Fishes—*Lamna, ...nus, Carcharodon, Zeuglodon, Gallocerdo, Pristis, Histiophorus, Clupea*. Snakes—*Dinoptris* (20 feet long). Crocodiles. Birds—*Bubo*. Mammals—*Coryphodon, Helaletes, Eohippus, Orohippus, Lemuravus, Hyopsodus*, &c. Marsupials—*Triacodon*.

Laramie or Lignitic Period.—The beds of this division attain a thickness in the Rocky Mountains region of several thousand feet. They partly consist of brackish water beds, which in general are unconformable to the overlying Tertiaries. Lignite or carbonised woods and beds of mineral coal are largely developed. The plant remains are extremely interesting, and it is difficult to determine the true position of the group, as the affinities of the plants are more closely related to the underlying Cretaceous rocks than to the beds which next succeed them.

Characteristic Genera.

Plants—*Quercus, Carya, Populus, Acer, Ulmus, Morus, Carpinus, Fagus, Juglans, Betula, Alnus, Corylus, Ilex, Negundo, Platanus, Sapindus, Ficus, Cinnamomum, Laurus, Bimzoin, Persea, Myrica, Salisburia, Cornus, Ceanothus, Viburnum, Rhus, Olea, Rhamnus, Magnolia, Smila, Eucalyptus, Thuia, Thuyites, Sequoia, Abies, Taxodium, Glytostrobus, Sabal, Calamopsis, Flabellaria*. The genus *Inoceramus* occurs with other marine forms in the doubtful beds at the base of the group, referred by some to the Cretaceous formation.

NEW ZEALAND.

NEOGENE.

WANGANUI SYSTEM (Newer and Older Pliocene).

Professor Hutton (Quart. Journ. Geo. Soc., May, 1885), includes within this system the following; viz.—*Kéreru series, Ormond series, Pétane series, Putiki series, Older Glacial Deposits*, Lignites of Otago, Manuka, &c. Professor Hutton states: "Marine beds belonging to this system have been proved by palæontological evidence only in the southern half of North Island from Patea and Wanganui on Cook's Straits (Putiki series) to the Ngaruro River (Kéreru series), and Esk River (Pétane series) in Hawkes' Bay . . . also at Poverty Bay (Ormond series) at Taranaki round Manuka Harbour, on the west side of Whangarei Harbour, and in various other places in the Province of Auckland. In the South Island the marine beds of the North appear to be represented by thick unfossiliferous gravels . . . difficult to distinguish from the upper gravels of the Pareora System," upon which they rest unconformably. "From 70 to 90 per cent. of the Mollusca, and all the Brachiopoda, are recent." (Hutton.)

Characteristic Fossils.

Mollusca—*Trophon expansus, Pisania Drewii, Pleurotoma, Wanganuiensis, P. tuberculata, Galerus inflatus, Trochus conicus, Zizyphinus Hodgei, Dentalium nanum, Cytherea assimilis, Ostrea corrugata*. Actinozoa—*Trochocyathus quinarius, Flabellum rugulosum*.

PALÆOGENE.

PAREORA SYSTEM (Miocene).

Within this System the same authority includes the following series; viz.:—*Awatére, Kéreru, Tāwhiti, Ahuriri, Waitemāta*, and Brown Coal of Pomahāka, &c.

In the North Island the members of the System are widely distributed, often forming cliffs; from Cape Rodney, Kawau, and Kaipara Harbour to Auckland, where they form cliffs round Waitemata Harbour; on the West Coast at White Cliffs in Taranaki; on the East Coast the system covers a large district between East Cape and Poverty Bay (Tāwhiti series); Napier to Cook's Straits (Ahuriri series); in the upper parts of the Rangitiki, Wanganui, and Waitotāra Rivers towards the centre of the Island. In the South Island the "system attains an elevation of 3000 feet at Mount Pleasant, and also in several valleys in the centre of the New Zealand Alps." In the Port Hills, near Nelson, thick beds of gravel "are distinctly interbedded with sandstone containing Paréora fossils; and these gravels, sometimes cemented into conglomerates, pass inland to Lake Rotooiti, attaining in the Moutére and Wai-iti Hills an elevation of 2334 feet." The System lies unconformably on the Oamaru System in Auckland Province, although it is stated that in Canterbury "no unconformity has been made out."—(Hutton). A section from Howick, Auckland, to the Wairoa River, show the *Paréora System* horizontally abutting unconformably against the *Oamaru System*, while the latter, in inclined beds, rest unconformably upon the slopes of the *Maitai System*. From 20 to 45 per cent. of the species are recent.

Characteristic Fossils.

Mammalia—*Phocænopsis Mantelli*. Birds—*Moa* sp. Fishes—*Carcharodon megalodon*. Mollusca—*Cominella Robinsoni, Voluta corrugata, V. pacifica, Triton spengleri, Pleurotoma sulcata, Conus Traillii, Turbo superbus, Natica solida, Struthiolaria cincta, S. tuberculata, Dentalium Mantelli, D. læve, D. solidum, Cucullæa alta, Pectunculus laticostatus*, P. globosus, Pecten secta, P. Triphooki, P. accrementa, P. Burnetti, P. polymorphoides*, Cardium spatiosum, Crassatella ampla, Limopsis insolita, Ostrea ingens, O. Wullerstorfi, O. Nelsoniana*. Actinozoa—*Flabellum corbicula, Platyhelia distans*.

OAMARU SYSTEM (Oligocene).

Professor Hutton includes within this division the following series; viz.—*Mount Brown, Aotéa, Otātara, Turangānui*, and coals of Waikato, Kaiāngata, &c. The system is thought to be unconformable to the lower Waipara System. In the North Island it attains an elevation of 4000 feet east of Lake Waikaremoana. In the South Island it probably never exceeds 2500 feet. "Valuable seams of coal lie conformably below marine sandstones at the Bay of Islands and at Whangarei. In Nelson Province the brown coals of West Wanganui probably belong here, as also much of the brown coal up the Buller River." "About 9 or 10 per cent. of the species (Molluscs) appear to be recent."—(Hutton.)

Characteristic Fossils.

Aquatic Mammalia—*Kekenodon onomata*. Birds—*Palæeudyptes antarcticus*. Crustacea—*Harpactocarcinus tumidus*. Mollusca—*Aturia zic-zac*, var. *Australis,* Pleurotoma hebes, Struthiolaria senex, Scalaria Browni, S. rotunda, Dentalium tenue, Panopæa plicata, Pecten Hochstetteri, P. Zittelli,* P. Williamsoni, P. Fischeri, P. Hutchisoni, P. athleta, Lima lævigata, L. paleata*. Echinodermata—*Lovenia formosa, Macropneustes spatangiformis, Meoma Crawfordi, Schizaster rotundatus*. Actinozoa—*Isis dactyla, Flabellum laticostatum*.

*Those species marked with an asterisk occur also in the marine beds of Palæogene age in Australia and Tasmania.

The freshwater beds at Drury and Waikato have yielded the following genera of plants; viz.—*Fagus, Lorantho phyllum, Myrtifolium, Phyllites*.

SOUTH AUSTRALIA.

NEOGENE.

Lacustrine Deposits of the Upper Murray, chiefly composed of travertin, thinly bedded limestones, red and blue clays; compact earthy argillaceous limestones, friable sandstone, with occasional layers of coarse sand, reddish coloured calciferous clays, often abutting against the cliffs of the Upper Murray, and forming a minor plateau against the major one of the older marine Tertiaries. Professor Ralph Tate states that "the materials of the minor plateau are of freshwater origin—at any rate, no palæontological evidences have been adduced for or against—while the extreme angularity of the sand constituents and their false-bedded arrangement demonstrate rapid accumulation, such as takes place where torrential streams debouch into lake basins."

PALÆOGENE.

Professor Tate divides the older Tertiaries of South Australia and Victoria (composed of the sediments of the older Tertiary shallow sea which at one time divided Western Australia from the eastern Cordillera, and whose southern extremities extended as far south as Cape Grim, Table Cape, and Flinders' Island in northern Tasmania) into four principal groups in descending order; viz.—*Upper, Middle*, and *Lower Murravian*, and *Inferior Marine Beds*, as under:—

UPPER MURRAVIAN.

Section near Glensforslan, Blanchetown, in descending order—1. Oyster bank; 2. Friable sandstone, with fragments of shells and cidaris; 3. Oyster bank; 4. Red and yellow clayey sand, with scattered oysters. In all 14 feet 6 inches.

Section North-West Bend Head Station.—1. Hard sandstone; 2. Soft sandstone, false bedded; 3. Oyster bank—a dense mass of shells in a calcareous paste, oysters, pearl shells, *Trigonia acuticostata*, &c., and casts of Univalves; 4. Sand rocks, unfossiliferous. In all, 28 feet.

Section at four miles south from Morgan.—Oyster band, 12 feet.

Observations—Fauna very meagre, and it is only at few spots where other than the ubiquitous oyster is found, and even then the forms are imperfect and difficult to determine. Besides the common oyster there is a large *Margaritifera, Trigonia acuticostata, Pectunculus M'Coyi?, Arca 2 sp., Tellina, Mactra*, &c.—*Clypeaster Gippslandicus*.

MIDDLE MURRAVIAN.

Section, Glensforslan, near Blanchetown.—1. Dense mass of *Cellepora Gambierensis* in a reddish calcareous paste, a few oysters and fish teeth; 2. White friable earthy limestone, stained at top with iron, phosphatic concretions. Highly charged with *Waldheimia Macleani*, and casts of molluscs in gypsum; 3. Yellow limestone, with *Torcula Murrayana* in gypsum; 4. Light grey calciferous sandstone, with a thick band of *Cellepora Gambierensis*. In all, 56 feet.

Section at North-west Bend Head Station—Yellowish-grey calcareo-argillaceous sand rock, with hardish bands of *Cellepora Gambierensis*. Polyzoa abundant, numerous Palliobranchs and Echinoderms. 43 feet.

Section near Morgan.—1. Hard lumpy yellow sandstone; 2. Yellowish-grey limestone, with clayey sand layers; 3. Yellowish-brown clayey sand, with *Cellepora Gambierensis*; 4. The same, with hard lumps and imperfect stony bands, very fossiliferous, particularly rich in gasteropods; 5. Shell sand with streak of stiff blue clay; 6. Same as No. 4; 7. Yellow soft calciferous sandstone. In all, 91 feet.

Mount Gambier, white limestone.

LOWER MURRAVIAN.

Near Glensforslan.—1. Hard grey calciferous sandstone, with *Lovenia Forbesi, Cellepora Gambierensis, Nautilus*; 2. Brown friable calciferous sandstone; 3. Hard grey calciferous sandstone, with casts of *Torcula Murrayana*; 4. Brown calciferous friable sandstone; 5. Same as 3; 6. Same as 2 and 4, *Panopea* sp.; 7. Same as 3; 8. Yellow grey friable calciferous sandstone, with casts of *Torcula* in gypsum. 26 feet in all.

INFERIOR MARINE BEDS.

1. Chalk rocks, Bunda Cliffs.
2. Mulwoortie clays and other lower beds.
3. Aldinga glauconitic limestone.

Characteristic Fossils.

Middle Murravian—*Charcarodon angustidens, Otodus Desori, Lamna elegans, Aturia zic-zac, Typhis M'Coyi, Triton Abbotti, Ranella Prattii, Nassa Tatei, Ancillaria semilævis, A. mucronata, A. herbera, Cassis textilis, Voluta Hannafordi, V. antiscalaris, V. strophodon, Marginella Wentworthii, M. propinqua, Niso psila, Eulima acutispira, Leiostraca Johnstoni, Mangelia bidens, Daphnella gracillima, Triforis ...ulcata, T. Wilkinsoni, T. planata, Cerithium cibarioides, Cypræa gigas, C. leptorhyncha, C. consobrina, Trivia avellanoides, Conus Traillii, Cancellaria varicifera, Torcula Murrayana, Natica Beddomei, N. Hamiltonensis, Solarium acutum, Minolia strigata, Liotia Robinii, Cyclostrema acuticarinata, Xenophora undulata, Fissurellidæ malleata, Leda transenna, Cylichna exigua, Bulla scrobiculata, Pecten Yahlensis, P. Foulcheri, P. incertus, P. Darwinii, P. Atkinsoni, P. spondyloides, Lima Bassi, L. Jeffreysiana, Spondylus pseudoradula, Leda inconspicua, Nucula tumida, N. Atkinsoni, Limopsis Belcheri, Pectunculus M'Coyii, Cucullea Coriensis, Crassatella oblonga, Lepton crassum, Chama lamellifera, Cardium pseudomagnum, Chione cainozoica, C. dimorphophylla, Corbula ephamilla, Rhynchonella squamosa, Terebratula Scoulari, T. Davidsoni, Magasella Woodsiana, Waldheimia Garibaldiana, W. grandis, W. Taylori, W. Tateana, W. divaricata, W. Coriensis, Terebratula vitreoides, Leiocidaris Australis, Echinus Woodsi, Temnechinus novus, Catopygus elegans, Micrastor brevistella, Brissiopsis Archeri, Holaster Australiæ, Echinolampas Gambierensis, Lovenia Forbesii, Eupatagus rotundus, E. Murrayensis, E. Wrightii, Arachnoides Australis, Megalaster compressus, Deltocyathus viola, D. alatus, D. excisus, Sphenotrochus Australis, Flabellum Victoriæ, Placotrochus deltoideus, Antillia lens, Balanophyllia Australiensis*. Ostracods, foraminifera, and polyzoa enumerated by Messrs. Waters and Brady.

Lower Murravian Species—*Zeuglodon Harwoodii, Lovenia Forbesii, Magasella Woodsiana, Megalaster compressus*.

The greater number of these species are identical with those in the Table Cape beds, Tasmania, where, on palæontological grounds, it would be difficult to mark any satisfactory lines indicating corresponding subdivisions with those of South Australia.

NEW SOUTH WALES.

NEOGENE.

Alluvial deposits not clearly defined, from the deposits of Post Tertiary age, and referred by some authorities to *Lower Pliocene* or *Miocene*.

PALÆOGENE.

Felspathic Basalts and Tuffs, &c., immediately overlying ligneous deposits, as at Gulgong, containing in abundance the remains of a flora identical with that of the Victorian and Tasmanian auriferous and stanniferous drifts.

Lignite and Leaf-bed Formations, as in the Auriferous "Deep Leads" at Gulgong, Parkes, Forbes, Home Rule, and other Gold Fields: Deposits of the Great Dividing Range, at various elevations up to 4000 feet above sea level, composed of conglomerates, siliceous sandstones, clays, and ironstones, containing leaf impressions.

Mr. Wilkinson states that in lithological character these beds have a perfect resemblance to the Lower Miocene leaf-beds of Bacchus Marsh, Victoria; some of the impressions of leaves in the former seem to be undistinguishable from the Victorian fossils. Professor M'Coy states that the fossil plants of the ironstones are strikingly distinguished from the Tertiary leaf-beds of Daylesford and other gold drift deposits by the total absence of myrtaceous plants, and that the fossil leaves from this locality indicate a Lower Miocene or Upper Eocene Tertiary flora, in which lauraceous plants form a remarkable feature. This description would also relate them to the lauraceous deposits at Magnet Range, Mount Bischoff, and Macquarie Harbour, Tasmania.

Dr. Barnard states that the leaf and fruit remains at Gulgong are found immediately beneath the basalt, as at Breadalbane and elsewhere in Tasmania, in a layer of dark bluish clay, arranged in distinct layers. This clay overlies the "drift" or "washdirt" containing the gold, and varies in thickness from one to several feet. Beneath the latter is another layer of clay, all containing trunks of fossilised trees, branches, and roots of these, together with fruits, ferns, sedges, and the remains of animal life. The old "drifts" in this district occur at a depth of from 50 to 175 feet, and Mr. Wilkinson reports that in seven years they have yielded no less than 16 tons of gold.

Characteristic Fossils.

Mollusca—*Unio Aucklandicus*, var. *Wilkinsoni*. Phanerogamæ—*Spondylostrobus Smythii*. Monocotyledones—*Microrhagion Liversidgei*. Dicotyledones—*Conchocaryon Smythii, Celyphina M'Coyi, Conchotheca (?) rotundata, C. turgida, Trematocaryon Maclellani, Rhytidocaryon Wilkinsoni, Illicites astrocarpa, Dieune pluriovulata, Ochthodocaryon Wilkinsoni, Pleiacron elachocarpum, Eucalyptus Deanei*... *Pleiacron leptocelyphis, P. prisca, Eisothecaryon semiseptatum, Pentacoila Gulgongensis, Penteune brachyclinis, P. Clarkei, P. trachyclinis, Phymatocaryon angulare, P. bivalve, P. Mackayi, Tricoelocaryon Barnardi, Acrocoila anodonta*. Plantæ incertæ sedis — *Odontocaryon Macgregorii, Platycoila Sullivani, Pleiacron electrocarpum, Rhytidotheca Lynchii, Wilkinsonia bilaminata*, &c. Nearly all of these plants were described by Sir Ferdinand von Mueller, K.C.M.G. (Geol. Survey, Vic., Decades (figured) I. and II., 1874 and 1883).

Leaf-beds of Dalton, near Gunning, regarded by Professor Dr. von Ettingshausen as *Eocene*, from which the following plants, collected by Mr. C. S. Wilkinson, have been described:—

Filices—*Pteris Humei*. Dicotyledons—*Betula Daltoniana, Quercus Hookeri, Q. præphillipinensis, Q. drymeoides, Q. Darwinii, Fagus Wilkinsoni, Castanopsis Benthami, Ficonium Solandri, Artocarpidium Stuartii, Cinnamomum polymorphoides, C. Leichardtii, Laurus Australiensis, Knightia Daltoniana, Apocynophyllum Etheridgei, Tabernæmontana primigenia, Magnolia Brownii, M. Torresii, Bombax Sturtii, B. Mitchelli, Pittosporum priscum, Celastrophyllum Cunninghami, Pomaderrites Banksii, Eucalyptus Delftii, Dalbergia Diemenii, Cassia Cookii, Leguminosites Kennedyi*. All described by Professor Dr. von Ettingshausen.

VICTORIA.

NEOGENE.

UPPER TERTIARY.

Ferruginous sandstones, with marine shells, Geelong, Flemington, and Brighton; quartz gravels of Flagstone Hill, Melbourne, Haunted Hill, Tom's Cap, and Longford, to Woodside in Gippsland, northwards from Stawell towards the Wimmera River; freshwater limestones, Geelong; leaf-beds (part?) of Daylesford and Malmsbury, Ballarat, Creswick, and Haddon Leads.

Characteristic Fossils.

Mammalia—*Phascolomys pliocenus, Thylacoleo carnifex, Diprotodon longiceps, Arctocephalus Williamsi, Canis dingo, Sarcophilus ursinus, Procoptodon goliath, Macropus atlas*. Fishes—*Charcharodon angustidens, C. megalodon*. Mollusca—*Cerithium Flemingtonensis, Haliotis nævosoides, Waldheimia macropora, &c.* Radiata—*Lovenia Forbesi, Monostychia Australis, &c.* Flora—*Eucalyptus Pluti, Spondylostrobus Smythii, Phymatocaryon Mackayi, Celyphina M'Coyi, Conchotheca turgida, Platycoila Sullivani*, and others.

NOTE.—From conclusions formed by Professor Ettingshausen, it is most probable that the leaf-beds above described belong rather to the Middle Tertiary, as identical deposits with the same species of fossils occur in New South Wales and Tasmania which are pronounced to be as old as Miocene at least.—R. M. J.

PALÆOGENE.

MIDDLE TERTIARY.

White clays, with impressions of leaves beneath the older volcanic, Flemington, Berwick; ferruginous beds, with fossil flora, Pentland Hills, Dargo, and Bogong High Plains, Tangil, and Russell's Creek; fossiliferous, sandy, and calcareous beds on the coast between Warrnambool and Cape Otway, and between Loutitt Bay and Geelong, Mooraboel River, Leigh River, Bairnsdale, Gippsland Lakes Entrance, Longford, and Merriman's Creek near Sale, Curdie's River, and other localities; lignites, M'Kirley's Creek, north of Crossover and Tarwin River, near M'Donald's Track; calcareous beds, underlying Upper Tertiary of the plains bordering the Murray; siliceous conglomerates and quartzite underlying older volcanic rocks, Gippsland.

Characteristic Fossils.

Fauna—*Squalodon Wilkinsoni, Physetodon Bayleyii, Cetiolites, Trigonia acuticostata, T. semiundulata, T. Howitti, Tethya Newberyi, Graphularia Robinæ, Clypeaster Gippslandicus, Haliotis Mooraboolensis, H. ovinoides, Placotomaria Tertiaria, Pecten* various species, *Hinnites Corioensis, Spondylus gæderopoides, Terebratula*, various species including *Waldheimia Coriensis, Cardium pseudomagnum, Cucullea Coriensis*. Flora—*Cinnamomum polymorphoides, Laurus Werribeensis, Salisburia Murrayi, &c.*

NOTE.—It is doubtful if these marine beds, or at least a portion of them, are not of a lower horizon, as identical species occur in South Australia and Tasmania, which, according to evidence of percentage of living to extinct species of Mollusca (about one per cent.), would place them as far down as Lower Eocene. The term *Palæogene* for Middle and Lower Tertiary would be a much safer classification.—R. M. J.

LOWER TERTIARY.

Grey clays, with septaria, near Schnapper Point and mouth of Gellibrand River.

Characteristic Fossils.

Mollusca—*Limopsis aurita, L. Belcheri, Pectunculus M'Coyi, Aturia zic-zac* var. *Australis, Nautilus, Voluta Hannafordi, V. antiingulata, V. strophodon, V. antiscalaris, V. macroptera, Cypræa gigas, C. gastroplax, C. consobrina, C. contusa, C. platypyga, C. platyrhyncha, &c.*

NOTE.—From fossil evidence, there is no good reason for separating the Middle and Lower Tertiary beds, as at Table Cape, Tasmania, nearly all the species of both divisions enumerated are intimately associated together in the same beds.—R. M. J.

TASMANIA.

NEOGENE (Pliocene).

Ferruginous nodular clays, with fossil leaf impressions derived from *Palæogene* beds; pebble terrace drifts on the higher slopes of the main valleys, with abundance of waterworn siliceous fossil conifers throughout the Launceston Tertiary Basin (Upper Zone), and also in the stanniferous regions of the east and west.

Similar deposits on the Derwent, near Bridgewater, Cornelian Bay, Beauty Bay, Macquarie Harbour, and elsewhere, frequently overlying recent nepheline and olivine basalts, the latter most frequently overlying Palæogene leaf-beds and lignites.

The absence of fossils makes it difficult to determine the upper or lower limits of this division.

During this period there is some evidence of a colder climate, and of increased pluvial action. It is not improbable that changes in the distribution of the land surface at the close of the Palæogene epoch (*e.g.*, the rising of the bed of the old marine sea formerly dividing Eastern from Western Australia, running north and south), together with greater elevation, may have diverted the warm gulf stream, and so caused a greater refrigeration of climate. This elevation of the land may have caused the formation of small glaciers in alpine situations, of which there is some evidence in the deep sub-alpine valleys of the Western Highlands of Tasmania in the shape of huge granite erratics, notably in the bed of the Mackintosh River.

PALÆOGENE (Miocene, Oligocene, and Eocene).

Felspathic Basalts and Tuffs, overlying leaf-beds, lignites, and marine beds, Launceston Tertiary Basin, Deloraine, New Ground, Port Sorell, Beaconsfield, Lefroy, Ringarooma, Myrtle Bank, Branxholm, Campbell Town, York Plains, Breadalbane, Fingal, Corners, Avoca, Lake Sorell, Great Lake, Lake St. Clair, Bronté, River Dee Bridge, Hamilton, Ouse, New Norfolk, Glenora, Brighton, Richmond, Geilston, Cornelian Bay, Beauty Bay, Prince of Wales Bay, One Tree Point, Hobart, Kingston, Pearson's Point, Margate, Port Esperance, Huon Island, Cape Grimm, Montagu, Table Cape, Torquay, Magnet Range, Mount Bischoff, Emu Bay; *Flinders' Island*—Little Badger Corner, The Patriarchs, Babel Island, &c.

In the tuffs, overlaid by overflows of basalt, at Breadalbane, Corra Lynn, Little Badger Corner, Geilston, and One Tree Point, there have been discovered bones of *Hypsiprymnus* sp., *Phalascomys* sp., siliceous and calcareous trunks of fossil woods of Banksia, conifers, &c.

Lignite and Leaf-bed Formations, mainly composed of white, grey, or ferruginous sandstones, often intercalated with grits, blue, white, yellow, or blackish clays, and irregular bands of lignite. These formations are often from 400 to 1000 feet in thickness, and sometimes, as in the Launceston Tertiary Basin, cover an area of at least 600 square miles.

The clays and sandstones are replete with the remains of plants, among which the leaf impressions of the Oak, Elm, Beech, Laurel, Cinnamon, and Araucaria are especially noticeable. In the lignites, fossil fruits of proteaceous, sapindaceous, and coniferous trees are abundant. Lignified stumps, chiefly of coniferous trees, are also very abundant among the auriferous drifts at Beaconsfield, Lefroy, and elsewhere. The most of the auriferous and stanniferous drifts belong to this group. Some of the deposits, as at Table Cape, are probably as old as the *Eocene* period. It is most probable that the various deposits cover the whole of the period comprised within the larger division here adopted—viz., *Palæogene*—and that our present knowledge does not justify us in separating them into well-defined subdivisions. The principal localities are—Launceston Tertiary Basin, Beaconsfield, Lefroy, Derwent Basin, Glenora Basin, Hamilton Basin, Ouse Basin, Table Cape, Leven, Kentishbury, Richmond.

Characteristic Genera.

Plants—*Lomaria, Trichomanides, Pteris, Myrica, Betula, Alnus, Quercus, Fagus, Salix, Cinnamomum, Laurus, Dryandroides, Apocynophyllum, Echitonium, Cordia, Premna, Sapotacites oligoneuris, Ceratopetalum, Sapindus, Cassia, Eucalyptus, Ulmus, Cupressus, Conchotheca, Penteune, Platycoila Sullivani, Plesiocapparis, Rhytidotheca, Eloeocarpus, Carpolithes, Spondylostrobus Smythii, Araucaria Johnstoni, Taxites, Cycadites, Phyllites*. Mollusca—*Unio Tasmanica, U. Johnstoni, Helix, Vitrina, Bulimus, &c.*

Marine Beds, at Table Cape, Heathy Valley, Flinder's Island, Montagu, Cape Grim, composed of alternating bands of shelly limestones, calcareous sandstones, coral rag, ferruginous, gritty, and pebbly bands, replete with fossil shells, corals, &c. Zones of hard calcareous grits, rich in remains of corals (*Cellepora Gambierensis*), echinoderms (*Lovenia Forbesi*, var. *Woodsi*), and various brachiopods (*Waldheimia grandis, W. Garibaldiana, Rhynchonella squamosa*.) Sandstones, with marine shells (*Turritella Warburtonii, Panopæa Agnewi, &c.*), and land plants (*Pteris Belli, Sapotacites oligoneuris, &c.*), intermixed as at Table Cape (*Turritella Zone*).

Characteristic Fossil Genera.

Only from 1 to 3 per cent. of the Mollusca are of existing species. Fishes—*Carcharodon angustidens, Lamna elegans? Oxyrhina trigonodon*. Mammalia—*Hypsiprymnus, Halmaturus, Phalascomys*. Corals—*Antillia, Balanophyllia, Conotrochus, Dendrophyllia, Flabellum, Paleoseris, Heliastræa, Placotrochus, Sphenotrochus, Thamnastræa, Deltocyathus*. Echinodermata—*Lovenia, Micrastor, Cidaris*. Polyzoa—*Cellepora, Lepralia, Pustulipora, Retepora, Salicornaria, Bushia*. Crustacea—*Balanus, Cypris*. Brachiopoda—*Terebratula, Waldheimia, Terebratulina, Terebratella, Rhynchonella*. Lamellibranchiata—*Arca, Aspergillum, Barbatia, Chamostrea, Cytherea, Cardium, Cardita, Chama, Chione, Corbula, Crassatella, Cucullea, Dosinia, Diplodonta, Gouldia, Lima, Limea, Limopsis, Nucula, Leda, Lucina, Myodora, Mytilicardia, Panopæa, Placunanomia, Pecten, Pectunculus, Psammobia, Solecurtus, Spondylus, Tellina, Trigonia, Unio, Vola, Zenatiopsis*. Gasteropoda—*Terebra, Pleurotoma, Daphnella, Mangelia, Cancellaria, Murex, Typhis, Fusus, Cominella, Ricinula, Ringicula, Buccinum, Thala, Mitra, Columbella, Voluta, Marginella, Erato, Tritonium, Cassis, Cassidaria, Turbonilla, Odostomia, Leiostraca, Cerithiopsis, Rissoa, Rissoina, Torcula, Turritella, Tenagodus, Vermetus, Potamides, Trochita, Crepidula, Turbo, Calcar, Imperator, Euchelus, Thalotia, Zizyphinus, Trochus, Trivia, Gibbula, Margarita, Liotia, Delphinula, Adeorbis, Trivia, Cypræa, Scalaria, Crossea, Natica, Pyramidella, Fissurellidæ, Emarginula, Pileopsis, Cylichna, Actæon, Ancillaria, Dentalium, &c.* Cephalopoda—*Aturia*. Rhizopoda—*Biloculina, Triloculina, Quinqueloculina, Discorbina, Nummulina, Marginulina, Orbulina, Dentalina, Alveolina, Polymorphina, Cassidulina, Nonionina, Textularia agglutinans, &c.*

Characteristic species (Table Cape)—*Voluta anticingulata, Voluta Tateana, Tritonium Abboti, Marginella Wentworthi, Cassis sufflatus, Calcar Flindersi, Trivia avellanoides, Cypræa Archeri, C. platypyga, Natica Wintlei, Ancillaria mucronata, Turritella Warburtonii, Daphnella gracillima, Typhis M'Coyi, Cardium pseudomagnum, Corbula ephamilla, Crassatella aphrodina, Dosinia Johnstoni, Nucula tumida, Myodora Australis, Panopæa Agnewi, Waldheimia Coriensis, W. Garibaldiana, Lovenia Forbesi, Cellepora Gambierensis, Placotrochus deltoideus, &c.*

Leaf-beds, Macquarie Harbour, Mount Bischoff.

Along the northern shore line of *Macquarie Harbour*, from Long Bay to Kelly's Basin, there exists broad fringing terraces from 40 to 70 feet in height, covered by a grey layer, and abruptly sloping to the shore—composed generally in descending order of—(1) irregular beds of sand and clay, alternating with thick irregular coarse shingly drifts derived from the ancient neighbouring rocks; (2) Carbonaceous and ferruginous clays, sands, and sandstones, regularly and horizontally stratified and laminated, interbedded with layers of lignite, all being replete with the remains of a rich flora, among which lauraceous types are particularly conspicuous. The characteristic species are—*Cinnamomum polymorphoides* (M'Coy), *Eucalyptus Milligani* (Johnston), *Sapotacites oligoneuris* (Ettings.)

At *Mount Bischoff* and the *Magnet Range* there exists, immediately underlying the basaltic sheet, from 100 to 300 feet of white, brown, blue, and blackish clays, intercalated with red, grey, and whitish sandstones, and with lignites replete with impressions of plants, among which the following are very characteristic; viz.—*Laurus Sprengelii* (Johnston), *Eucalyptus Kayseri* (Johnston), *Quercus Bischoffensis* (Johnston), *Ulmus Tasmanicus* (Johnston), *Taxites Thureaui* (Johnston), &c.

WILLIAM THOMAS STRUTT,
GOVERNMENT PRINTER, TASMANIA.

If we carefully examine the preceding lists of fossils, and compare them with corresponding tables belonging to the Mesozoic period, we can easily discern that the differences presented in plant and animal life are very remarkable. The modern aspect of the life of the Tertiary period is at once apparent.

Flora.

As regards the Plants, we find this feature well exemexemplified :—The characteristic genera of ferns of the Mesozoic period in Australia—viz., *Thinnfeldia, Alethopteris, Pecopteris, Neuropteris, Sphenopteris, Tæniopteris, Cyclopteris*—have altogether disappeared, and so also have the Cycads, Horestails, and Conifers, represented by the genera *Pterophyllum, Podozamites, Zamites, Phyllotheca, Baiera, Gingkophyllum, Salisburia*, and *Zeugophyllites*.

In their stead the vegetation of the Tertiary period in Australia is represented by sparing remains of ferns belonging to existing genera—viz., *Pteris Lomaria* and *Trichomanes*—and a wonderfully luxuriant vegetation, mainly *Angiosperms*, showing, as a whole, apparently a closer relation to the existing vegetation of Europe than to the existing plant life of Australia. A close examination of the genera of plants occurring so abundantly in our Tertiary leaf-beds leads to many interesting speculations. In the earlier formations in Tasmania and New South Wales, representatives of the existing Australian vegetation, such as *Eucalyptus, Pomaderris, Cassia, Lomatia, Banksia*, &c. are only to be found sparingly; whilst the remains of the following associated genera, still existing in Europe, are found in rich profusion—viz., *Acer, Laurus, Salix, Quercus, Platanus, Betula, Alnus, Myrica, Ulmus*, and *Fagus*.

This mixture in our Tertiary formations of the elements of the existing floras of Europe and Australia is of the greatest interest, and has recently been ably investigated by Professor von Ettingshausen. In one of his latest communications[a] he summarises the results of his painstaking investigations of the Australian Tertiary Flora as follows :—"When we take into consideration only those fossil species which are represented by fruits, seeds, and characteristic

[a] Geol. Mag., Aug., 1887, pp. 359-362.

forms of leaves, we obtain new and sufficient proofs concerning the view which I have brought forward in the first part of these contributions, that the elements of the floras are mixed together in the Tertiary Flora of Australia. These proofs consist of facts relative to the common appearance of the genera endemic in Australia with genera we find in other floras, but which are strange to the Australian one. For example, there occur in the fossil flora of Vegetable Creek and Elsmore (New South Wales) the following genera of the Australian element:—*Phyllocladus*, *Casuarina*, *Santalum*, *Persoonia*, *Grevillea*, *Hakea*, *Lomatia*, *Banksia*, *Dryandra*, *Callicoma*, *Ceratopetalum*, *Pomaderris*, *Boronia*, and *Eucalyptus*. On the other hand, we find here, intermixed with the former, types belonging to—*Sequoia* (California), *Myrica* (Europe, North America, Asia, South Africa), *Alnus* (Northern Hemisphere), *Quercus* (Northern Hemisphere), *Cinnamomum*[a] (Asia), *Sassafras* (North America and East India), *Aralia* (North America, Japan, and New Zealand), *Elæocarpus* (Tropical Asia), *Acer* (Northern Hemisphere), *Copaifera* (Tropical America)." From such considerations, this able authority concludes: "There is now scarcely any doubt that the general character of all Tertiary Floras of the globe is one and the same in regard to the mixture which they exhibit, and continued so until the separation of the elements of floras into the existing special floras towards the commencement of the present period."

He also gives a synopsis of the conclusions drawn from the general results obtained from the investigation of the Tertiary Flora of Australia, as follows:—

1. "The geographical distribution of plants in Australia at the Tertiary period deviated in many respects from the present one. Therefore the materials for comparison obtainable from the present flora of Australia are not at all sufficient for the investigation of the Tertiary one, and must be completed from other floras of the globe."
2. "Types of plants of the Southern as well as of the Northern Hemisphere of the globe are associated together in the Tertiary Flora of Australia."

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[a] Also Australia.

3. "The flora elements represented in the Tertiary Flora of Australia chiefly contain Phylones (ancestor types), which are also common to other Tertiary Floras of the globe. The character of the Tertiary Flora of Australia cannot, therefore, be considered essentially different from that of the latter."
4. "The Australian Tertiary Flora, in accordance with the preceding statements, is but a part of one and the same original flora upon which all the living floras of the globe are founded."
5. "The comparison of this original flora to the present floras of the globe shows that in Australia the differentiation of the Phylones has reached its highest degree."
6. "Many analogies to the Tertiary Flora are nevertheless to be found in the living Australian Flora."

The genesis of the existing floras of the globe has thus been ably shown to have been derived from generic ancestor types living in the original flora of the Tertiary period. The genesis of these original ancestor types, themselves from a further removed line of ancestry in the Mesozoic period, is a more difficult matter, and is only briefly referred to by the learned authority quoted in his observations with respect to the New Zealand Fossil Flora[a]. In commenting upon the Cretaceous Flora of New Zealand, he states that plant remains have been collected from four localities—Pakawau, Grey River, Wangapeka, and Reefton. "The Cretaceous Flora contains" 37 species, distributed into 29 genera and 17 families. Of these 4 are *Cryptogamæ*, 8 *Coniferæ*, 4 *Monocotyledons*, 13 *Apetalæ*, and 8 *Dialypetalæ*. "Several species seem to be the ancestors of Tertiary ones, particularly of the genera *Aspidium*, *Podocarpus*, *Dacrydium*, *Quercus*, *Fagus*, *Cinnamomum*, *Dryandroides*, *Ceratopetalum*, *Cupanoides*, &c." *Ulmophylum* is also referred to as an ancestor of the Tertiary *Ulmus* and *Planera* species. The plant forms, having a characteristic Cretaceous facies associated with them, are stated to be certain conifers belonging to the genera *Podocarpium* and *Dacrydinium*.

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[a] On the Fossil Flora of New Zealand (Geol. Mag., Aug., 1887, pp. 363-367.

As regards the relationship of the various Australasian leaf-beds to each other, and their exact position within the period, there is much that is uncertain and obscure. It is true that the learned authority, for whom the author entertains the highest respect, has referred the Travertin beds at Risdon and other leaf-beds of the Derwent near Hobart to Miocene age, while beds containing a very similar flora in New South Wales (Dalton and Vegetable Creek) have been referred to Eocene, and even Lower Eocene age; but as the author has recently discovered a characteristic species of the Derwent (*Sapotacites oligoneuris*, Ett.) intercalated with other plant impressions in marine beds at Table Cape, deemed to be of Eocene age, it proves that it is hazardous to attempt to define their position in accordance with the nomenclature of Europe, and especially with the particular association of genera found there within definite local subdivisions.

The reference to the wider grouping (*Palæogene*), as adopted by the author, appears to be the safer course at present, when we take into consideration the great difference in longitude and latitude of the deposits referred to, and the possible original differences of elevation.

Fauna.

The Australian Tertiary Fauna, as a whole, also presents a clearly modern aspect. The foraminifers, brachiopods, gasteropods, pteropods, and pelecypods nearly all belong to genera still existing in Australian seas. Of the Tertiary molluscs of Australia and Tasmania, however, there is, according to latest accounts, not more than 2 per cent. of the species identical with existing forms. *Fishes* of the shark family are alone known, and these are represented by four genera (*Carcharodon*, *Lamna*, *Otodus*, *Oxyrhina*), all of which have living congeners. The carnivora are represented by a member of the seal family (*Arctocephalus Williamsi*, M'Coy); and Cetaceans, by the characteristic genera *Squalodon* and *Zeugolodon*. Professor M'Coy has also figured three species of *Cetotolites* from the Tertiary beds near Geelong, which are declared to be the ear-bones of different species of whales.

Perhaps the most interesting group of mammals, so far as Australia is concerned, is the ancestral types of the existing marsupials. As yet the more remarkable forms of this group have been found in the later cave breccias and other deposits of Australia deemed to be of Post-Pliocene age.

Marsupial remains have not yet been detected in Australia in deposits older than the Tertiary period. Mammalian remains of Mesozoic age,—such as *Microlestes*, *Amphitherium*, *Amphilestes*, *Phascolotherium*, *Stereognathus*, *Plagiaulax**, *Spalacotherium**, *Galestes**, and *Peratherium* of Europe ; and *Allodon*, *Ctenacodon*, *Dryolestes*, *Stylacodon*, *Asthenodon*, *Laodon*, *Diplocynodon*, *Docodon*, *Enneodon*, *Menacodon*, *Tinodon*, *Triconodon**, *Bracidus*, and *Paurodon* of the Jurassic age, in North America,—have heretofore been referred to the Marsupialia on the authority of Professor Owen and other eminent specialists : the dentition of certain of them approaching closely to the existing Hypsiprymnus of Australia ; of some to the existing Opossums ; and of others to the existing *Myrmecobius* of Western Australia.

The remains in the earlier Tertiary formations of Australia are generally very imperfect. From the teeth and other bones preserved, however, Professor Owen and other authorities have recognised the following genera—viz., *Bettongia*, *Hypsiprymnus*, *Halmaturus*, *Nototherium*, *Phalangista*, *Sarcophilus*, and *Phascolomys*. With the exception of the giant extinct vegetable-feeder, *Nototherium*, all the genera here referred to have living representatives either in Australia or Tasmania.

Of the genera marked with an asterisk, Professor Alleyne Nicholson states[a] : "Fourteen species are known from the Middle Purbeck beds of England (*Oolitic*), all of which are probably referable to the Marsupialia, and all of which, except *Plagiaulax*, are Polyprodont." The largest of these are deemed to be no bigger than a polecat or hedgehog. *Plagiaulax* is by various authorities believed to be most nearly allied to the existing kangaroo-rats of Australia and Tasmania (*Hypsiprymnus*). Professor Owen, however, regards it as more allied to the carnivorous group. The genera *Spalacotherium*, *Triconodon*, and *Galestes* have been referred to as insectivorous, having their nearest allies in our Australian phalangers and in the American opossums.

[a] Manual of Palæontology, 1879, vol. ii., p. 292.

Professor Marsh, who has recently devoted much attention to these earlier forms of the Mammalia, has latterly[a] given good reason for the view that it is extremely doubtful whether these earlier forms can properly be referred to the order Marsupialia. Many of them appear to depart from the normal type of Marsupial structure, approximating to the Insectivora; and for these and other reasons, Professor Marsh has come to the conclusion that it is more probable that they represent two distinct primordial groups, termed by him Pantotheria and Allotheria, both of which are supposed to have no living representatives.

Local General Features.

Taken as a whole, the general features of the Tertiary system in Tasmania correspond exactly with those of the mainland of Australia. The rock formations may be conveniently divided into four main groups, in descending order, as follows :—

Neogene......	Older raised terrace drifts, often overlying the plateaux of basalt.
Palæogene..	1. Basaltic sheets and associated tuffs overspreading lacustrine formations. 2. Lacustrine deposits of great thickness and extent, composed of sands, clays, lignites, travertines, and sometimes including auriferous and stanniferous drifts. Contains the remains of a rich and varied flora. 3. Marine deposits in the northern part of Tasmania.

Palæogene Epoch.

Marine Formations.—The marine formations occur in isolated patches fringing the northern coast of Tasmania and the islands in Bass's Strait, notably near Cape Grim, Sandy Cove, Table Cape, and Heathy Valley, Flinders' Island. The members present a somewhat uniform

[a] Geol. Mag., July, 1887, pp. 297-298.

character, like their equivalents along the Lower Murray in Australia, and most probably they form the southern limits of the ancient Tertiary sea which occupied the greater part of the existing plains bordering the Great Australian Bight, and extending over the lower levels of South Australia and Victoria within the limits indicated in preceding chapter (p. 217). The rocks generally are composed of alternating bands of shelly limestones, calcareous sandstones, coral rag, ferruginous, gritty, and pebbly bands, replete with fossil shells, corals, foraminfers, echinoderms, sharks' teeth, &c. Certain thin zones of a hard calcareous character recur, invariably showing similar characteristic fossils, notably, *Cellepora Gambierensis*, *Lovenia Forbesi*, *Waldheimia grandis*, *W. Garribaldiana*, *Rhynchonella squamosa*.

The sandstones are also replete with fossils, in the upper beds of which the following are typical; viz.—*Turritella Warburtonii* (T. Woods), *Panopea Agnewi* (Ten.-Woods), *Voluta Tatei* (R. M. Johnston), *V. Hannafordi* (M'Coy), *V. Weldii* (T. Woods), *V. anticingulata* (M'Coy), *Cypræa Archeri* (T. Woods), *C. platypyga* (M'Coy).

In the sandstones of the Upper or "Turritella zone" at Table Cape, land plants occur, intermixed with the marine shells, among which may be noted a species of Pteris (*P. Belli*, Johnston) and (*Sapotacites oligoneuris*, Ettings.) The latter form has also been found by the author in lacustrine formations at Macquarie Harbour and Hobart, and may be of much value hereafter in determining the relative age and position of the isolated marine and lacustrine formations throughout the island.

The lowermost bed at Table Cape is almost wholly composed of the remains of *Crassatella oblonga* (T. Woods,) and rests upon the upturned edges of slates belonging to Silurian age. At Cape Grim and Table Cape the whole series are capped with bosses of nepheline basalt, similar to the older basalts of Victoria; and nowhere along the Tasmanian coast does the marine group exceed 70 feet in thickness. From the character of the molluscs and the small percentage (not exceeding 2 per cent.) of species having living representatives, it is clear that the marine beds of Tasmania must be placed at the base of the Palæogene group, equivalent to the early Eocene of other countries.

Although many earlier references are made respecting the Tertiary marine deposits of Tasmania, their history has only been worked out fully and systematically within the last eleven or twelve years. The Palæontology of these deposits has been ably investigated and described mainly by the Rev. J. E. Tenison-Woods, Professors Duncan, Busk, and Tate, from collections made in great part by the author within the last fourteen years. In addition to the numerous memoirs communicated to the Royal Society of Tasmania upon the geology and stratigraphy of the various Tertiary marine deposits of Tasmania, the author has also added somewhat to its Palæontology—about forty new species of molluscs, described by him, having been added to the general list.

The following are the sources from which the greater part of the information may be gained respecting the Geology and Palæontology of the Tasmanian deposits :—

Woods (Rev. J. E. T.) On some Tertiary Fossils from Table Cape, Tasmania. Papers and Proc. Roy. Soc. of Tas. for 1875, pp. 4 and 13-26, 3 plates.

—— On the History of Australian Tertiary Geology. *Ibid* for 1876, pp. 76-78.

—— Notes on the Fossils (from the Tertiary Marine Beds, Table Cape) collected by R. M. Johnston. *Ibid* for 1876, pp. 91-115.

—— On the Tertiary Deposits of Australia. Jour. R. Soc. of New South Wales for 1877, xi., pp. 65-82.

Duncan (Prof. P. M.) On some Fossil Corals from the Tasmanian Tertiary Deposits. Quart. Journ. Geol. Soc., 1875, xxxi., pp. 677, 688, and 380.

—— On some Fossil Reef-building Corals from the Tertiary Deposits of Tasmania. *Ibid*, xxxii., pp. 341-351 and 22.

Tate (Prof. Ralph.) On the Australian Tertiary Palliobranchs. Trans. R. Soc. S. Australia, 1880, iii., pp. 140-170, pls. 7-11 ; *Ibid.*

—— Notes of a Critical Examination of the Mollusca of the Older Tertiary of Tasmania, alleged to have living representatives. Papers and Proc. Roy. Soc. of Tas., 1884, pp. 207-214.

—— The Fossil Marginellidæ of Australia. Trans. Phil. Soc., Adelaide, for 1877-78, pp. 90-98.

—— Description of New Species of Mollusca of the

Upper Eocene Beds at Table Cape. Papers and Proc. Roy. Soc. of Tasmania for 1884, pp. 226-231.

Tate (Prof. Ralph.) Supplemental Notes on the Palliobranchs of the Older Tertiary of Australia, and a description of a New Species of Rhynchonella. Trans. Royal Soc. of South Australia, 1885, pp.

—— The Lamellibranchs of the Older Tertiary of Australia (Part I.) *Ibid* for 1885, pp. —, 11 plates: Part II. for 1886, pp. —, 7 plates.

Etheridge (R., Jun.) A Catalogue of Australian Fossils (including Tasmania and the Island of Timor) Stratigraphically and Zoologically arranged. Edited for the Syndics of the University Press, pp. viii. and 232. (8vo., Cambridge, 1878.)

M'Coy (Prof. F.) Geological Survey of Victoria; Prodromus of the Palæontology of Victoria. Decades i-vii, (1874-1885).

Johnston (R. M.) Further Notes on the Tertiary Marine Beds of Table Cape, Tasmania. Papers and Proc. Roy. Soc. of Tas. for 1876, pp. 79-90: [Section] showing position of Tertiary Marine Beds at Sandy Cove, Table Cape.

—— Notes on certain Tertiary and Post-Tertiary Deposits on Flinders', Barren, Badger, and other Islands in Bass's Straits. *Ibid*, pp. 41-50. Sections of Badger, Green, and Flinders' Islands.

—— Notes regarding certain Fossil Shells at Table Cape, supposed to be identical with living species. *Ibid* for 1884, p. 199.

—— Third Contribution to the Natural History of the Tertiary Marine Beds of Table Cape, with a description of 30 new species of Mollusca. *Ibid* for 1879, pp. 29-41.

—— Additions to the List of Table Cape Fossils, together with further Remarks upon certain Fossil Shells supposed to be identical with living species. *Ibid* for 1884, pp. 220-224.

—— Description of new species from Eocene Beds, Table Cape. *Ibid*, 1884, pp. 232-233 (two plates).

—— Notes regarding the discovery of Plant Remains in the Tertiary Marine Beds at Table Cape. *Ibid*, 1886, p. xx., two plates, leaf figures, &c.

Johnston (R. M.) Reference List of the Tertiary Fossils of Tasmania. Papers and Proc. Roy. Soc. of Tas. for 1886, pp. 124-140.

Lacustrine Formations.—The more important lacustrine formations, as might be expected, are mainly found in the original valleys and eroded basins of the earlier rocks, and generally consist of regular or irregular bands or layers of white, grey, or ferruginous sandstones, alternating with grits; blue, white, yellow, or blackish clays; lignites; and sometimes, in the neighbourhood of the older slates and crystalline rocks, the ancient channels formed in them contain drifts of a richly auriferous or stanniferous character. Many of the formations are found along the course of existing rivers and watercourses in the form of raised bordering terraces. In other places, as in the Launceston Tertiary Basin, they occupy the floor of broad undulating plains, covering an area of not less than 600 square miles, and ranging from 400 to 1000 feet in thickness. Being comparatively of a loose and incoherent nature, the beds are unable to resist the eroding influences of air and water, and are, therefore, greatly denuded along the course of existing rivers and their tributaries. The extent of this denudation is well exemplified along the lower course of the North Esk in the neighbourhood of Breadalbane, St. Leonard's, and Launceston. In this vicinity it is estimated that strata from 15 to 20 miles long, by 1 to 1½ miles broad, have been denuded to a depth ranging from 50 to 500 feet. These lacustrine deposits are found throughout the island from sea level to an altitude of four thousand feet above it; sometimes, as at Magnet Range, Mount Bischoff, Branxholm, and Ringarooma, concealing and composed of the waste of the oldest or pre-Archæan rocks, with associated stanniferous granites and porphyries; again, as at Macquarie Harbour, Beaconsfield, Lefroy, Back Creek, Tullochgorum, Mangana, and Black Boy, bordering and concealing the Silurian slates with quartz dykes and veins, from the destruction of which they have derived their auriferous drifts. At Geilston, Cornelian Bay, Hobart, Sandy Bay, and One-Tree Point they are associated with the mudstones and intrusive greenstones; while at Launceston, Longford, Ross, Jerusalem, and Hamilton, they are mainly derived from the associated or underlying sandstones, clays, shales, and carbonaceous formations of Mesozoic age.

In each case, notwithstanding the similarity or identity of fossil plants common to them all, the nature of the later rocks shows that the mineral characteristics of each basin vary in correspondence with the rocks with which they are now immediately associated, and from the waste of which, in the main, they originally derived their sands, clays, grits, and gravels.

The clays and ferruginous sandstones are in most places replete with the remains of a luxuriant vegetation, among which the leaf impressions of forms more allied to the existing European flora are especially noticeable—such as those belonging to certain extinct species of the oak, elm, beech, laurel, willow, and elder. With these occur ancestral forms of banksia, lomatia, eucalyptus, pittosporum, cinnamon, fig, araucaria, and other conifers. The mixture in our Tertiary formations of types which characterise widely separated provinces of the globe at the present day is very interesting, and has already been commented upon in a previous chapter. It would seem that the Phylones or ancestral-types of the existing flora had already attained a very high state of development and specialization into well-known generic types in the early Tertiary period, and that the existing vegetation, restricted more or less to particular provinces, now only partially preserves the descendants of genera once more widely distributed. The tendency of influences operating in later times apparently is marked in the isolation into widely separated provinces of generic groups, once intimately associated together, rather than in the direction of newer generic creations; and, therefore, it is absolutely true, as indicated by Dr. von Ettingshausen, "the materials for comparison of the flora of any one province, or even hemisphere, are not at all sufficient for the investigation of the Tertiary one, and must be completed from other floras of the globe."

During the last seventeen years the author has also devoted much time to the investigation of the Tertiary Flora of Tasmania, the results of which have been communicated in a series of papers to the Royal Society of Tasmania. Nine of these papers[a] (with numerous figures

[a] 1. Johnston (R. M.) Regarding the composition and extent of certain Tertiary Beds in and around Launceston. Proc. R. Soc. of Tasmania for 1873, pp. 34-48 (sections and figures).

of fruit, leaf impressions, &c.) are devoted to the elucidation of the Tertiary lacustrine deposits and their plant remains.

Prior to the author's investigations certain of the deposits were briefly described by Dr. Milligan, Count Strzelecki, Professor Morris, the illustrious Darwin, and Morton Allport; and two or three of the plant remains were figured by Strzelecki in his work on "The Physical Description of New South Wales and Van Diemen's Land." It is from such sources, and from various collections examined, that the eminent phytologists, Baron von Mueller (Sir Ferd.), of Victoria, and Baron von Ettingshausen, of Vienna, have been enabled recently to make a more systematic investigation of the Tertiary Flora of Tasmania. The investigations of Baron von Ettingshausen are summarised in an abstract recently communicated to the Geological Magazine, in which the labours of the author are kindly acknowledged. As the views of Baron von Ettingshausen are of the greatest value in matters pertaining to palæo-botany, the portion dealing more particularly with the Tasmanian Flora is here reproduced.

In relation to the Travertin at Geilston, near Hobart, Baron von Ettingshausen writes:—"This Travertin has been ably investigated and written on by Mr. R. M. Johnston. I have examined in the British Museum a

2. Johnston (R. M.) The Launceston Tertiary Basin; second paper. Proc. R. Soc. of Tasmania for 1874, pp. 29 and 53-62 (figures).

3. —— Note on the discovery of *Spondylostrobus Smythii* (V. Mueller), and other Fruits in the Deep-lead Drift at Brandy Creek (Beaconsfield) Gold Field. *Ibid* for 1879, pp. 29-41.

4. —— Table of the Fossil Flora of Australia of the Tertiary period. *Ibid* for 1879, p. 29.

5. —— Notes on the relations of the Yellow Limestone (Travertin) of Geilston Bay, with other fluviatile and lacustrine Deposits in Tasmania and Australia, together with Descriptions of two New Fossil Helices. *Ibid* for 1879, pp. 81-90.

6. —— Notes showing that the Estuary of the Derwent was occupied by a Freshwater Lake during the Tertiary period. *Ibid* for 1881, pp. 1-21 (diagrams and figures).

7. —— Description of some Fossil Leaves from Tertiary deposits at Mount Bischoff. *Ibid* for 1885, pp. cxii-cxiii (figures).

8. —— Description of new species of Fossil Leaves from the Tertiary deposits of Mount Bischoff, belonging to the genera *Eucalyptus*, *Laurus*, *Quercus*, *Lamia*, &c. *Ibid* for 1885, pp. 322-325 (figures).

9. —— Notes. *Ibid* for 1886, pp. xx-xxi, (figures).

series of fossil plants from Risdon, Geilston Quarry, and Shoobridge's Limekiln, &c., near Hobart. The first is one of the best localities for the Travertin containing the leaves. In the British Museum there is also a series of fossil plant-remains, which are labelled '*Erebus* and *Terror*,' and were collected during the exploring voyage of those vessels to the Antarctic Seas by Dr. C. M'Cormick, who was attached as Surgeon and Naturalist to the *Erebus*. The fossil plants I examined came from the Tertiary Travertin, which is so extensively developed in the neighbourhood of Hobart Town. Finally, I have also examined the figures (afterwards reproduced) in R. M. Johnston's Paper (' Notes showing that the Estuary of the Derwent was occupied by a Freshwater Lake during the Tertiary period.' Proc. Roy. Soc. Tas., 1881, pp. 1-21 [5 plates, sections; and 6 plates, containing 102 figures)], with the view of enlarging the knowledge of this interesting fossil flora. It contains till now 35 species, which are distributed into 21 genera and 17 families. Of the species I have to mention—*Araucaria Johnstoni* (V. Mueller), *Myrica Eyrei*, closely allied to *M. salicina* of the European Miocene; *Betula Derwentensis*, corresponding to the Miocene *B. Brongniartii*; *Alnus Muelleri*, nearly allied to the Miocene *A. gracilis*; *Quercus Tasmanii*, like the *Q. Palæococcus* of the fossil flora of Radoboj; *Fagus Risdoniana*, nearly allied to *F. Deucalionis*; *Salix Cormickii*, closely allied to *S. varians*; *Cinnamomum Woodwardii*, allied to the Miocene *C. Scheuchzeri*; *Lomatia præ-longifolia*, allied to *L. borealis* of the European, and to *L. Torreyi* of the American Tertiary flora, as well as to the living Australian *L. longifolia*; *Dryandroides Johnstoni*, referring to living species of *Banksia* and *Dryandra*; *Coprosma præ-cuspidifolia*, the ancestral species of the living *C. cuspidifolia* of Australia; *Echitonium obscurum*, allied to *E. macrospermum* of the European Miocene flora; *Elæocarpus Bassi*, nearly allied to the Miocene *E. Albrechti*; *Sapindus Tasmanicus*, nearly allied to *S. falcifolius* of the European Miocene; *Cassia Flindersii*, allied to *C. ambigua* of the same strata. Besides these, species of *Apocynophyllum*, *Cordia*, *Premna*, *Sapotacites*, and *Ceratopetalum* occur. This flora contains more characteristic genera referable to the living Australian flora than that of Dalton, in New South Wales, especially such genera as *Lomatia*, *Dryandroides*, *Coprosma*, *Ceratopetalum*, but with a great number of genera occurring in the Tertiary flora of Europe, North America, and North Asia.

"The species are mostly allied to Miocene, and therefore the leaf-beds of the Tertiary Travertin belong, I believe, to the Miocene formation.

"The result of my report is as follows:—I find the Tertiary Flora of Australia is far more nearly allied to the Tertiary Floras of other Continents than to the living flora of Australia. It seems, therefore, that the numerous forms which characterise the latter have been developed out of Pliocene or Post-Tertiary forms of plants till now unknown to us. The recent flora of Australia contains also genera which characterise other floras, but not the Australian. It was till now enigmatical how they came to form part of this recent flora, as the species are endemic, and have not wandered; for instance, the species of the European and North American genus *Fagus*, of the Asiatic genera *Tabernæmontana* and *Elæcarpus*, &c.

"As some of them now have been discovered in the Australian Tertiary,—for instance, the above-named,—there is no doubt they passed over into the living flora from the Tertiary. The proofs of this may be easily introduced into palæo-botanical science by means of future discoveries and investigations: for in every case the more species from large and well-preserved series, the more readily shall we be enabled to show the origin of our living floras."

Basalt and Basaltic Tuffs.—One of the most characteristic features marking the close of the Palæogene period in Tasmania is the prevalence of extensive sheets, dykes, and masses of nepheline and anamesite basalts, associated with basaltic tuffs, already referred to in a former chapter under the heading "VOLCANIC ACTIVITY," p. 152. These basalts, although sometimes found as conical hills and isolated patches, are generally spread out over the Tertiary leaf-beds as sheets or terraces along the valleys or plains, as in the neighbourhood of Bronté, Great Lake, Mount Bischoff, Deloraine, Port Sorell, Campbell Town, Avoca, Cornelian Bay, Beauty Bay, Branxholm.

The rock varies considerably in composition, colour, structure, and texture. Some of the characteristics are due to having been subjected to different degrees of pressure and various modes of cooling, but more frequently to the effect of long continued action of decomposing agencies. The structure of the rock is mainly sphæroidal, polygonal, or hexagonal, concretionary, and much jointed, although sometimes showing a very perfect columnar or prismatic appearance as at Emu Bay and other places along the North-West Coast; and the texture varies from compact to vesicular, vesicular-amygdaloid, or spongy (basaltic pumice); the latter form, as at One-Tree Point, Hobart, often so light that it floats in water, and, but for its black or brownish colour, might readily be mistaken for true trachyte-pumice. In Tasmania, as in the older eruptive basalts of Victoria, the three sub-species of basalt (1. Dolerite, Dolerite Lava; 2. Anamesite, Anamesite Lava; 3. Basalt, Basalt Lava) may graduate vertically or laterally into each other. Professor Ulrich's description of these three sub-species of basalt, with respect to Victoria, serve equally well for Tasmania, and may be of much value to local geologists. He states :—

"Proceeding now to a special description of the older and newer basalts relative to their lithological character, bearing in mind their essential mineral composition, viz.—"augite," "labradorite," and "titaniferous iron,"—we have in Victoria the three established sub-species,—viz. dolerite, anamesite, and basalt,—besides an infinite number of varieties dependent on texture and other characters.

(1) "Dolerite, Dolerite Lava.—A crystalline-granular, dark and light-bluish or greenish-grey rock, in which crystals of its principal components (augite and labradorite) can be distinctly recognised by the naked eye. This species has not as yet been observed within the older basalt areas, and is also rare within those of the newer.

(2) "Anamesite, Anamesite Lava.—Of a bluish or greenish, often brownish grey or black colour, and distinctly recognisable, yet so finely crystalline-granular a texture, that the component minerals (augite and labradorite) cannot be clearly distinguished without the aid of the magnifying glass, and then only by their difference in colour. It is apparently the most prevailing. Its frac-

ture is flat-conchoidal, with a glittering surface, and it is sometimes rendered porphyritic by crystals of *hornblende* and *oligoclase*, and grains of *olivine*," (one of the varieties placed under this group is described by Professor Ulrich as *nephelinite*), "having numerous crystals (hexagonal prisms) of *nepheline*, some more or less decomposed, besides large plates of black or brown *mica*, patches of *triclinic feldspar*, apparently *oligoclase*, crystals of black *hornblende*, and large grains of *titaniferous iron*." This variety is also in places characterised "by the great abundance of zeolites, especially *analcime* and *natrolite*."

(3) "Basalt, Basalt Lava.—Dark grey to mostly black, quite homogeneous-looking; in fracture generally somewhat dull, though in some places . . . quite of the aspect of *Lydian stone*.

(*a*) "Earthy Basalt.—A bluish, greyish, or brownish black, mottled, earthy-looking, and more or less vesicular mass, with frequently embedded nodules of a denser texture, found in some places on top of the plains, and also beneath sheets of hard basalt.

(*b*) "Basalt Scoria.—Of dark brown or black colour, highly vesicular or cellular; the vesicles or cells irregular in size and shape, and showing glazed walls very similar to some of the slags of iron furnaces. It occurs in masses of irregular shape and of all sizes, principally on the tops and slopes of the craters and points of eruption. The same is the case with—

(*c*) "Basaltic Pumice.—A scoria, so spongy and light that it floats in water, and might, except for its black or brownish-black colour and absence of fibrous texture, be mistaken for true trachyte-pumice." (Occurs at One-Tree Point, Hobart).

(*d*) "Basaltic Ash (Tuff).—Earthy and compacted, ashy-grey or brown, sometimes

> mottled in these colours; found near craters and points of eruption, frequently in stratified layers. The compacted kinds are in some localities (Warrnambool, Terang, &c.) advantageously used as building stone, being, when freshly broken, soft enough to be sawn into blocks of all sizes, but hardening considerably on exposure to the atmosphere."

"Both the older and newer basalt rocks are rich in accessory minerals, partly original, partly of secondary origin. As the most noteworthy original mineral may be mentioned, *Olivine*—common in all our basalts, but more especially characteristic of the newer; in fact it is so frequent in places (Deloraine, Table Cape) as quite to assume the place of an essential constituent of the rock. It is generally of an olive-green, sometimes emerald and bottle-green colour, has a glassy lustre, and appears in grains and larger and smaller nests or polygonal masses of granular texture, up to several pounds in weight, irregularly distributed through the rocks. . . . It seems to decompose more readily than the mass of the rock, leaving behind it a reddish-brown substance, principally consisting of hydrous ferric oxide."

In their mode of occurrence, the three sub-species and their varieties, so graphically described by Professor Ulrich, differ in some respects from those described from basalt districts in Europe, inasmuch as they do not always occur in distinct masses with defined outlines, but rather, as described by Professor Ulrich, whom the author has so largely quoted, they "form here rather irregular portions of undefinable size and shape, graduating one into the other, laterally as well as vertically throughout the same sheet or stream of lava. They present, in fact, only as it were, differing forms and stages of mineral aggregation during the cooling of the molten matter. The same quarry yields thus frequently both *anamesite* and *basalt*, and at Malmsbury a quarry produces, besides these, also *dolerite*."

It is evident, from a study of these igneous rocks, that the eruption from the same point took place again and again after considerable intervals of repose, and this is substantiated at One-Tree Point, at Hobart, and also at Geilston, by the discovery of bone breccia lying under a solid sheet of basalt, and apparently occupying the crevices of the partly denuded surface of an older flow. The bones and teeth so found appear to belong to Marsupials of the following genera :—*Hypsiprymnus*, *Phalangista*, *Phascolomys*.

Formerly both Mr. Gould and Mr. Allport concluded from the bone remains that the "Geilston travertin must be of Recent Tertiary or Post-Tertiary age," and consequently that the associated intrusive basalt must be of still more recent origin.

The discovery of certain fossil seeds of plants, which have since proved to be identical with fruits widely distributed in Australia and Tasmania, in Palæogene formations, led Mr. Allport to enquire more particularly into the circumstances connected with the discovery of the fossil bones. This enquiry fully justified his supposition that the bones were obtained from a matrix derived from the originally deposited travertin, and deposited in crevices of the same rock probably formed by the intrusion of the overlying basalt. (Notice of Roy. Soc. Proc. of Tas., 13th June, 1876).

In a paper on the Launceston Tertiary Basin, read before the Royal Society of Tasmania in the year 1876, the author suggested that the travertin beds might belong to the same series as those in the neighbourhood of Launceston, and possibly of the same age as the marine beds at Table Cape and elsewhere in Australia. This suggestion was made because of the close resemblance between certain of the undetermined leaf remains common in the respective deposits, and from the circumstance that all the deposits referred to are capped by a more or less decomposed basalt; all of which, upon analysis, proves to be the same chemically and structurally. Professor Ulrich also informed the author that the basalts at Geilston Bay, Breadalbane, and Table Cape are essentially the same as the rock known as the "Older Volcanic" in Victoria, which also frequently caps the marine beds in Victoria, now certainly proved to be of the same horizon as the marine beds at Table Cape. The recent discovery of *Sapotacites oligoneuris* (Ett.) in the marine beds of Table Cape, also common to the lacustrine beds, seems to confirm this view.

The author has also gathered abundant evidence of the very wide distribution of this rich soil-maker from nearly all parts of Tasmania, particularly in the plains about Campbell Town, Fingal, Avoca, Piper's River, Myrtle Bank, Ringarooma, Deloraine, George Town, Torquay, Flinders' Island, Lake St. Clair, Mount Bischoff, Middlesex Plains, Cattley Plains, &c., in all which places it forms the rich chocolate soil of the district, and in auriferous and stanniferous regions it frequently overspreads the older auriferous and stanniferous drifts.

Through the praiseworthy labours of Professor Ralph Tate, Professor Hutton, R. Etheridge, Jun., R. L. Jack, S. H. Wilkinson, F. A. Krause, Rev. J. E. Tenison-Woods, S. H. Wintle, R. A. F. Murray, A. W. Howitt, Norman Taylor, Daintree, Thureau, Brough Smythe, and other Australian geologists, abundant materials for the determination of the Tertiary beds have been gathered together, and, recently, in the hands of the leading palæontologists they have yielded important results. From the writings of the gentlemen named we may learn that the extensive fluviatile and lacustrine formations in Australia, particularly at Haddon, Bacchus Marsh, Malmsbury, Daylesford, Werribee, Beechworth, Tangil River, Gulgong, Richmond River, Orange River, and in the Darling Downs, Queensland, are the equivalents of similar deposits in Tasmania at Beaconsfield, Nine-Mile Springs, Muddy Creek, Tamar, Breadalbane, Avoca, included within my definition of the Launceston Tertiary Basin, and also of the yellow limestone of Geilston Bay, Hobart, and similar deposits elsewhere in various parts of the Island. These freshwater deposits are undoubtedly of vast extent and of great thickness. The relations of the isolated though closely related groups of beds cannot be definitely ascertained, nor, when we take into consideration existing distribution of particular vegetable and animal forms, can we hope to draw satisfactory conclusions in regard to their exact sequence. The preponderance of proteaceous forms in one locality, or of coniferous remains in another, gives no clue to chronological sequence. It may only indicate the existence of varied forms of contemporaneous vegetable life under, perhaps, slightly altered circumstances as regards area, soil, or altitude.

No better conception of the restriction of particular forms to certain areas can be had than from a glance at the distribution of certain forms of the existing flora and fauna, *e.g.*, *Fagus Cunninghami*, *Frenela Australis*, *Anodopetalum biglandulosum*, *Arthrotaxis cupressiformis*, *Acacia dealbata*, *Eucalyptus globulus*, *Banksia serrata*; and *Helix Launcestonensis*, *H. antialba*, *H. Weldii*, *H. Pictilis*, *H. Bischoffensis*, *H. lampra*, and *Bulimus Tasmanicus*. The remarkable restriction of these examples affords striking illustrations of localization. With respect to land and freshwater contemporaneous remains, too, we ought to expect greater local differences in separate areas than in more widely separated contemporaneous areas of marine formations.

In summing the general features of the *Palæogene* period in Tasmania, the author was much struck with their resemblance to the general features of the Lower Miocene of France as described by Lyell. In respect of these he remarks[a]:—

"Lacustrine strata, belonging for the most part to the same Miocene system, as Calcaire de la Beauce, are again met with further south in Auvergne, Cantal, and Velay. They appear to be the monuments of ancient lakes, which, like some of those now existing in Switzerland, once occupied the depressions in a mountainous region, and have been each fed by one or more rivers and torrents.

"The country where they occur is almost entirely composed of granite and different varieties of granitic schist, with here and there a few patches of secondary strata much dislocated, and which have suffered great denudation. There are also some vast piles of volcanic matter, the greater part of which is newer than the freshwater strata, and is sometimes seen to rest upon them, while a small part has evidently been of contemporaneous origin. . . .

"The study of these regions possess a peculiar interest, very distinct in kind from that derivable from the investigation either of the Parisian or English tertiary areas. For we are presented in Auvergne with the evidence of a series of events of astonishing magnitude and grandeur, by which the original form and features of the country have been greatly changed, yet never so far obliterated but that they may still, in part at least, be restored in imagination.

[a] Elements of Geology, 1871, pp. 206-207.

Great lakes have disappeared—lofty mountains have been formed by the reiterated emission of lava, preceded and followed by showers of sand and scoriæ—deep valleys have been subsequently furrowed out through masses of lacustrine and volcanic origin—at a still later date . . . new lakes have been formed by the damming up of rivers, and more than one assemblage of quadrupeds, birds, plants—Eocene, Miocene, and Pliocene—have followed in succession; yet the region has preserved from first to last its geographical identity; and we can still recall to our thoughts its external condition and physical structure before these wonderful vicissitudes began, or while a part only of the whole had been completed."

This remarkable picture of the lacustrine formations of the south of France would be a tolerably faithful description if taken with special reference to similar formations of vast extent in Victoria and Tasmania.

Climate of the Palæogene Period.

The climate, as evidenced by the rich flora and fauna, has already been discussed, p. 153. It is probable that the climate varied from subtropical to temperate between the close of the *Mesozoic* and the commencement of the *Neogene* periods.

Neogene Epoch.

Upper Tertiary.—In Tasmania a series of deposits, generally resting either upon the Palæogene basalts or the lacustrine or marine beds. These deposits consist mainly of clays of various shades of colour, sands coarse and fine, ferruginous sands, and, more conspicuously, of gravels and pebbles, frequently conglomerated among which, in many localities, as at Longford, occur a wonderful abundance of waterworn pebbles derived from the silicified stems of conifers and other fossil trees. The apparent absence of marine formations and of the newer basalts, found in Victoria, render it difficult to mark the upper limits of this division with any degree of satisfaction. The absence of fossils, other than those derived from the lower divisions, also deprives the classifier of the most reliable guidance in such matters. There is little doubt, however, so far as Tasmania is concerned, that there is represented a perfect continuity of land and freshwater deposits from the Mesozoic period to the present time. As we cannot, therefore, look for any limit corresponding to a complete stratigraphic break, and as no contemporaneous fossil organisms have yet been found which would help us to fix the character of the various beds, the evidence as to their age must be based upon the nature of their position in relation to altitude, superposition, and particularly to the earlier signs of erosion of existing lake-basins, valleys, and watercourses (500 to 700 feet above existing channels) throughout Tasmania. Among the more important of these deposits may be noted the gravelly and gritty accumulations forming the older terraces overlying the Archæan and Silurian formations of the western part of Tasmania, and more particularly the older gravel drift terraces of the 600 to 700 feet level forming the upper zone of the Launceston Tertiary Basin, occupying nearly the whole of the rolling plains drained by the Tamar and its important tributaries. Fine sections of these older Neogene drifts are to be seen in the neighbourhood of Breadalbane, Perth, and Longford.

Where there are elevated plains composed of lignites, leaf-beds, clays, or older basalts in ascending order, and where these, again, are immediately succeeded by sandstones, pebble drifts, and conglomerates, we may with some degree of confidence separate the latter from similar deposits formed by erosion of the older formations, and redistributed along the lower levels of the broad valleys, now in places cut to a depth of more than 500 feet below the levels of the ancient lakes and watercourses. Formations, often of great thickness, fringing the shores of Macquarie Harbour, and occurring in the neighbourhood of Port Davey, Pieman River, and Long Plains, afford similar evidence. Between the Arthur Ranges and the parallel channel of the Upper Huon similar elevated terraces, with deeply cut cross valleys eroded by old or existing tributaries, also afford evidence of the great extent of formations accumulated during the Neogene period.

The older gravel drifts, sometimes 70 feet above the more recent alluvial flats bordering the River Derwent, and forming terraces flanking the mudstones of Upper Palæozoic age, are also no doubt members of the Neogene period. Evidences of a similar character in the north-east are also abundant in the older terraces of the stanniferous region in the vicinity of Gladstone, Moorina, and Ringarooma.

Similar deposits exist in Victoria and New South Wales, and the same difficulties in respect of classification are there also experienced. The descriptions of local geologists in Victoria and New South Wales in respect of these Australian deposits are quite applicable to Tasmania. For example, if we take the graphic description of the Neogene rocks of New South Wales, so ably given by the Head of the Geological Department, Mr. G. S. Wilkinson, we may see that the relationship and character of the rocks and the difficulties of classification are very similar. At page 57 of the publication issued by the Mines Department (1882.—*Notes on the Geology of New South Wales*), Mr. Wilkinson writes :—

"Now the remains of old river beds do actually occur upon these high lands (above the 800 feet level), but as no fossils have been found in them, it is doubtful whether they belong to the Miocene or Pliocene periods. Without the aid of fossils or of natural sections showing the relation of these deposits to older or newer formations, there will always be a difficulty in determining their age. In fact it will almost be impossible to draw a hard and fast line between them, as the subaerial conditions of the Miocene period continued into the Pliocene; for, during the Upper Miocene, Pliocene, and Pleistocene periods the land appears to have been gradually rising, and, of course, subject to continued atmospheric denudation, which varied occasionally in intensity. During this long period the valleys were gradually eroded, though at intervals they were partly filled with fluviatile deposits and flows of lava, and then eroded to deeper levels. Thus in every large valley, as that in which the Macquarie drains, we find at different elevations terraces of gravel and alluvium which mark the successive levels of the valleys during the intervals when the denuding agencies were not sufficiently powerful to prevent the accumulation of such deposits. The more ancient of these fluviatile drifts are sometimes covered with basalt, showing that these old valleys, during their erosion, were at different times modified by the flowing into them of lava through which the drainage water either cut a fresh channel or was diverted, and eroded on taking another direction. In many places along the high lands of the Great Dividing Range the basaltic lava completely filled the shallower valleys and formed extensive plateaux, such as we see in the New England District." It is remarkable how applicable these remarks of Mr. Wilkinson are with respect to Tasmania. The description could not be more accurately given if applied to similar formations on the Magnet Range, at Mount Bischoff, and in the valleys of the North and South Esk, near Launceston.

Climate of the Neogene Period.

The evidences available with respect to climate are vague and unsatisfactory, as already indicated, p. 155. It is clear, however, that the conditions under which the successive irregular coarse shingly terrace drifts had been formed in the main valleys were very different from those under which the Palæogene formations were deposited, and it is also probable—as suggested in respect of equivalent formations in New South Wales by Mr. G. S. Wilkinson, and in South Australia by Professor Tate—that the mode of deposition and other circumstances indicate a much greater rainfall than at present. The paucity of life in the formations, by itself—while depriving us of the aid of Palæontology in the classification of the rocks and in inferring local climatic conditions—only affords negative evidence in support of a growing refrigeration of climate.

Whether this supposed change in the direction of a colder climate became sufficiently intense within the period to produce the local ice sheets and glaciers—of which there is evidence in valleys of the Western Highlands, notably along the deeply cut ravines of the Mackintosh River—it is difficult to determine. It is quite conceivable, however, that simultaneously with the rising of the floor of the old Palæogene sea the adjacent land partook of a corresponding elevation, and we may therefore expect to find, as a direct consequence, a considerable change of temperature over the limits of the areas so affected.

There is additional support to this view from the circumstance that in the opinion of Professor Hutton corresponding causes were producing similar effects in New Zealand during the interval between the Paréora system and the marine beds of the Wanganui system, an interval which closely corresponds with that which divides the Palæogene and Neogene epochs in Australia and Tasmania. Thus, in his "Sketch of the Geology of New Zealand" (Quart. Journal Geol. Soc., May, 1885, p. 211), Professor Hutton states, "the former great extension of our glaciers was caused by greater elevation of the land[a] during the interval between the Paréora system and the marine beds of the Wanganui system." He adds, however, that complete proof is wanting owing to the absence of fossils, as in the raised terrace drifts of Tasmania.

It may be well to state, however, that the indications pointing to a glacial period in Australia have been referred by some geologists to causes which introduced more recently the glacial epoch in Europe and North America, and that the traces of glaciers on the Alps of New Zealand and Australia were deemed by them to be the counterpart of effects produced during the glacial epoch in the northern hemisphere, and attaining their maximum there during the Pleistocene period.

But although it be admitted that the primary cause of the glacial epoch in the northern hemisphere in the Pleistocene period may be due to the high phase of eccentricity of the earth's orbit in combination with winter in aphelion—the effect of precession—it does not necessarily follow that the extreme effects of glaciation have been produced in both hemispheres or in different epochs by the recurrence of such astronomical causes alone. It is admitted that warm ocean currents have such an important bearing upon the question that, if they were not debarred to a great extent from the hemisphere specially affected by the astronomical causes referred to, glaciation of an extraordinary character would not be appreciable. Now the preponderance and the nature of the distribution of the land in the northern hemisphere render the latter more liable to the obstruction or diversion of the warm equatorial ocean currents, produced by geographical changes, while, with the smaller extent of elevated land and its insular position, the southern hemisphere would be comparatively unaffected. It is also conceivable that during the Cretaceous and early Tertiary period the greater part of the

[a] The marine beds attain an elevation of more than 2000 feet near Napier.

western equatorial current of the Pacific Ocean swept southwards through the then broad open mesial gulf dividing Eastern and Western Australia, and the diversion of this powerful warm current upon the rising of the land towards the close of the *Palæogene* period may have had a larger influence in lowering the local temperature than that due to the astronomical causes referred to.

The effect of the influence of warm oceanic currents in equalising or modifying local climatic effects, however produced, cannot well be over-estimated in regions open to their passage. To them we owe, as Dr. James Croll, Wallace, and others have so admirably shown, all the amelioration of climate in regions which otherwise would be uninhabitable. Wallace, in his very remarkable work, "Island Life," p. 183, states: "Owing to the peculiar distribution of land and sea upon the globe, more than its fair proportion of the warm equatorial waters is directed towards the western shores of Europe, the result being that the British Isles, Norway, and Spitzbergen have all a milder climate than any other parts of the globe in corresponding latitudes. That such considerations must have great weight with those who are directing their attention to the possibility of a glacial epoch in the Southern Hemisphere in later times corresponding to that of the Northern Hemisphere during the Pleistocene period is most certain; for, as Mr. Wallace explicitly states (p. 201, *loc. cit.*), "a concurrence of favourable geographical conditions is essential to the initiation of glaciation" . . . and, he continues: "When, however, geographical conditions favour warm Arctic climates—as it has been shown they have done throughout the larger portion of geological time—then changes of eccentricity, to however great an extent, have no tendency to bring about a state of glaciation, because warm oceanic currents have a preponderating influence, and without very large areas of high . . . land to act as condensers no perpetual snow is possible, and hence the initial process of glaciation does not occur."

Accordingly, from the very smaller proportion of elevated land in the Southern Hemisphere, and from the improbability of the equatorial ocean currents having been appreciably excluded at any time, owing to the absence of connected land barriers, it is reasonable to infer that the combined effects of astronomical and geographical causes—similar to those which brought about the glacial epoch in Europe and North America—are not likely to have operated intensely in Australasia. That this seems to be the more reasonable view as regards Australia is borne out by local evidences.

In the first place, the Neogene epoch of Tasmania corresponds with the Pliocene epoch of Europe, and, consequently, whatever the local climatic conditions may have been, they cannot in all respects be referred to causes which entered into combination in a succeeding epoch in the Northern Hemisphere. In the second place, while admitting the evidence of former glaciation in local alpine regions, there is no satisfactory proof that the erratics found in such regions belong to the period in which our raised terrace drifts were formed, and neither in these nor in the latter deposits of the extensive lower levels do we find any clear signs of ice action, such as are exhibited so widely in Europe and America, in the shape of moraines, boulder drift, striated blocks, perched blocks, and other huge ice-born erratics, &c. On the contrary, the prevailing terrace drifts in Tasmania are formed from materials derived from the adjacent or underlying rocks; and, with the exception of huge boulders at the base or on the slopes of mountain ranges, clearly traceable to gravitation, there is not the slightest trace of rock masses which would necessitate the agency of ice as a means of transport, if we except also those evidences in alpine regions in the Western Highlands, which are, more probably, local effects due mainly to a much greater elevation of the land in former times. The author is personally familiar with the various evidences of glaciation in Scotland at the higher and lower levels, and his knowledge of Tasmania is sufficiently wide to enable him to state with confidence that corresponding evidences in the latter place are entirely wanting within the Tertiary and later periods.

The Rev. J. E. Tenison-Woods, A. W. Howitt, and others having a most intimate knowledge of Australian Geology, give similar evidence as regards the absence of unmistakable signs of glaciation other than those now due to greater elevation, as in the Alps of New Zealand at the present day.

It is true, Professor Tate reports the occurrence of erratic boulders of granite and striated rock surfaces on the beach near Adelaide, and the opinion of such an experienced observer has great weight with me; but these signs, in the absence of further evidence, are not quite satisfactory, and they have, moreover, received different interpretations by other observers. Besides, as Professor Tate states (p. 53, Jour. and Proc. R. Soc. of S. Australia, 1884-5) that "a glacial period and a pluvial period mean the same to me (Professor Tate), being referable to the same cause—rain or snow—according to latitude or elevation," it is evident that his views do not differ materially from those concurred in by the author, who at present is inclined to hold that, although astronomical conditions may have been the initial cause of that intense form of glaciation which characterises a true glacial epoch, their direct influence would not have produced this effect, even in the Northern Hemisphere, had they not been supplemented by geographical changes which barred the warm equatorial currents from northern latitudes; and it is solely because of the absence or imperfection of the latter combination necessary to produce a true glacial period, that he dissents from the view which attributes the milder form of local glaciation in the Southern Hemisphere to the combination which resulted in the glacial epoch of Europe and North America during the Pleistocene period. Dr. von Lendenfeld quite recently has discovered traces of ancient glaciers in the Wilkinson Valley leading up to the elevated plateau of Mount Kosciusco[a], in the shape of numerous rôchs montonées and polished rocks, and his observations are also of much interest. His interpretation, however, is that (1) at the time of the glaciation of the Southern Hemisphere Australia was subjected to a glacial period as well as New Zealand; (2) that the climate was then not very cold, so that the glaciers only covered the highest part of the Australian Alps, and were consequently very small; (3) that, with the exception of small glaciers at the source of the Murray and at the head of the Crackenbach, he concluded that it is not likely that glaciers existed anywhere else in Australia at the time, although believed to be isochronous with similar alpine glaciers in New Zealand.

[a] "The Glacial Period in Australia," by R. von Lendenfeld, Ph.D. (Proc. Lin. Soc. N. S. Wales. Vol. X., Part I., pp. 44-53, plates).

This glacial period, strangely enough, is referred to a very recent period, 2000 or 3000 years ago, when he assumes, even then, the existence of the gigantic Diprotodon and other extinct marsupials, together with a pluviatile period, when the rivers were large, and when there was a dense vegetation in many parts of the country now barren. Professor Hutton accepts the facts of Dr. von Lendenfeld as regards the glaciation of the Australian Alps, but demurs to his conclusions both with respect to the time of their occurrence and the conditions under which they were caused. In his very interesting paper "On the supposed Glacial Epoch in Australia" (Proc. Lin. Soc. N. S. Wales, Vol. X., Part III., p. 335, he observes: "But although I do not wish to deny the former existence of these glaciers, it is necessary to point out that it by no means follows that they were caused by a glacial epoch; because they might equally well have been due to greater elevation combined with atmospheric moisture, and no evidence is given to show that elevation has not occurred." At page 338 he continues: "but all New Zealand geologists, whatever views they may hold as to the cause, are of opinion that the *glacier* epoch was long anterior to the *glacial* epoch of Europe and North America"; and, at p. 341, *ibid.*, he concludes: "If now I should be asked, To what, then, do you attribute the ancient glaciers of the Australian Alps? I should answer, It is more probable that Mount Kosciusco once stood some three thousand feet higher than at present, when Tasmania was joined to Australia, and Central Australia was, perhaps, a vast lake, than that the temperature of the surrounding ocean should have been reduced ten degrees without any apparent cause, which is the only alternative."

These conclusions of Professor Hutton are in complete harmony with the reasonings already advanced in this section; and, in the author's opinion, the evidences of Tasmanian rocks lend them additional support.

TASMANIAN HEPATICÆ.

By R. A. Bastow, F.L.S.

In popularly written botanical handbooks the *Hepaticæ* are usually not described, the authors chiefly confining their attention to plants of larger growth. The phanerogamous plants receive full notice; the *Ferns* and *Lycopods* may also be described; but here the line is usually drawn. The *Mosses*, *Hepaticæ*, *Lichens*, and *Fungi* are dismissed with some such remark as that they are distributed throughout the world, and are of no economical importance; or that they form beautiful transition from low to high organisation, and that they are evascular.

Few persons ever dreamed that earthworms were of any importance until Darwin observed and described their habits; and, probably, quite as few are aware of the aid lent by the *Mosses* and *Hepaticæ* to the economy of nature in the formation of peat; it is not at all unlikely that the *Hepaticæ* cushioned the swampy ground ages ago, and contributed their share in the structure of coal for the use of man at the present day. It may, therefore, not be wasted time if we bestow a little attention to the Natural Orders of Australasian Cryptogams, containing, as they do, the more minute forms of plant life.

I essayed during the last session of this Society to describe, to the best of my ability, the Tasmanian *Mosses*, and now venture upon a description of the *Hepaticæ*. Doubtless, many errors may be found that a more experienced and abler pen would have avoided; but as the reference to descriptions is a first necessity in the study of *Hepaticæ*, even if that reference be but a poor one, and as the subject has not yet been taken in hand since the publication of Hooker's "Flora Tasmaniæ,"—with the exception of the valuable supplement in Vol. XI. of Baron von Mueller's "Fragmenta Phytographiæ Australiæ,"—and as those who reside far away from the city and are desirous to know something about the *Hepaticæ* that grow in such profusion in the moist gullies and by the banks of streams, but have no hand-book on the subject that they can consult, I may venture to hope that the following compilation may to some extent be useful, its many shortcomings notwithstanding.

The entire structure of some of the *Hepaticæ* so resemble the *Mosses* (Pl. ii. f. 2) as to render them popularly regarded as identical: but they may be distinguished therefrom by their soft, spongy, lax texture, by their leaves being destitute of nerves, by their frequently less vivid colours, and by their affecting moister situations. They vary in size, as do the *Mosses,* from six inches long or more, and remarkable for their beauty as well as their size, to very minute capillary forms, scarcely distinguishable as plants without the aid of the microscope. The fruiting specimens are not so easily detected as they are in moss plants, but that apparent deficiency is more than counterbalanced by the numerous and exquisite forms of leaves (Pl. iii.), which afford excellent characteristic points for the determination of genera and species.

It is probable that the *Hepaticæ* grow in greater profusion and variety, and attain greater size and beauty, in the densely ferned and matted dingles on the moist slopes of the mountains of Tasmania than in any other part of the world. A little rough scrambling through the tangled masses of vegetation, and a little climbing over fallen forest giants, yet keeping near to the stream, and we are certain soon to discover the old decaying logs completely covered with *Hepaticæ,*—so much so as to effectually conceal the decaying wood that supports them.

Some of the cavities in the logs are matted with an abundance of long, stringy, whitish plants, these are soft and yielding *Lepidozia* (Pl. xxii.-v.), and charming objects for the stage of the microscope, the leaves being scarcely visible to the naked eye. Other logs will be found covered with the giant amongst *Hepaticæ—Gottschea Lehmanniana.* It is of light green colour, and is suspended in masses over the stream. The large size of this plant—six inches or more—makes it a prominent object, yet its leaves are so curiously laminated and folded that it is very difficult to dissect for the purpose of absolute certainty in determination of species. Some of the rocks are covered with a dark green moss-like coating, rough velvety both in appearance and touch—the genus *Lejeunia* (Pl. xxvii.); although the leaves are minute, each leaf is furnished with a sac, the water in the sac swarming with moving bodies. Others are covered with a light brown and beautifully pinnate plant—*Polyotus magellanicus* (Pl. xxix.), each leaf bearing a club-shaped lobule, so curious an appendage that when once observed it will not be readily forgotten.

All the foregoing belong to that section of *Hepaticæ* known as FOLIOSÆ (Pl. ii., f. 1, 2, 3). They are plants with distinct stems, bearing distinct leaves.

But there are other *Hepaticæ* that have no distinct stems or leaves, these organs being fused into one flat leaf-like frond, hence the name of the section FRONDOSÆ (Pl. ii., f. 4, 5). To this section belong the *Blyttia*, *Metzgeria*, and other genera. The latter may be observed forming a perfectly flat network around the bark of living trees. It is almost impossible to secure a perfect specimen without taking the bark as well; but the collector will be amply repaid when he settles down to its examination with the microscope. The under side of the frond is particularly interesting.

The third section of the Order is called CARNOSÆ (Pl. ii., f. 6-8). In this the fronds are broad and fleshy, of a vivid green colour, having oblique scales on their under sides. They cover moist rocks or stumps, and sometimes grow on earth. By the aid of a pocket lens small receptacles will be observed on the upper surfaces surrounded by a beautiful pellucid fringe; the receptacles contain small reproductive bodies called *gemmæ*. Seen for the first time they are sure to remind the observer of a miniature bird's nest with eggs in.

The remaining section is ANTHOCEROTÆ (Pl. ii., f. 7); these also have fleshy fronds, but differ from the preceding section in being without scales on the under sides, and in the manner of fruiting.

The plants of this Natural Order are nearly always procumbent, the *dorsal* side of the stem being the upper side *as it grows* (Pl. iii., f. 4), and the under side the *ventral* (Pl. iii., f. 4).

For the purposes of identification, botanists have divided the *Foliaceous Hepaticæ* according to the manner in which the leaves are set on the stem; they are either *succubous*, *vertical*, or *incubous*, and it is not easy for beginners in the study to determine in which manner the leaves are actually set; it is, therefore, important to make the differences very clear. If the lowest part of the base of the leaf is on the *dorsal* side of the stem the leaf is *succubous* (Pl. iii., f. 1, 2). If the base of the leaf crosses the stem transversely, it is *vertical* (Pl. iii., f. 3). If the lowest part of base of the leaf is on the ventral side of the stem, it is then *incubous* (Pl. iii., f. 4.)

The *stipules* are the third rank of leaves, and are, generally, comparatively small; they are, however, of great use in identifying the genus and species of the plant.

The fruit, as in mosses, is generally *terminal* or *lateral*. If terminal, the *pedicel* of the *capsule* will proceed from the apex of the stem; if *lateral*, the pedicel will proceed from the side of the stem. In some of the genera the fruit is embedded in the frond. Usually, the fruit of *Hepaticæ* may be known by the pellucid cellular fruitstalk, with four brown radiating arms at the tip of the stalk; it generally consists of an *involucre*, a *perianth*, a *calyptra*, and a *capsule*. The *involucre* is a few elongated and, sometimes, lobed leaves, and, in most cases, the *perianth* may be observed within these. The *perianth* is an erect, tubular, or inflated sheath. It is sometimes *compressed*, and is frequently *angled* or *keeled*. The *mouth* of the *perianth* may be *contracted*, *dilated*, *entire*, or *lobed*, these distinctions being, in many cases, specific characters. Within the perianth the transparent oblong or globose *calyptra* will be seen if the fruiting is sufficiently advanced, and here, at the base of the fruitstalk, it remains, not ascending with the *capsule* as in mosses; of all the fruiting organs in *Hepaticæ* this alone is never absent. As the *capsule* ripens it bursts the *calyptra*, and is carried through it and upwards as a small blackish ball at the tip of the pellucid stem, and, when ripe, it bursts, in most species, into four valves (Pl. v.); the *capsule* then appears as a small brown cross. The *capsule* contains innumerable *spores*, mixed up with long spiral threads called *elaters*; when the *capsule* bursts these *elaters* twist about and throw the *spores* to some distance. *Elaters* are never found in the fruit of mosses.

The *female inflorescence* or *archegonia* consist of minute and slender flagon-shaped bodies with long tubular necks; within each there is one solitary loose cell. One of these becoming fertilised, it eventually ripens into the *calyptra* above described, the loose cell becoming the *capsule* (Pl. xi., f. 1, 2.)

The *male inflorescence* or *antheridia* are very minute pedicelled sacs on the same or on different plants from those containing the *archegonia*. They are usually solitary on the axils of modified (*perigonial*) leaves, which sometimes occupy proper branchlets (Pl. xi., f. 3, 4). The fruit of the FRONDOSE *Hepaticæ* is somewhat different. In the *Marchantia*, for instance, the *involucre*, *perianth*, and *capsule* are contained on the surface of a green or brownish-stalked receptacle (Pl. ii., f. 6). These will be familiar to most persons as small green-stalked knobs, growing from leafy expansions on wet rocks or stumps. The *gemmæ* contained in the fringed receptacles found on these frondose expansions, and before alluded to, are themselves reproductive.

BIBLIOGRAPHY.

The illustrations, descriptions, and references are, for the most part, taken from the following works :—"Flora Tasmaniæ," "Flora Novæ-Zealandiæ," "Flora Antarctica," and "Handbook of the New Zealand Flora," by Dr. J. D. Hooker, F.R.S.; "Musci Exotici," by William Jackson Hooker, F.R.A. and L.S.; "Fragmenta Phytographiæ Australiæ," by Baron von Mueller, M.D., Ph. D., &c.; "Hooker's Botanical Miscellany;" "London Journal of Botany;" "Species Hepaticarum," by J. B. G. Lindenberg; "Icones Plantarum Asiaticarum," by Griffiths; "Hoffmeister's Higher Cryptegams; MSS. from H. Boswell, Esq., M.A., Oxford; MSS. and Drawings from Dr. Carrington, M.D., F.R.S.G., and W. H. Pearson, Esq., Eccles, England; Mr. Archer's Herbarium, Roy. Soc., Hobart, arranged by Mr. Mitten; and the Hepaticæ in the author's Herbarium.

DETERMINATION OF GENUS.

In order to determine the genus to which one of the *Hepaticæ* belongs, the accompanying Key to Genera will be found useful.

1st. Determine if the plant possesses distinct leaves; if it does, its genus must be looked for in the section FOLIOSÆ, headed A.

If the plant has not leaves, but is simply a long or short thin frond, it belongs to section FRONDOSÆ, under B.

If the frond is fleshy, with scales on its under side, it will be amongst the CARNOSÆ, under C.

If the frond is fleshy, but without scales beneath, it then comes under the section ANTHOCEROTÆ at D.

2nd. Assuming that the plant to be identified is *foliaceous*, the manner in which the base of the leaf is set on the stem must be accurately determined. It may be *succubous*, or *vertical*, or *incubous*; but it will come under one of these three headings. If *succubous*, its genus will be found in the first fifteen genera; if *vertical*, its place will be in one of the genera from sixteen to nineteen inclusive; if *incubous*, its genus must be looked for in the genera numbered twenty to twenty-nine inclusive.

3rd. Note the *perianth*; it may be leafy, or it may be a fleshy bag, or the plant may not have a *perianth*.

Assuming that the leaves are *succubous*, and that the *perianth* is *leafy*, the plant will belong to one of the first ten genera.

4th. Ascertain whether the fruit is *terminal* or *lateral*.

Assuming that the fruit is *lateral*, the plant will belong to one of the genera numbered eight, nine, or ten. Reading the short descriptions of these three genera in the key, we find that one genus is without *stipules*, another possesses *stipules*, and the remaining one has its leaves deeply cleft. These are sufficient differences for determination of genus.

KEY TO GENERA.

The arrangement of the *Hepaticæ* of New Zealand by Mr. Mitten, in Hooker's Handbook of the Flora of that Colony, is very useful in aiding the student to determine the genera, and the following *Key* is an illustrated adaptation of that arrangement to the *Hepaticæ* of Tasmania.

A.—FOLIOSÆ.—Leaves distinct. (Pl. ii., f. 1, 2, 3.)

* Leaves succubous; base with the lowest angle on the upper side of the stem. (Pl. iii., f. 1, 2.)

(*a.*) PERIANTH, LEAFY. (Pls. iv.–xv.)

1. *Fruit terminal.*

1. PLAGIOCHILA.
   Perianth compressed; stems erect or ascending; no stipules. (Pl. iv., v.)
2. LEIOSCYPHUS.
   Perianth compressed; stems procumbent, stipulate. (Pl. vi.)
3. TEMNOMA.
   Perianth above trigonous, truncate. (Pl. vi.)
4. LOPHOCOLEA.
   Perianth triquetrous; angles often alate; mouth three-lipped, closed; stems procumbent, stipulate. (Pl. vii., viii., ix.)
5. TRIGONANTHUS.
   Perianth trigonous; mouth contracted; stems procumbent, stipulate near the fruit. (Pl. ix.)

6. JUNGERMANNIA.
Perianth tubular ; mouth contracted, dentate , stipules none, or present on the stem. (Pl. x.-xii.)

7. SOLENOSTOMA.
Perianth obovate, 5-plicate above, with a tubular beak. (Pl. xi.)

2. *Fruit lateral.*

8. ADELANTHUS.
Stems erect, nodding ; no stipules. (Pl. xii.)

9. CHILOSCYPHUS.
Stems procumbent, stipulate. (Pl. xiii., xiv., xv.)

10. PSILOCLADA.
Stems procumbent ; leaves and stipules deeply cleft. (Pl. xv.)

(*b.*) PERIANTH A DESCENDING FLESHY BAG. (Pl. xvi., xvii.)

1. *Fruit terminal.*

11. TYLIMANTHUS.
Stems erect or ascending ; leaves nearly entire ; no stipules. (Pl. xvi.)

12. ACROBOLBUS.
Stems procumbent ; leaves, 2-fid ; stipules small or none. (Pl. xvi.)

13. LETHOCOLEA.
Stems procumbent ; leaves entire ; no stipules. (Pl. xvi., xvii.)

14. BALANTIOPSIS.
Stems procumbent, stipulate. (Pl. xvii.)

2. *Fruit lateral.*

15. MARSUPIDIUM.
Stems erect or ascending ; no stipules.

** **Leaves vertical ; base crossing the stem transversely. (Pl. iii., 3.**

(*a.*) PERIANTH NONE. (Pl. xviii.)

1. *Fruit terminal.*

16. GYMNOMITRIUM. (Pl. xviii.)

(*b.*) PERIANTH LEAFY. (Pl. xviii.)

1. *Fruit terminal.*

17. ISOTACHIS.
Leaves and stipules nearly equal; perianth tubular; mouth connivent. (Pl. xviii.)

18. SCAPANIA.
Leaves complicate; no stipules; perianth compressed in plane with leaves; mouth truncate. (Pl. xix.)

19. GOTTSCHEA.
Leaves with adherent lobe; perianth overlaid by involucral leaves. (Pl. xx.)

***Leaves incubous; base with the lowest angle on the under side of the stem. (Pl. iii., f. 4).

† Without an inferior lesser lobe.

(*a.*) PERIANTH LEAFY.

1. *Fruit terminal.*

20. SENDTNERA. (Pl. xxi.)

2. *Fruit lateral.*

21. LEPEROMA.
Leaves and stipules deeply cleft; calyptra adnate with the involucral leaves; fruit near the top of stem. (Pl. xxi.)

22. LEPIDOZIA.
Leaves and stipules usually deeply cleft; perianth near the base of the stem, trigonous. (Pls. xxii., xxiii., xxiv., xxv.)

23. MASTIGOBRYUM.
Leaves and stipules entire, or with their apices truncate, dentate; perianth in the lower part of the stem, trigonous. (Pl. xxvi.)

†† With an inferior lesser lobe.

(*a.*) LOBULE PLANE.

1. *Fruit terminal.*

24. RADULA.
Perianth compressed in plane with leaves; mouth truncate; no stipules. (Pl. xxvi.)

25. Lejeunia.
Perianth obovate, 3-6-plicate; mouth a tubular beak. (Pl. xxvii.)

26. Trichocolea.
Calyptra and involucral leaves combined; leaves capillary, multifid. (Pl. xxviii.)

2. *Fruit lateral.*

27. Mastigophora.
Perianth ventricose, subcampanulate. (Pl. xxi.)

(*b.*) Lobule inflated-galeate.

28. Frullania.
Perianth 3-6-plicate or terete, with a tubular beak. (Pls. xxviii., xxix.)

29. Polyotus.
Involucral leaves overlying each other, adnate below. (Pl. xxix.)

B.—FRONDOSÆ.—Without distinct Leaves.

(Pl. ii., f. 4, 5.)

(*a.*) Perianth complete.

30. Fossombronia.
Perianth on upper side of frond; leaves angular. (Pl. xxx.)

31. Zoopsis.
Perianth lateral; frond continuous, with alternate lateral projections, tipped with cilia. (Pl. xxx.)

32. Podomitrium.
Perianth from the under side of a continuous frond. (Pl. xxxi.)

33. Steetzia.
Perianth on upper side of a continuous frond. (Pl. xxxi.)

(*b.*) Perianth none.

34. Symphyogyna.
Calyptra on upper side of often stipitate frond; nerve narrow. (Pl. xxxii.)

35. METZGERIA.
Calyptra on under side of continuous frond; nerve narrow. (Pl. xxxii.)

36. SARCOMITRIUM (ANEURA).
Calyptra lateral; frond composed almost entirely of thickened nerve. (Pl. xxxiii-iv.)

C.—CARNOSÆ.—Fronds fleshy, with oblique scales on under side. (Pl. ii., f. 6, 8.)

(*a.*) FRUIT IMBEDDED IN SUBSTANCE OF FROND.

37. RICCIA. (Pl. i.)

(*b.* FRUITS TERMINAL ON THE UNDER SIDE OF FROND.

38. TARGIONIA.
Involucre two-valved. (Pl. xxxiv.)

(*c.*) FRUITS, MANY ON THE UNDER SIDE OF A STALKED PELTATE RECEPTACLE.

39. MARCHANTIA.
Perianths opening downwards. (Pl. xxxv.)

40. REBOULIA.
Perianth none; involucres opening by two valves. (Pl. xxxv.)

41. FIMBRIARIA.
Perianth split into bands, cohering at their apices. (Pl. xxxv.)

D.—ANTHOCEROTÆ.—Frond fleshy, without scales beneath. (Pl. ii., f. 7.)

42. ANTHOCEROS. (Pl. xxxv.)

DETERMINING SPECIES.

The proper genus being determined, it will be advisable, in determining the species, to cut a small portion of the stem into very small fragments, in a drop of water on a glass slip, with a sharp knife. Cover the fragments with a thin glass cover, and examine them on the stage of the microscope. Most of the specific characters will then be distinctly seen as the fragments lay detached. A $1\frac{1}{2}$-inch objective is the most generally useful power, but some species are so minute that a $\frac{1}{2}$-inch, or even a $\frac{1}{4}$-inch, objective will be found necessary.

Unless the student carefully reads the description of each species in the genus, he cannot hope to succeed in the correct specific determination.

The accompanying drawings of species will commend themselves to those persons desirous of making the acquaintance of this beautiful order of plants. They are copied, in most instances, from the best works on the subject, and more would have been inserted had we the required works in the Colony. In nearly every drawing the plant is shown in its natural size, with magnified representations of the leaves, their setting, stipules, &c.

GENERIC AND SPECIFIC DESCRIPTIONS.

1. PLAGIOCHILA, *Nees and Montagne.*

Perianth compressed. Stipules 0.

Stems from a creeping rhizome, erect, ascending, or creeping; often large and rigid. Leaves distichous, succubous, dorsal margin decurrent and reflexed, often obliquely. Stipules 0. Fruit terminal or lateral. Involucral leaves two, larger than the cauline. Perianth compressed at right angles to the insertion of the leaves; mouth truncate, entire, or toothed. Calyptra membranous. Capsule on a long or short fruit-stalk, ovoid; elaters with two spiral fibres. Antheridia covered by small imbricated ventricose perigonial leaves.

I. Stems sparingly branched. Leaves alternate, concave, more horizontal than vertical. Lower margin not much decurrent nor recurved.

1. *P. circinalis,* 1–3in. high.

II. Leaves more or less vertical, alternate, the margins recurved, dorsal decurrent.

* Stems erect from a creeping rhizome, tall, very much branched in a tree-like or fascicled manner. Leaves toothed and usually spinulose.

2. *P. fasciculata,* 3in. high.

** Stems not dendroid nor fascicled, either simple or dichotomous, or sparingly divided.

(*a.*) Leaves entirely or very slightly toothed, or 1–2 toothed at the apex.

3. *P. microdictyum,* 2–3in. high.
4. *P. Magellanicum,* 1½in. high.
5. *P., pusilla,* ¾in. high.

(*b.*) Leaves much toothed and spinulose.

6. *P. Stuartiana.*
7. *P. strombifolia,* 1–4in. high.
8. *P. deltoidea,* 2–4in. high.
9. *P. annotina,* 3–5in. high.
10. *P. Lyallii,* 2–3in. high.
11. *P. retrospectans,* 2in. high.
12. *P. bisirealis,* 2in. high.

1. P. CIRCINALIS, *Lehm*; Fl. Antarct. i., 348. Stems tufted, erect, branching, stout, 1-3in. high, olive brown. Leaves closely imbricate, erecto-patent, obliquely cordate, concave, quite entire or minutely toothed; margins recurved, dorsal gibbous; involucral similar, but large. Perianth obconic, compressed; mouth entire or slightly toothed.—Syn. Hep. 53, 652. *P. hemicardia,* Fl. Antarct. 148, t. 63, f. 2. Syn. Hep., 627.

Tasmania—Labillardiere. New South Wales; New Zealand.)

2. P. FASCICULATA, *Lindbg.* Stems ascending, dichotomous below, fastigiately branched above. Leaves obliquely orbicular-oblong, convex; ventral margin and apex unequally toothed. Perianth lateral and on the forks, long exserted, obovate; mouth compressed, obliquely truncate, ciliate. Syn. Hep., 27. Fl. Tasm., ii., 224. *P. Colensoi.?*—Tayl. in London Jour. Bot., 1846, 269. (Pl. iv., fig. 1, 2, 3.)

The specimens marked *P. aculeata,* in Herb. Hooker are precisely the common state of *P. fasciculata*; but amongst the specimens distributed under the name of *P. aculeata* some have been found to belong to *P. Stephensoniana,* a species not yet found in Tasmania. *P. uncialis* belongs to the same group. In Crypt. Antarct. the teeth on ventral side are too numerous, and the dorsal margin is not commonly toothed.

St. Patrick's River—Gunn. South Huon—Oldfield, Archer. Near Hobart—R. A. B.

3. P. MICRODICTYUM, *Mitten,* in Fl. N.Z., ii., 131, t. 94, f. 6. Stems 2-3in. high, slender, sparingly branched; branches with incurved tips. Leaves green, spreading, closely imbricate, deltoid-ovate, the angles rounded; dorsal margin quite entire, ventral sometimes slightly toothed; involucral a little toothed; perianth oblong, compressed. lips ciliate-toothed. (Pl. iv.)

St. Crispin's Well, Mt. Wellington, R. A. B. (New Zealand.)

4. P. MAGELLANICA, *Lindenberg.* Sp. Hep., p. 164. *P. Lindenbergiana,* Lehm. in Linn., iv., p. 367. *P. Sphalera,* Hook f. and Tayl. Fl. Antarct., p. 121. *P. unciformis,* Syn. Hep., p. 653.

The Tasmanian species of this genus are larger than any of those collected at Cape Horn, and have all their leaves entire; in every other respect they correspond so nearly that they may be supposed to be one entire leaved variety, similar to those observable in allied plants, as *A. falcata* and *P. retrospectans*. The inflexion of the dorsal margins of the leaves readily distinguishes *P. Magellanica* from its allies; the leaves themselves vary in being patulous or appressed; but their form is the same in all the plants described as above and referred to this species. (Pl. iv.)

In Lond. Jour. Bot., 1844, p. 457, *P. unciformis* is described as with tufty stems a few inches wide, ½ inch high, erect, nearly simple, apex uncinate, leaves imbricate, erect, secund, appressed, ovato-rotundate; inferior margin gibbous, denticulate; upper incurved; base almost nerved; leaves increasing in size towards the top; cells minute. Related to *P. biserialis*, but not above one-fourth the size, denticulations more minute, not round and decurrent at the anterior margin, nor strikingly flexuose, as in that species.

Stems not more than ¾ inch high, curved.

5. P. PUSILLA, *Mont.*; Lind. Sp. Hep., p. 164. Stems short, curved. Leaves denticulate, anterior margins not decurrent.

This plant is larger than *P. minutula*, the shoots of the latter being scarcely one-tenth of an inch high. Lond. Jour. Bot., pp. 373 and 460.

Tasmania, Hb., Montagne. Among *Lepidozia ulothrix*, Hombron, (Voyage au Pôle Sud, Crypt t. 16, f. 3). Among *Chiloscyphus sinuosus*, Mt. Wellington, Gulliver.

6. P. STUARTIANA (Gottsche, in Linnæa, tom. 28, p. 548). Branches ascending, leaves obovate-cordate, apex rotundo-obtuse, dorsal margin suberect, entire, ventral margin arcuato-dentate. Near to *P. ambigua*, Lindbg. and Hamp. in Linn., t. 24, p. 640.

Tasmania, Stuart.

7. P. STROMBIFOLIA, *Tayl.* Stems creeping, 2-4in. high, vaguely branched, branches ascending. Leaves more crowded and secund towards the top of the shoot, imbricate, semi-ovate, convex, slightly obtuse, upper margin shortly decurrent, ventral margin round, sparingly and unequally dentate, dorsal margin denticulate or entire. Fruit in forks. Perianth ovate, mouth dentate. *J. Strombifolia*, Lond. Jour. Bot., 1844, p. 578. (Pl. 3, f. 1.)

Resembles *P. deltoidea* in appearance, but its leaves are less deltoid, and more of an ovate outline, and the teeth are more spinous; the perianth, too, is of a different form, and there is no dorsal wing.

Tasmania—Hooker, Gunn, Oldfield. Mount Wellington—R. A. B.

8. P. DELTOIDEA, *Lindbg.* Variable in size and form; stems erect; branches somewhat fascicled, 2-4in. high. Leaves vertical, closely imbricate, subsecund, rhomboid-obovate; dorsal margin quite entire; ventral arched and the apex toothed. Perianth terminal, ovate, compressed; mouth toothed and ciliate. Syn. Hep. 55.

P. gregaria—Hook. f. and Tayl., Lond. Jour. Bot., 1844, 564.

Tasmania—Labillardière. A very fine large plant.

9. P. ANNOTINA, *Lindbg.* Fl. N.Z., ii., 131. Stems stout, erect, 3-5in. high, dichotomous. Leaves very closely imbricate, dimidiate-ovate, convex, obtuse, toothed and ciliate; ventral bases conniving and forming a crest. Perianth terminal and lateral, oblong, with a narrow-toothed wing; mouth truncate, compressed, fimbriate. Syn. Hep. 41, 643.

J. adiantioides, Hook. Musc. Exot. t. 90. (Pl. v., f. 1, 2, 3, 4.)

Tasmania. (New Zealand.)

Ventral margin and apex only spinous.

10. P. LYALLII, *Mitten* in Fl. N.Z., ii., 132. Stems erect, dichotomously and fastigiately branched, slender, flexuous, 2-3in. high. Leaves brown-green, rather remote and rigid, broadly ovate or semi-cordate; dorsal margin quite entire; ventral and apex spinous; involucral similar, more toothed. Perianth narrow, oblong-clavate, compressed; tips rounded, toothed. (Pl. v.)

St. Patrick's River—Gunn. Gullies Mt. Wellington—R. A. B. (New Zealand.)

The Tasmanian specimens are a little larger than those from New Zealand, but have the same habit, and the leaves a little more directed towards the ventral side.

Leaves dentate, one remarkable.

11. P. RETROSPECTANS, *Nees. P. ophisthotona,* Tayl. in Lond. Jour. Bot., 1844, p. 577. Tufts wide, olive-green. Stems 2in. high. Leaves clustered into a compressed capitulus at the top, which is bent back; each lower leaf is imbricated on at least one-half of the one immediately above, erect, adpressed even in the moistened state, rotundate or very widely ovate, obtuse, with a remarkable tooth on the summit, both margins

dentate; perichætial leaves longer and more upright than the cauline, closely adpressed to the base of the calyx, which is three times their length. Perigonia in short slender spikes, usually terminal, of a brown colour, the leaves minute, tumid at the base and closely imbricated. The *P. biserialis* of *Lind.* and *Lehm.* approaches nearest to our plant in habit, but is far more slender, has the leaves smaller, and their teeth larger.

St. Patrick's River—Gunn. Near Hobart—M. Hombron. Brown's River and Mt. Wellington—Hooker, R. A. B. Dense tufts on rocks with *A. falcata*, Goat Hills—Oldfield.

Var. B., leaves entire. St. Patrick's River—Gunn. Western Mountains, Archer.

12. P. BISERIALIS, *L.* and *Lindg.* Stems 2in. high, strikingly flexuous. Leaves round and decurrent at the anterior margin, denticulate, bispinous at the apex. Lindenberg, Sp. Hep., p. 126, t. 26.

Near to *P. retrospectans* in habit, but is far more slender, has the leaves smaller, and the teeth larger.—Tayl. Lond. Jour. Bot. 1844, 577. SEE *P. Magellanica.*

On an old stump of *Fagus Cunninghami*, at an elevation of 2000 ft.—Gunn. Wellington Falls—R. A. B.

2. LEIOSCYPHUS, *Mitten.*

Fruit terminal.

Perianth compressed; stems procumbent, stipulate.

Stems prostrate, creeping, or ascending; branches spreading. Leaves succubous, spinulose, distichous, close set, entire, rarely 2-fid. Stipules small, 2-4-fid. Fruit terminal. Involucral leaves like the cauline. Perianth dilated upwards, compressed at right angles to the direction of the leaves; mouth entire or toothed. Capsule on a slender fruitstalk. Antheridia in the bases of perigonial leaves, as in *Chiloscyphus.*

1. L. CHILOSCYPHOIDES, *Mitten*, in Fl. Tasm. ii., 225. Stems creeping, sparingly branched. Leaves subimbricate, semi-vertical, convex, orbicular; dorsal margin reflexed. Stipules small, free, distant, ovate, 2 partite; segments subulate, flexuous; margins 1-toothed.

Perianth elongate, obliquely obovate; lips dilated, incurved.—*Chiloscyphus amphibolius*, Nees, and *retusatus*, Hook. f. and Tayl., Fl. Antarct. 441, t. 161., f. 3. *Plagiochila*, Syn. Hep. 647. (Pl. vi.)

Among *Mastigobryum accretum*; St. Patrick's River—Gunn. St. Crispin's Well, Mt. Wellington—R. A. B. (Lord Auckland's Group, Fuegia, Falkland Islands.)

3. TEMNOMA, *Mitten.*

Perianth truncate.

From the truncate mouth of the perianth. Succubous, Perianth leafy. Fruit terminal. Perianth above 3-gonous. truncate.

Included in genus Jungermannia in Flora Tasm., and removed from that genus by Mitten.

1. T. PULCHELLA, *Mitten.* *J. pulchella*, Hook. Musc. Exot., t. 94. Fl. N.Z. ii., 128. Stems tall, erect, nearly simple. Leaves half vertical, subquadrate, 4-fid., very membranous. Stipules broad, 5-6-fid.; divisions obtuse, ciliated. Perianth tubular 3-gonous above; mouth truncate, fringed with long cilia that point in all directions. (Pl. vi.)

Tasmania—Oldfield. (New Zealand.)

4. LOPHOCOLEA, *Nees.*

Fruit terminal.

Perianth 3-quetrous; angles often alate; mouth 3-lipped, closed; stems procumbent, stipulate.

Stems prostrate, creeping. Leaves succubous, distichous, flaccid, decurrent at the base, 2-multifid. Stipules 2-4 cleft. Fruit terminal. Involucre of 2-4 large leaves. Perianth tubular below, 3-gonous above; lobes toothed and crested. Calyptra short, membranous, rupturing transversely at the base or irregularly at the apex. Capsule on a slender fruit-stalk, oblong; elaters and antheridia in the bases of the perigonial leaves.

* Stipules connate by the decurrent bases on one or both sides, with the leaves below them.

1. *L. heterophylloides.*
2. *L. Gunniana.*
3. *L. Tasmanica.*
4. *L. biciliata.*
5. *L. leucophylla.*

*Stipules free.

†Leaves entire, or nearly so.

6. *L. austrigena.*
7. *Nov. Zealandiæ.*

††Leaves 2-fid. or 2-dentate at the apex (not serrate).

8. *L. bidentata.*
9. *L. lenta.*
10. *L. amplectans.*
11. *L. decurva.*

†††Leaves toothed.

12. *L. muricata.*

1. L. HETEROPHYLLOIDES, *Nees;* Fl. N.Z. ii., 135. Stems ½ inch long, procumbent, nearly simple. Leaves yellow-green, imbricate, horizontal or semivertical, flat, orbicular-ovate, rather retuse. Stipules 2-fid., ciliate, toothed at the base, decurrent and connate on one side to the leaf below. Perianth triquetrous; mouth 3-lipped, toothed. Syn. Hep. 157. *Chiloscyphus canaliculatus,* Hook. f. and Tayl. Lond. Jour. Bot. 1844, 563 (perianth inaccurately described); Syn. Hep., 710. (Pl. vii.)

Fragrant. On logs under water and on the earth and decayed wood: St. Patrick's River. York Town Rivulet—Gunn. Johnny's Creek, New Norfolk; Springs, Mt. Wellington—Hooker. Dense tufts on stones: Back River Gully, near the Derwent, Port Esperance, and Woodbourn, near Richmond—Oldfield. Rivulets, Cheshunt—Archer. Macrobie's Gully, Mt. Wellington, and gully near Mt. Nelson.—R. A. B. (New Zealand and Australia.)

2. L. GUNNIANA, *N. ab* E. Syn. Hep., p. 169; *Mitten,* in Fl. Tasm. 2, p. 225, n. 1. In tufts of grass; Hampshire Hills—Gunn, 1838. *Hb. Nees ab Essenbeck.* Also on logs under water in St. Patrick's River, Nov. 26, 1844—Gunn.

N. Fl. Tasm. This species is retained as distinct from the preceding, from the absence of decided intermediate specimens; but there are not wanting some which seem to indicate that, like some forms of *L. Nov. Zealandiæ*, the form of the stipule may be considerably modified, as well as the habit of the plants, by the situation in which they may have grown.

3. L. Tasmanica, *Mitten.* Stems 1 in. long, procumbent, vaguely branched; leaves divaricate (in one plane), subovate, bidentate, with small sub-oblique sinus at the apices, rarely one-tooth on dorsal margin, united to the stipules; the stipules 4-toothed. Perianth prismatic, winged, wings dentate. (Pl. vii.)

Nearly allied to *L. connata*, Sw., and *L. Beechyana*, Tayl. From the first it differs in the form of the leaf and emargination, the sinus being narrower, and the cells have thinner walls; from *L. Beechyana*, as well as from *L. Martiana-Nees,* it recedes in the entire ventral margins of its involucral leaves.

4. L. biciliata, *Mitten.* Fl. N.Z. ii., 137, t. 97, f. 4. Stems one inch long, procumbent, nearly simple. Leaves broad, spreading, brownish-green, loosely imbricate, deltoid-ovate, truncate, and 2-toothed, teeth slender. Stipules small, 2-partite; segments 2-toothed on one side.—*Chiloscyphus*, Hook. f. and Tayl. Lond. Jour. Bot., 1845, 84; Syn. Hep., 707. (Pl. iii., f. 2. Pl. vii.)

Brown's River—A. J. Taylor. Gully Mt. Wellington—H. J. Smith, R. A. B. (New Zealand.)

Lophocolea Colensoi, *Mitt.*, is transferred to *Chiloscyphus;* it resembles *C. Coalitus.* (Pl. vii.)

5. L. leucophylla, *Taylor.* Syn. Hep., p. 155. Stems 2-3in. long, slender, creeping, branched. Leaves pale-greenish or whitish-brown, closely imbricate, rather horizontal than vertical, convex, membranous, cellular, pellucid, triangular-ovate; margins strongly recurved, broadly connate, with the stipules sharply toothed all round. Perianth terminal; laciniæ entire, obtuse.—*Chiloscyphus*, Fl. Antarct., 157, t. 65, f. 4. Syn. Hep., 181, 706. (Pl. xiv.)

Tasmania, Hb., *Greville.* A few slender stems have been picked from amongst other *Hepaticæ* from the Acheron River, gathered by Mr. Gunn. Mt. Wellington—Gulliver; R. A. B. (New Zealand.)

6. L. austrigena, *Taylor, Jung. Austrigena, Hook,* f. and *Tayl.* Fl. Antarct., p. 125 to 157, f. 7, and t. 158, f. 5; G. L. and N., Syn. Hep., p. 702. (Pl. viii.)

Growing in water on the top of Fatigue Hill, elevation 4000ft. A smaller form submersed; St. Patrick's River—Gunn. Wet places in gullies near Brown's River—Oldfield.

7. L. NOVÆ-ZEALANDIÆ, *Nees.* Fl. N.Z. ii., 135. Stems procumbent, branched. Leaves yellowish-green, cellular, imbricate, spreading, orbicular quadrate, quite entire or slightly emarginate; involucral oblique, 2-toothed. Stipules free, ovate, reflexed, 2-fid. Perianth terminal, obovate, 3-gonous, wingless, 3-fid.; segments unequally toothed. *L. subviridis*, Fl. Antarct., 438, t. 159, f. 4. *L. rivalis*, 437, t. 158, f. 7. *L. sabuletarum*, 437, t. 158, f. 8. *J. subintegra*, 443, t. 160, f. 5. Hook. Handbook, 510. (Pl. viii.)

Near Hobart—Hooker. Gully Mt. Nelson, Fern Tree Gully, and Macrobie's Gully—R. A. B. (New Zealand, Australia, Falkland Islands.)

8. L. BIDENTATA, *Nees.* Fl. N.Z., ii., 136. Stems variable in length, sparingly branched, prostrate. Leaves divaricating, flat, pale green, triangular ovate, flaccid, 2-dentate, with a shallow sinus. Stipules small, distant, 2-partite; segments 2-fid, entire, or toothed. Perianth sub-sessile, angles not or slightly winged; mouth laciniate and toothed. Syn. Hep., 157. *J. recurvifolia*, Hook f. and Tayl. Lond. Jour. Bot., 1844, 562. *J. leptantha*, *J. divaricata*, and *J. alternifolia*, Fl. Antarct., t. 159, f. 6 and 161, f. 2 and 8. *J. textilis*, Fl. Antarct., 435, t. 158, f. 9; Fl. N.Z., ii., 137. Hook. Handbook, 510. (Pl. viii.)

Tasmania—Stuart. Banks of the Derwent, Springs, Mt. Wellington. Deep Gully, Mt. Wellington; high bleak hill, Major's Falls, New Norfolk. In brackish swamps near the sea, N. West Bay—Oldfield. Cheshunt—Archer. Gully, Mt. Wellington—R. A. B. (New Zealand.)

9. L. LENTA, *Hook.* f. and *Tayl.* Fl. Antarct., 154; Fl. N.Z., ii., 136, t. 97, f. 2. *J. diademata*, Lond. Jour. Bot., 1844, 560. Patches thin, several inches wide, pale dusky olive. Stem about one inch long; the branches few, patent. Leaves scarcely imbricated, lying in the same plane, oblong, the outline swelling out about the middle of the anterior margin, their cells large, their sinus obtuse, the segments much divaricated. The stipules have four setaceous segments, which are quite entire. The perichætial leaves are more erect, wider, and their margin is more waved than the cauline; they are sometimes sparingly dentate. The

oblong triquetrous calyx has the mouth beautifully fringed, and one lip much longer than the other ; it has usually three wings, which are strongly dentate. The perigonia occur about the middle of a shoot, and consist of closely imbricated, adpressed, upright leaves, ventricose at the base, their points standing out from the stem ; the stipules of the perigonia are less compounded than those of the rest of the stem, being, for the most part, simply bifid. The capsule is oblong, splitting into four elliptical valves, discharging numerous minute round seeds and spiral filaments, with a double helix.

This species approaches the European *J. bidentata, L.* differing from it by its smaller size, more deeply notched leaves, their segments more elongated, by the quadrifid stipules with entire segments, but, above all, by the inequality of the two lips of the calyx. Lond. Jour. Bot., 1844. (Pl. viii.)

Near Hobart—Hooker, Archer. (New Zealand, Fuegia.)

Scarcely different from *L. bidentata.* Hook. Hd. Book, n. 511.

10. L. AMPLECTENS, *Mitten.* Stems tufty, decumbent, vaguely sub-pinnately branched ; leaves imbricate, subquadrate, 2-fid, laciniæ acute, amplectant. Stipules ovate, 2-fid, outer segments one-toothed. (Pl. ix.)

Yellow-green or brownish. In size and habit very nearly resembling the European *Harpanthus scutatus, Spruce* (*J. scutata*—Hook.), but its leaves and stipules are of a different form, and were it not for the form of the stipule being exactly that which prevails in almost all the species of *Lophocolea*, it would rank nearer to some *Jungermanniæ.*

Amongst rocks near the top of Mt. Wellington—Oldfield.

11. L. DECURVA, *Mitten.* Stems procumbent, nearly simple ; leaves ovate, bidentate, sinus small, dorsal margin long, decurrent, ventral arcuate ; stipules wide, ovate, inflexed, tri-partite, teeth recurved, subulate. (Pl. ix.)

Beautiful green, one inch high, slender; leaves imbricate, apices decurved; stipules large, concave.

A small plant, readily distinguishable by its concave stipules, which have their two slender teeth bent back. In general appearance it has more resemblance to some small forms of *Plagiochila Mauritiana*—*Nees*, than to any *Lophocoleæ.* (Fl. Tasm., n. 227.)

12. L. MURICATA, *Nees.* Stems minute, $\frac{1}{6}$in. to $\frac{1}{4}$in. long, procumbent, branched. Leaves close set, pale, sub-horizontal, and stipules sub-quadrate-ovate, acutely 2-dentate, spinulose-ciliate, muricate, with short hairs above. Perianth terminal, ovate, plaited; mouth 5 to 6-fid. Syn. Hep., 169, 703. *L. hirtifolia*—Hook. f. and Tayl. Lond. Jour. Bot., 1846, p. 366.

On *Sticta chloroleuca*—Hook. On the old fronds of a fern, St. Patrick's River—Gunn. (New Zealand, South Africa, South America, Java, India.)

5. TRIGONANTHUS, *Spruce.*

Perianth trigonous, stipulate near fruit.

Stems procumbent. Succubous, perianth leafy, trigonous, mouth contracted, fruit terminal. Approaches *Lophocolea*, but the perianth is different, and the stipules usually wanting on the barren stems. The Tasmanian species is *J. dentata*.

Included in Genus Jungermannia in Flor. Tas., and removed from thence by Mitten.

1. T. DENTATA, *J. dentata* (*Raddi;* G. L. and N. Syn. Hep., p. 143.) Stems creeping, with erect branches, swelling at the tips. Leaves rather remote, broader than the stem, sub-vertical, complicate-concave, orbicular-ovate, 2-fid. to the middle, toothed; involucral numerous, imbricate, deeply 2-fid. Stipules subulate. Perianth narrow, membranous, 4-plicate, mouth denticulate. (Pl. ix.)

On charred wood near York Town—Gunn. On rotten timber, Grass Tree Hill—Hooker. Common, New Norfolk—Oldfield, Archer. Ben Lomond—De Bomford. Huon Road—Rodway. On charred wood, gully, Kangaroo Point—R. A. B. (New Zealand, Europe.)

These specimens, in colour and habit, agree very nearly with *J. divaricata*, described by Dr. Taylor as *J. exiliflora*. May be distinguished by the braided appearance of the leaves, and the margins everywhere recurved. At the base at the outer side they are sometimes spiruloso-papillose, but the small teeth of the edges, from their downward direction, often present the same appearance when the papillæ are absent. Fl. Tas.

6. JUNGERMANNIA, *Linn.*

Perianth tubular. Stipules 0.

Stems prostrate, creeping. Leaves succubous, distichous, entire, or lobed. Stipules usually present. Fruit terminal on the main stem or on a lateral branch. Involucral leaves free. Perianth tubular, angular; mouth toothed or laciniate. Calyptra usually included. Capsule ovoid or globose, on a slender fruitstalk; elaters with 2 spiral fibres. Antheridia in the bases of inflated perigonial leaves.

Minute. Leaves distant.

1. J. PERIGONIALIS, *Hook.* f. and *Tayl.* Fl. Tasm., ii., 222. Minute; stems slender, ½in. high. Leaves dark-brown or purplish, distant, suberect, secund, concave, semi-amplexicaul, ovate-orbicular or obovate, retuse or unequally 2-fid at the apex, quite entire; involucral acutely 2-dentate. Perianth tubular, elongate; mouth plicate, contracted, toothed. (Pl. x.)

   Stems dark, leaves rather glossy, brown.

   Rocks near Cummings' Head, Western Mountains—Archer.

Leaves acuminate.

2. J. MONODON, *Hook.* f. and *Tayl.* Fl. N.Z., ii., 128. Stems 1-2in., purple or brown, flexuous. Leaves closely imbricate, ovate-lanceolate, acuminate, oblique, sometimes a tooth on one side; involucral 2-multifid, toothed. Perianth oblong, 4-plicate, mouth ciliated. Syn. Hep., p. 664. Lond. Jour. Bot., 1844, p. 559. (Pl. x.)

   Tasmania—Spence, Gunn. New Zealand—Hooker.

Leaves oblong, recurved.

3. J. TASMANICA, *Hook.* f. and *Tayl.* Stems tufted, ascending, branched. Leaves imbricate, patent, oblong, margin recurved, entire. Perianth terminal, oblong, tumid, subincurved, 4-plicate; mouth minutely denticulate. Involucral leaves 2-digitate, laciniate. Perianth appressed. *J. revolvens*, Hook. f. and Tayl. Lond. Jour. Bot., 1846, p. 275. (Pl. ii., f. 1. Pl. x.)

   Yellowish-green. Vaguely branched, creeping or ascending. Leaves ovate-oblong, obtuse, sometimes retuse; margin recurved. Patches wide, pale olive-green. Stem about 1in. long, irregularly branched, creeping, the new shoots ascending. Both margins of the leaves recurved, as in several *Plagiochilæ;* the cellules large at the junction of the leaves to the stems. No stipules except a few almost inconspicuous towards the tops of the male shoots. Calyx curved, as in *J. lanceolata*, L. The perichætial leaves or scales are concealed by the adjoining pair of cauline leaves; they are anomalous, being deeply laciniated; by which character, and by the recurvation of both margins of the leaves, our present plant differs abundantly from *J. lanceolata*, L. Lond. Jour. Bot., 1846, p. 275.

Circular Head, York Town—Gunn. Brown's River Gully—Oldfield. Wellington Falls and Proctor's Road—R. A. B.

Furnished with scaled flagellæ.

4. J. COLORATA, *Lehmann*. Stems one to two inches high, purple or dusky green, sending off long thread-like flagellæ covered with scales. Leaves closely imbricate, nearly vertical, orbicular, quite entire; involucral incised. Stipules 0. Perianth ovoid, 8-10-plicate; mouth contracted, toothed. Syn. Hep., 36 and 673. (Pl. x.)

On a stunted *Fagus*, altitude 2000 ft., St. Patrick's River—Gunn. On rocks, Goat Hills, New Norfolk; Grass Tree Hill and Hospital Bay, South Huon—Oldfield, Archer. Near Hobart and Wellington Falls—R. A. B. (New Zealand, Australia, South Africa, Juan Fernandez, Chili, Fuegia, &c.)

Leaf margin thickened.

5. J. MARGINATA, *Mitten*. Stems erect, rigid, branched; branches frequently attenuated in a flagelliform manner; leaves patent, secund from the front, oval, entire, apex obtuse or rarely retuse, margin thickened, composed of two rows of cells; stipules ovate, bifid.

Dull brownish-green or black. Stems two inches or more in height, flexuous; stipules as wide as the stem is thick.

A rigid species, with some resemblance to elongated states of *J. scalaris*, but larger and with more oval leaves. Its evidently margined leaves readily distinguish it from its allies. (Pl. xii.)

Arthur's Lakes—Gunn. Brown's River Gully—Oldfield. Wellington Falls—R. A. B.

Leaves whitish, divided.

6. J. MULTICUSPIDATA, *Hook.* f. and *Tayl.* Fl. Antarct., 150. Stems loosely tufted, prostrate, sparingly branched. Leaves distant, whitish, suberect, membranous, pellucid, obovate, 2-4-fid. to the middle, sinus obtuse, segments acute. Perianth lateral or terminal, long, cylindric, split at the side, mouth 3-4-toothed. Syn. Hep., 686.
   On *B. Halleriana*—Archer.

7. J. BASTOVII, *Carr.* and *Pear.* Roy. Soc. Trans. Tas., 1887. Monoicous, cladocarpous, pale glacous green; stems slightly branched, creeping, filiform, rigid; branches lateral; leaves approximate, nearly transverse, subsecund, subquadrate, ovate, convexo-conduplicate, divided half way down into two acute spreading segments, sinus acute, margin entire, exstipulate; involucre on short lateral branches; perigonial leaves 4-6 pairs, turgid at the base, monandrous. (Pl. xi. and xl.)
   Ploughed Fields, Mount Wellington—R. A. B.

8. J. TERES, *Carr.* and *Pear.* Roy. Soc. Trans. Tas., 1887. Dioicous, densely cæspitose, flagelliferous; reddish brown colour; stems sub-ramose, terete, wiry, rigid, filiform, flexuose, branches postical; leaves closely appressed, imbricate, sub-amplexicaul, erect, broadly ovate, obtuse, margin hyaline, entire; under leaves none; involucral bracts much larger, laciniate-dentate, bracteole ovate-acute, slightly dentate; perianth ovate cylindric, deeply 4-6-plicate, mouth incurved, denticulate. (Pl. xi. and xlii.)
   Mt. Wellington—R. A. B.

7. SOLENOSTOMA, *Mitten.*

This genus includes *Jungermannia rotata.* The perianth adheres to the base of the uppermost leaves. Hook. Handbook Flora N.Z., p. 753.

Leaves quite entire.

1. S. ROTATA, *Mitten.* *Jungermannia rotata*, *Hook* f. and *Tayl.* Fl. N.Z., ii., 129, t. 24, f. 4. Stems procumbent, tufted, branched, recurved, flexuose, 1-3 in. high. Leaves imbricate, dark green, secund, erecto-patent, almost vertical, orbicular, concave, quite entire, ventral margin sub-decurrent; involucral similar. Stipules

appressed, lanceolate, or none. Perianth obovate, above obtusely 4-gonous, with four inflexed laminæ. Syn. Hep., 672. (Pl. xi.)

Wellington Falls—R. A. B.

8. ADELANTHUS, *Mitten.*

Fruit apparently lateral. Stipules 0.

Stems erect from a creeping rhizome, branched. Leaves succubous, distichous, vertical, the dorsal margin decurrent. Stipules 0. Fruit terminal on short ventral branchlets, concealed at the bases of the branches. Involucral leaves 3-farious. Perianth tubular, subtrigonous; mouth connivent, toothed. Capsule on a slender fruitstalk. Elaters with two spiral fibres. Antheridia in small ventral spikes.

1. A. FALCATUS, *Mitten* in Journ. Linn. Soc., vii., 243. *Plagiochila*, Flor. Tas., ii., 223. *J. falcata*, Hook. Musc. Exot., t. 89. Stems much branched, 1-3 in. high; branches falcate, incurved, thickened upwards. Leaves dingy green, or brown, or black, imbricate, vertical, erect, sub-opposite, orbicular; dorsal margin sub-inflexed, quite entire, decurrent; ventral toothed. *Auli-cularia occlusa*, Fl. Antarct., 146. Syn. Hep., 619. (Pl. xii.)

Stems 3 in. or more in height, the leaves erecto-patent and rather loosely disposed; in the lower parts of the stems they are quite entire, but as they approach towards the apex they become more and more denticulate. Flora Tas.

Tasmania—Gunn, Archer. Kermandie Rivulet, South Huon—Oldfield. St. Crispin's Well, Mount Wellington—R. A. B. (New Zealand, Campbell's Island.)

9. CHILOSCYPHUS, *Corda.*

Fruit lateral, stems procumbent, stipulate.

Stems prostrate, creeping, rooting from the bases of the stipules. Leaves succubous, distichous, decurrent. Stipules often decurrent and connate with the leaves below them. Fruit terminal on very short lateral branches. Involucre of 2-6 leaves. Perianth 2-3 partite. Calyptra herbaceous, globose or clavate, often longer than the perianth, bursting irregularly at the apex. Capsule ovoid, on a slender fruitstalk; elaters with two spiral fibres. Antheridia in the saccate dorsal bases of perigonial leaves, which resemble the cauline.

I. Leaves opposite, stipules united to both the leaves below them by their decurrent margins.

*Leaves united by their dorsal bases (free in *J. Billardieri.*)

†Leaves entire, or nearly so, at the apex.

1. *C. conjugatus.*
2. *C. Billardieri.*
3. *C. Gunnianus.*
4. *C. sinuosus.*

††Leaves strongly 2-5 dentate at the apex.

5. *C. fissistipus.*

**Dorsal bases of the leaves not connate.

†Leaves 2-4-toothed at the apex.

6. *C. coalitus.*
7. *C. Colensoi* (?)

II. Leaves alternate, stipules united by one decurrent margin to a leaf below them.

8. *C. laxus.*
9. *C. tridentatus.*

III. Leaves opposite or alternate, stipules free.

10. *C. echinellus.*
11. *C. cymbaliferus.*

1. C. CONJUGATUS, *Mitten.* Stems creeping, elongate, sparingly dichotomously branched; leaves imbricate, oblong-rotund, united at the dorsal margin, remotely spinulose-dentate at the base or entire, opposite. Stipules half as large as the leaves, incurved, sparingly denticulate. Cells of leaves minute, round. Fl. Tas., ii., p. 228. (Pl. xiii.)

Without exception the largest species of the genus. In external appearance and colour it resembles *C. Billardièri*, but the form of its leaves, and particulary that of the stipules, which resemble nothing so much in outline as the human occiput as seen from behind, render it very distinct from all allied species. The united dorsal margins cross the stem transversely without the least tendency to decurrence. The apices of the leaves being a little incurved, and the leaves themselves sub-connivent, give the plants a canaliculate appearance.

Rivulet near Acheron River—Gunn.

2. C. BILLARDIERI, *Nees*. Fl. N.Z., ii., 139. Stems 3-5 in. long; prostrate, dichotomously branched. Leaves green or brown, opposite, ovate, subacute, obscurely 2-dentate; ventral margin arched; dorsal straight, 6-9-toothed at the base, free or connate with that of opposite leaf. Stipules imbricate, transverse, convex, 2-toothed, connate with the leaves below. Perianth campanulate; mouth laciniate, fimbriate. Hook. Musc. Exot., t. 61. Syn. Hep., 175. (Pl. viii.)

Tasmania—Labillardière, Menzies. (Australia, New Zealand, Campbell's Island.)

3. C. GUNNIANUS, *Mitten*. Stems creeping, vaguely branched. Leaves imbricate, sub-deltoid, bispinous at the apices, dorsal margin spinous dentate, ventral margin bi-dentate, suddenly arcuate to the stipule. Stipule oblong, apex bi-dentate, extus 4-toothed.

Stem 2 in. high, flaccid. Dirty pale brown. (Pl. xiii.)

A remarkable species, possessing considerable resemblance to *C. Billiardièri* in the general outline and dentation of its leaves, but its areolation is altogether different. Fl. Tas., ii., p. 228.

Tasmania—Gunn.

4. C. SINUOSUS, *Nees*, Fl. N.Z., ii., 141. Stems 3-4 in. long, procumbent. Leaves crowded, brownish green, opposite, ovate-oblong, obtuse, obscurely 2-toothed at the apex, connate, or almost so, by their dorsal bases; ventral margin undulate; dorsal very decurrent; involucral incised. Stipules distant, spreading, 5-partite, segments toothed, connate with the leaves below. Perianth ovate; mouth laciniate, inflexed. Syn. Hep., 175. Hook. Musc. Exot., t. 113. (Pl. xiii.)

C. oblongifolius, Hook. f. and Tayl. in Lond. Jour. Bot., 1845, 563. This species bears some resemblance to *J. integrifolia*, L. and L.; in this, however, the termination of the leaf is altogether destitute of the two remarkable teeth present in our species. Syn. Hep., 705.

Valleys near Hobart, North West Bay Gully—Oldfield. Mount Wellington Gullies—R. A. B. (New Zealand, Lord Auckland's Group.)

5. C. FISSISTIPUS, *Hook.* f. and *Tayl.* Fl. Antarct., 157. Stems ½ in. to 1 in. long, procumbent, branched. Leaves ovate, united by their dorsal bases, 2-4-toothed at the apex; ventral margin undulate, 1-2-toothed; dorsal straight; involucral 2-3-fid; margins toothed and laciniate. Stipules imbricate, reniform, spinulose, connate with the leaves below them. Perianth campanulate; mouth open, laciniate. Syn. Hep., 175 and 704.

Tasmania—Labillardière. St. Patrick's River and Circular Head—Gunn. Back River Gully—Oldfield. Tents Creek—Archer. Mount Wellington Gully—R. A. B. (New Zealand, Lord Auckland's Group.)

6. C. COALITUS, *Nees.* Fl. N.Z., ii., 141. Stem 1 in. long, creeping. Leaves opposite, ovate-quadrate truncate, 2-dentate; teeth subulate; involucral small, 2-fid. Stipules 4 to 6-toothed, connate with the leaves below them. Perianth obovate; mouth 4-toothed. Hook. Musc. Exot., t. 123. Syn. Hep., 180, 706. (Pl. xiv.)

Tasmania—Gunn, Hooker. Back River Gully and Mount Wellington—Oldfield. West End Rivulet—Archer. Mount Wellington Gully—Rodway, R. A. B. (NewZealand, Lord Auckland's Group, Java.)

7. C. COLENSOI (?) *Lophocolea Colensoi*, Mitten in Fl. N.Z., ii., 138, t. 97, f. 6. Stems 2-3 in. long, creeping, branched. Leaves brownish-green, imbricate, ovate-oblong, truncate, shortly 2-dentate; teeth sometimes obsolete. Stipules 2-partite; segments 1-toothed on each side. (Pl. vii.)

Resembles *C. coalitus*, but is larger, more succulent, the dorsal angles of the leaves are more widely separate; perianth short, companulate; lips toothed, not exserted beyond the leaves. Mitten in Hooker's Handbook to N.Z. Flora, p. 753.

The figure of this plant in Fl. N.Z. and the description do not appear to agree, the stipule being drawn as 2-toothed on each side.

Mount Wellington Gully—R. A. B.

8. C. LAXUS, *Mitten* in Fl. N.Z., ii., 142, t. 99, f. 1. Stems 2 in. long, brittle. Leaves bright green, sub-pellucid, alternate, rather remote, ovate oblong, unequally 3-4-toothed; cells large, lax. Stipules small, 2 partite; segments 1-toothed. (P. xiv.)

Amongst *Symphyogyna flabellata* and *Lepidozia tenax*, Gunn. With *Radula buccinata* and *Metzgeria* *furcata* ; Back River Gully ; North-West Bay Gully—Oldfield. Gully, Mount Wellington—R. A. B. (New Zealand.)

9. C. TRIDENTATUS, *Mitten.* *C. combinatus,* Fl. N.Z., ii., 141. Stems procumbent, slender, 1 in. long. Leaves brownish-green, convex, rigid, shortly oblong or sub-quadrate, truncate, 2 or 3 toothed at the apex; margins recurved ; stipules small, 4-toothed, connate on one side with a leaf below. (Pl. xiv.)

Tasmania—Dumont d'Urville — Archer. Damp ground, Grass Tree Hill—Oldfield. St. Patrick's River—Gunn. (New Zealand.)

10. C. ECHINELLUS, *Mitten* in Fl. N.Z., ii., 141. Stems small, procumbent. Leaves sub-imbricate, horizontal, sub-rotund, spinulose toothed. Stipules 2-partite ; segments lanceolate-subulate, toothed. *Lophocolea,* Syn. Hep., 703.

Creeping amongst mosses—Archer. (New Zealand.)

11. C. CYMBALIFERUS, *Hook.* f. and *Tayl.* *Jungermannia,* Fl. Antarct., 151, t. 64, f. 5. Stems tufted, 1 in. high, sub-erect or procumbent, curved. Leaves pale green or yellowish, flaccid, pellucid, densely and closely imbricate, erecto-patent, very concave, subsecund, obliquely orbicular, serrulate ; dorsal margin produced into an obovate inflated auricle. Stipules free, very broad, transverse, tumid, closely imbricating, obscurely 3-lobed or quite entire. Perianth lateral, ovate-oblong, tumid below, compressed below the plaited toothed mouth. Syn. Hep., 711. A very peculiar plant. (Pl. xv.)

Mount Wellington—Mossman, R. A. B. (New Zealand.)

12. C. LIMOSUS, *Carr.* and *Pear.* Roy. Soc. Tran. Tas. 1887. Dioicous ; tufts shallow, depressed, sordid green ; stems sparingly branched ; leaves complanate, nearly opposite, imbricate, ovate-triangular, rounded at the apex, sometimes retuse, decurrent ; under leaves connate with the adjacent leaves, patent, cuneate-quadrate, quadrifid, divided half way into four acute equal segments ; involucral bracts connate about half way, irregularly dentate ; perianth cyathiform, slightly alate, mouth wide, tri-laciniate-alate, irregularly sinuate dentate ; andrœcium amentiform, minute ; antheridia single, oval. (Pl. xv. and xxxix.)

Brown's River—R. A. B.

10. PSILOCLADA, *Mitten.*

Fruit lateral, stems procumbent; leaves and stipules deeply cleft.

Hirsute; stems capillary, creeping, sub-pinnately branched Leaves succubous, distant, minute, quadrate, 4-cleft. Stipules similar. Fruit lateral, on very short branches. Involucral leaves 2-fid, large, falcate. Perianth sub-cylindric, smooth; mouth laciniate; laciniæ falcate, secund. Calyptra, &c. unknown.

1. P. CLANDESTINA, *Mitten*, Fl. N.Z., ii., 143, t. 99, f. 4. Stems 1 in. long, capillary, procumbent, sparingly branched. Leaves bright green, microscopic, scarcely broader than the stem, remote, square in outline, consisting of a short horizontal blade and 4 erect subulate lobes at right angles to it; cells large, inflated; involucral, imbricate, large, falcate-secund, more cut. Stipules similar, smaller. (Pl. xv.)
   Tasmania—Gunn. (New Zealand.)

0. GYMNANTHE, *Tayl.*

Stems prostrate or ascending, vaguely branched. Leaves succubous, distichous. Stipules present or absent. Fruit terminal. Involucre a cylindrical pendulous tube, often fleshy and buried in the ground. Perianth 0 or adnate with the involucre. Capsule on a slender fruitstalk; elaters with two spiral fibres. Antheridia free in the axils of the leaves.

This genus has been divided by Mitten into five in Hooker's Handbook to N.Z. Flora, p. 753, the name *Gymnanthe* being too near *Gymnanthes* and *Gymnanthus.*

GYMNANTHE (Divided).

Perianth, a descending fleshy bag.

I. Fruit terminal.

* Stems erect or ascending, leaves nearly entire, stipules 0.

11. TYLIMANTHUS, *T. saccata*, *T. Tenella.*

** Stems procumbent, leaves 2-fid, stipules small or none.

12. ACROBOLBUS, *A. cinerascens.*

*** Stems procumbent, leaves entire, stipules 0.

13. LETHOCOLEA, *L. concinna, L Drummondii.*
**** Stems procumbent, stipulate.
14. BALANTIOPSIS, *B. diplophylla.*

II. Fruit lateral.
Stems erect or ascending, stipules 0
15. MARSUPIDIUM, *M. Urvilleana.*
11. TYLIMANTHUS, *Mitten.*

Perianth, a descending fleshy bag.

Fruit terminal.

Stems erect or ascending ; leaves nearly entire ; stipules 0.

1. T SACCATA, *Gymnanthe saccata, Tayl.* in Fl. Antarct. 153. Stems erect from a creeping rhizome, 2-3 in. long, flexuous, fertile incurved. Leaves distant, 3 farious, distichous, ovate-quadrate, flat, decurrent, truncate, emarginate ; ventral margin and apex toothed ; dorsal sub-reflexed, entire. Involucre terminal, fleshy. Hook. Musc. Exot. t. 16, *G. tenella,* Hook. f. and Tayl. Fl. N.Z. ii., 143. Syn. Hep., 192, 712. Fl. Tasm. ii., 229, t. 179, f. 3, *J. abbreviata,* Hook. f. and Tayl. in Lond. Jour. Bot. 1843, 374. Syn. Hep. 647 (*Plagiochila*), Pl. xvi.

Oven's Creek, *Archer,* Fork Creek, *Rodway* (New Zealand, Lord Auckland's Group, Fuegia.)

A common and variable plant, *G. tenella,* seems to be a small state of it. Hook. Handbook Fl. N.Z.

2. T. TENELLA, *Gymnanthe tenella, Tayl.* in Lond. Jour. Bot. 1844, p. 377. Stem simple, ascending. Leaves sub-imbricate, erecto-patent, concave, sub-secund, obovate from a narrow base, apex very obtuse, bilobed, dentate. Receptacle elongate, obconic, striate. Pl. xvi.

Stems scarcely tufted, erect, slightly incurved above, from one to three inches long, prolonged at the top by annual innovations arising from the base of the perichastium, when this is present. The leaves, in the series from the base to the summit of the stem, are constantly increasing in size. The receptacle is elongate, obconical, of a pale tawny colour, striated ; the barren pistilla are crowded, erect, linear, covered by a pair of laciniated scales, descending at a considerable angle from the stem and emitting rootlets. The perigonia are spikes situated in the course of the stems, and have leaves closely imbricated, erect, swollen at their bases, each containing several dusky oblong anthers whose pedicals are elongated.

Fl. Tasm.—It appears by no means improbable that *G. saccata*, *G. tenella*, and *G. Urvilleana* are different states of the same species. St. Patrick's River, *Gunn.* Mount Wellington, *Oldfield*, *Mossman*; Cheshunt, *Archer.* St. Crispin's Well, *R. A. B.* (New Zealand, Fuegia).

ACROBOLBUS, *Lehm.* and *Lindb.*

Perianth, a descending fleshy bag.

Fruit terminal.

Stems procumbent, leaves 2-fid, stipules small or 0.

1. A. CINERASCENS, *Gymnanthe cinerascens*, *Lehm.* and *Lindb. Mitten. Jungermannia cinerascens*, *Lehm.* and *Lindb.* in Pug. Pl. 4. p. 46; G. L. and N. Syn. Hep. p. 78.

Note.—Fl. Tasm. ii., 229. Although the perfect torus of this species (*Gymnanthe cinerascens*) is wanting, there are sufficient indications present in the specimens to warrant its being placed in this genus. The stipules, overlooked in the description of the plants in the " Synopsis Hepaticarum," are nevertheless present as well in the specimen kindly contributed by Dr. Lehman as in those gathered by Mr. Gunn, but they are not obvious on all the stems, and are thus easily overlooked. The involucral leaves scarcely differ in form from the cauline, but are concave, and enclose four or five pistils seated on the dorsal side of the abrupt and slightly thickened apex of the stem itself; within the involucre there has been observed a small stipule-like leaflet, but not apparently representing the stipule, which, although present, has no part in the formation of the torus in the plants of this and allied genera. Pl. xvi.

St. Patrick's River, *Gunn.*

13. LETHOCOLEA, *Mitten.*

Perianth, a descending fleshy bag.

Fruit terminal.

Stems procumbent, leaves entire, stipules 0.

1. L. CONCINNA, *Gymnana concinna*, *Mitten*, in Fl. Tasm.

ii., 230. Stems creeping, 3 to 8 lines long, branched. Leaves imbricate, oblong, ovate, concave, pale green, under surface scattered with rootlets, fruit descending from the apex.

A very small species of a very neat habit, and with somewhat the look of the stems of some states of *Jungermannia nana,* Nees. The apex of the stem is slightly thickened and curved downwards, and the involucral leaves being directed upwards at right angles, give the stems of this and some allied species an abrupt appearance. The areolation is similar to that of *G. Urvilleana.* Pl. xvi.

Tasmania, *Gunn,* creeping over *Jungermannia Tasmanica.*

2. L. DRUMMONDII, *Mitten* in Fl. N.Z. p. 144, Pl. 99, f. 8. Stems ½in long, stout, creeping, rooting at the the tips. Leaves greenish-brown, imbricate, spreading, flat, upper larger, ovate, obtuse, quite entire; dorsal margin sub-recurved. Involucre as long as the plant, clavate, with scattered rootlets. *Riccia squamata,* Tayl. in Drummonds Swan River mosses. *Podanthe squamata,* Tayl. in Lond. Journ. Bot. 1846, p. 413. Syn. Hep. 789. Pl. xvii.

Bogs, Brown's River, *Oldfield.* (Australia, New Zealand.)

14. BALANTIOPSIS, *Mitten.*

Perianth, a descending fleshy bag.

Fruit terminal

Stems procumbent, stipulate.

1. B. DIPLOPHYLLA, Mitten, in Fl. Tasm. ii., 230, t. 179, f. 5. Stems short, ½-1in. in length, creeping. Leaves white, pellucid, membranous, cellular, closely imbricate, divaricating, conduplicate, unequally 2-lobed, upper lobe smaller, stipuliform, toothed and ciliate. Stipules 2-fid; segments toothed and ciliate. Perianth terminal, short, cylindric, purple. *J. diplophylla,* Fl. Antarct, 152, t. 64, f. 4. *Gotschea, Nees.* Syn. Hep. 624. Pl. xvii.

Bogs, Brown's River, and wet ground, Kermandie Rivulet, *Oldfield.* Elliot Rivulet, *Archer.* Fork Creek, *R.A.B.*

15. MARSUPIDIUM, *Mitten.*

Perianth, a descending fleshy bag.

Fruit lateral.

Stems erect or ascending, stipules 0.

1. M. Urvilleana, *Gymnanthe, Tayl.* in Fl. Antarct., 153. Rhizome creeping. Stems tufted, ½-2in. high, erect, tips nodding. Leaves spreading or appressed and imbricate, nearly round, with an indistinct notch or with one or two short teeth at their tops. Involucre attached to the lower parts of the stem by its side, rooting. Capsule on a long stalk, ovoid. *Plagiochila Urvilleana,* Mont. in Voy. Pole Sud., t. 16. *Jung. abreviata,* Hook. f. and Tayl. in Lond. Jour. Bot., 1844, 374. Syn. Hep. 647 (*Plagiochila*).
   Tasmania, *Gunn, Hooker, Archer.* (New Zealand, Lord Auckland's Group.)

16. GYMNOMITRIUM, *Corda.*

Perianth, 0.

Stems very slender or capillary. Leaves vertical, distichous, flat or concave, entire or 2-lobed. Stipules 0 or very inconspicuous. Fruit terminal. Involucral leaves, 2-4, convolute, emarginate. Perianth 0. Calyptra short. Capsule globose on a slender fruit stalk; elaters with 2 spiral fibres. Antheridia axillary, obovate.

1. G. concinnatum, *Corda.—Jungermannia,* Fl. N.Z. ii., 128. Stem erect, short; branches straight, thickened, obtuse and compressed at the apex. Leaves most densely imbricate, ovate, 2-fid, with a narrow membranous border. Stipules 0. Hook. Brit. Jung. t. 3. Pl. xviii.
   Densely matted, pale yellowish brown. Small. Summit of Mount Wellington, *R. A. B.* (New Zealand, Europe, Fuegia).

2. Gymnomitruim erosa, *Cesia erosa; Carr et Pear.* Monoicous, loosely cæspitose, pale olive green, rhizomatous, creeping, sparingly branched, filiform, fertile stems erect, clavate, leaves very closely imbricate, appressed, erect, ovate or roundish-ovate, entire retuse or slightly notched, margin hyaline, irregularly erose, crenulate; cells minute, guttulate; bracts broadly ovate to cardate-ovate, bidentate, sinus acute, inner bracts 3-lobate, dentate. Pl. xii.
   Mount Wellington, *R.A.B.*

For interesting observations on this plant and other six new species, see Messrs. Carrington and Pearson's communication in current proceedings of Roy. Soc. Tasmania.

It appears that the generic name *Cesia* has been taken from "Musci Scandinavica" by *Carr et Pear*, but as the Hookerian or Mittenian nomenclature prevails in works treating of Tasmanian *Hepaticæ*, *Cesia erosa* is here placed as *Gymnomitrium erosa*.

17. ISOTACHIS, *Mitten.*

Leaves and Stipules nearly equal.

Stem erect, branching with innovations almost trifarious. Leaves almost trifarious, vertical, imbricating, conduplicate, serrulate. Stipules nearly as large. Fruit terminal. Involucral leaves, inner minute, outer like the cauline. Perianth erect, tubular, fleshy, rigid; mouth contracted, toothed.

A Southern genus, of which its author says it may be recognised by its evenly arranged leaves and stipules, the latter so closely resembling leaves that the leaves may be almost called trifarious. It resembles Sendtnera in habit, but differs in the form of the perianth and free calyptra.

1. I. SUBTRIFIDA, *Mitten*, Fl. N.Z. p. 149. *Jungermannia subtrifida, Hook. f. and Tayl. Lond. Journ. Bot.*, 1844, p. 579. G. L. and N. Syn. Hep. p. 681. Fl. Tasm. t. 179, f. 7. Stem 1in. high, slender, simple; tips decurved. Leaves pale brown, upper rosy, loosely imbricate, secund, erecto-patent, ovate, conduplicate, 2-3 fid.; teeth and dorsal margin entire; ventral entire or toothed. Stipules similar, smaller. Pl. xviii.

Tufts rather loose, pale brown. Leaves loosely imbricated below, more closely towards the thickened summits of the stems, very tumid, the lower usually bifid, the upper trifid, the segments short, lanceolate, subapiculate. Lond. J. Bot., as above.

Tasmania, *Lawrence*, (New Zealand.)

2. I. GUNNIANA, *Mitten.* Brown, stems erect, proliferously branched, tufty, 1 or 2in. high. Leaves divaricate, sub-vertical, cordate, deeply notched. Perianth cylindrical, fleshy, rough, apex white, diaphanous. Pl. iii. f. 3. Pl. xviii.

Very nearly allied to *J. madida* in size, colour, and habit, but with wider and less deeply notched leaves, which are also more distant and divaricate. Fl. Tasm. 232, p. 179. f. 8.

Arthur's Lakes, *Gunn, Archer.* (New Zealand.) Summit of Mount Wellington, *R.A.B.*

3. I. INTORTIFOLIA (*Mitten*). *Jungermannia intortifolia, Hook,* f. and *Tayl.* Crypt. Antarct., p. 38, Pl. 64, f. 1. Stems 1½ to 2in. high, erect, flaccid, sparingly branched. Leaves purplish, spreading, imbricate, flaccid, cellular, very concave, ventricose, amplexicaul, orbicular, oblong, unequally, 2-4 fid, rarely entire; segments acuminate, incurved, toothed. Stipules imbricate, large, orbicular, very concave, emarginate, 2-fid or toothed-membranous. Pl. xviii.

On rocks, rivulet near Cummings' Head, Western Mountains, *Archer.* (New Zealand, Campbell's Island.)

18. SCAPANIA, *Lindenberg.*

Leaves complicate, stipules 0.

Stems erect or ascending. Leaves vertical, distichous, concave or complicate, 2-lobed. Stipules 0. Fruit terminal. Involucral leaves 2, larger than the cauline. Perianth compressed parallel to the direction of the leaves, mouth entire or ciliated. Capsule on a slender fruitstalk, ovoid; elaters with 2 spiral fibres. Antheridia in the forks of 2-lobed perigonial leaves.

A small genus, native of the north and south temperate zones, rare in the tropics. Hook, Handbook. Fl. N.Z., p. 511.

1. S. OBTUSIFOLIA, *Jungermannia obtusifolia,* Hook. Brit. Jung. t. 26. *J. domestica, Gottsche, Plantæ Muellereanæ.* Growing in dense tufts of a pleasant green colour, two or three inches in diameter, firmly attached by thick roots. Stems nearly erect, seldom much above a quarter of an inch in length, and unbranched. Leaves in two opposite rows, closely overlapping so as to conceal the stem, and divided half-way down into two unequal lobes, both rounded at the apex, and smooth at the edges. Calyx large, contracted, and toothed at the mouth. Capsule egg-shaped. Cook's Brit. Hep., p. 7. Pl. xix.

These specimens (Tasmanian) appear to agree in every respect with British examples, only that the stems are a little longer, and perianth a little shorter. Fl. Tasm. ii., 233.

Rivulet near Cummings' Head, Western Mountains, *Archer.* Grass Tree Hill, *Oldfield.* (Great Britain).

2. S. DENSIFOLIA, *Nees.* *S. vertebralis, Gottsche,* Fl. Antarct., 153. Stems 3-4in. high, erect, rarely branched. Leaves olive-green or brown, distichous, crowded, vertical, spreading, 2-fariously imbricate, 2-fid ciliated; lobes incurved, twisted. Syn. Hep. 73. Hook. Musc. Exot. t. 36. Pl. xix.

A most beautiful plant. There appears to be no difference, excepting the paler colour, to distinguish *S. vertebralis* from the present, and the perianth is, as in other species of the genus, flattened, and at the apex truncate.

Tasmania, *Gunn.* (Lord Auckland's Group, on trees, rare.)

19. GOTTSCHEA, *Nees.*

Fruit terminal.

Leaves with adherent lobe.

Stems erect or sub-erect from a creeping rhizome, simple, rarely branched, very stout, fleshy and cellular. Leaves vertical, very large, distichous, cellular and fleshy, 2-lobed, complicate, serrate or pinnatifid, lobes sometimes lamellate. Stipules rarely absent. Fruit terminal in the hollowed apex of the stem. Involucre tubular, with a lacerate mouth, or formed of imbricating stipular leaves, free or connate with the tumid apex of the stem, together forming the perianth. Calyptra ovate. Capsule on a stout fruit-stalk, oblong or ovoid; elaters with 2 spiral filaments. Antheridia in ventricose, imbricate, perigonial leaves similar to the cauline.

A magnificent genus, abundant in the damp gullies of Tasmanian mountains, also in New Zealand.

Stipules 0.

1. G. PINNATIFOLIA, *Nees.* Fl. Tasm., p. 233. Fl. N.Z. ii., 149. Stems 2-3in. high. Leaves dull green, closely imbricate, obliquely ovate-acuminate or ovate-lanceolate, irregularly toothed and ciliate; dorsal lobe nearly as long as, but narrower than, the ventral; involucral toothed. Stipule 0. Perianth cylindric-oblong; mouth 5-lobed; lobes toothed. Syn. Hep. 22.

Hook. Musc. Exot., t. 114; Fl. Antarct. 147, t. 63, f. 1. *G. ciliigera*, Hook. f. and Tayl. in Lond. Journ. Bot. iii., 376. Pl. xx.

In a rivulet near the Acheron River, with *Chiloscyphus conjugatus*, *Gunn.* (New Zealand, Lord Auckland's Group.)

Leaves stipulate.

2. G. CILIATA, *Mitten.* Fl. N.Z. ii., 151, t. 101, f. 4. Stems 2-3in. high, glabrous. Leaves purplish-green, closely imbricate, very broadly ovate, ciliated all round with hair-like cilia; lobes nearly equal. Stipules 2-4 fid., lobes rounded, long, ciliated. Pl. xx.

In the same locality, and with the preceding species, *Gunn.* (New Zealand). Mount Wellington, *R.A.B.*

Leaves lamellate, stipulate.

3. G. LEHMANNIANA, *Lindb.* Stems 2-3in. high. Leaves ovate-oblong, crested with short lamellæ, serrate, ventral lobe ovate-lanceolate, dorsal as long. Stipules ovate, 2-4 fid; segments ciliate, furnished at the base with pinnatifid leaflets. Perianth terminal; involucral leaves, connate, sub-pinnatifid at the apex, acute, ciliate, serrate. Syn. Hep. 20. Mont. Voy. au Pôle Sud. 276, t. 16, f. 1. *G. Hombroniana*, Mont.

Dense forest near Franklin River, near the Acheron River, and in a rivulet near the same, with the preceding species, *Gunn.* Back River Gully and elsewhere, common, *Oldfield.* Cheshunt, *Archer.* Gullies, Mount Wellington, abundant, Rodway, *R.A.B.*

20. SENDTNERA, *Endlicher.*

Leaves incubous, without lobe.

Fruit terminal.

Stems erect or inclined, tufted, pinnately branched; branches often recurved, attenuated. Leaves obscurely distichous, incubous, closely imbricate, 2-5 cleft, segments entire. Fruit terminal on long branches. Involucral leaves numerous, incised, connate with the perianth. Perianth tubular, deeply cleft, membranous at the base. Calyptra chartaceous. Capsule globose on a short fruitstalk; elaters free, with 2 spiral fibres. Antheridia in the axils of tumid perigonial leaves, on proper branches.

1. S. JUNIPERINA, *Nees.* Fl. Tasm. ii., 234; Fl. N.Z. ii., 153. Stems 3-5 in. long, sub-erect, slender. Leaves pale brown, and stipules oblong, 2-fid, with an obtuse

sinus; segments lanceolate, acuminate, straight or slightly diverging. Syn. Hep. 239. Hook. Brit. Jung. t. 4, and Suppl. t. 1. Pl. xxi.

This plant, like those from New Zealand, corresponds nearly with the species from Great Britain.

A few stems picked out of other Hepaticæ *Gunn.* In bogs summit of Mount Wellington, *Oldfield.* (New Zealand, India, Europe).

2. S. SCOLOPENDRA, *Nees.* See genus *Leperoma.* Pl. xxi.

3. S. FLAGGELIFERA, *Nees.* See genus *Mastigophora.* Pl. xxi.

21. LEPEROMA, *Mitten.*

This name is proposed by Mitten for *Sendtnera scolopendra*, also for *S. ochroleuca* and *S. attenuata* of the New Zealand species. Leaves distinct, incubous, without an inferior lesser lobe. Perianth leafy. Fruit lateral.

The leaves and stipules deeply cleft; calyptra adnate with the involucral leaves; fruit near the top of the stem.

1. L. SCOLOPENDRA, *Sendtnera scolopendra, Nees.* Hook. Musc. Exot. t. 40. Fl. N.Z. ii., 153. Stems 3-5in. long, erect, pinnate, branches deflexed, attenuated to the tips, flageliform, naked, often rooting. Leaves and stipules closely imbricate, scarious, rigid, oblong, 2-fid; segments diverging, again 2-fid, acuminate, diaphanous. Perianth in the axils of lateral branches, obovate, 4-fid, covered with imbricating leaves. Hook. Handbook, Fl. N.Z., 528. Pl. xxi.

Summit of Mount Wellington, *Oldfield, R.A.B.* (New Zealand, Lord Auckland's Group, Campbell's Island.)

22. LEPIDOZIA, *Nees.*

Fruit lateral.

Leaves and stipules deeply cleft; perianth near base of stem, 3 gonous.

Stems creeping, often very minute and slender, throwing out rootlets from the ventral surface. Leaves incubous, obscurely distichous, 4-toothed or 4-cleft. Stipules present. Fruit lateral. Involucral leaves numerous, short, broad, toothed. Perianth near base of stem, elongate, 3 angled, the faces hollow; mouth toothed. Calyptra membranous. Capsule or slender fruitstalk, globose; elaters with 2 spiral fibres. Antheridia solitary in the bases of conduplicate 2-3 cleft perigonial leaves.

A large genus of minute leaved plants, often themselves minute and almost microscopic. They are exquisitely beautiful objects over dark ground illumination in the microscope.

I. Leaves 3-5 fid, not toothed nor serrate.

*Stems flexuose, wiry, 1-4 in. long, much pinnately or bi-pinnately branched; branches decurved, attenuated.

1. L. microphylla.
2. L. procera.
3. L. quadrifida.
4. L. capilligera.
5. L. prænitens.
6. L. Gottscheana.
7. L. lævifolia.
8. L. pendulina.
9. L. centipes.
10. L. glaucophylla.

**Stems usually less than 1in. long, capillary, vaguely branched.

11. L. Lindenbergii.
12. L. capillaris.
13. L. cupressina.
14. L. patentissima.

II. Leaves 3-5 fid and also toothed.

15. L. tenax,
16. L. ulothrix.

1. L. MICROPHYLLA, *Lindb. Jungermannia microphylla*, Hook. Musc. Exot. t. 80. Fl. N.Z. ii. 85. Stems 1-2in. long, pinnately branched, branches pendulous with capillary tips. Leaves minute, distant, appressed, palmately 4-partite; involucre oblong-ovate, 2-4 fid. Stipules quadrate, flat, deeply 4-fid. Perianth cylindric, attenuate, incurved, obscurely toothed. Syn. Hep. 202. Pl. xxii.

Acheron River, *Gunn*. (New Zealand.)

2. L. PROCERA, *Mitten*. Stems erect, simply pinnate; branches attenuate, decurved; leaves minute, erecto-patent, remote, ovate-quadrate, quadrifid; laciniæ acute; stipules smaller, sub-quadrate, quadrifid.

Pale brown, stem 6 in. long, slender, simple Branches slender, attenuate, areolation small.

Similar in appearance to some states of *L. microphylla*, but differing in the narrow outline of its stems (owing to the shortness of the branches), and the leaves are more deeply quadrifid with more acute laciniæ, which are not collected together at their apices, but stand out from each other. Fl. Tasm. ii., 251, t. 180. f. 1. Pl. xxii.

Tasmania, *Gunn.* Mount Wellington, amongst *Plagiochila retrospectans* and *L. Ulothrix*, *Oldfield.*

3. L. QUADRIFIDA, *Lindb.*; *Gottsche.* Sp. Hep. Lepidozia. p. 23. t. 4.; G. L. and N. Syn. Hep. p. 203. Pl. xxii.

St. Patrick's River, *Gunn*, Plains rivulet, *R.A.B.*

4. L. CAPILLIGERA, *Lindb.* Fl. N.Z. ii., 145. Stems 1in. long, erect, simply pinnate; branches with capillary tips. Leaves olive-brown, sub-imbricate, ½ vertical or horizontal, and stipules, obovate-quadrate or cuneate, 4-fid to the middle, lobes divaricate, subulate. *L. tetrapila*, *Tayl.* in Lond. Journ. Bot. 1846. 370; Syn. Hep. 716. Pl. xxii.

Tasmania, *Labillardiere*, (H 6. Mont.) The Falls, *Archer.* Castle Forbes Bay Rivulet, *Oldfield.* Mount Wellington, *Mossman.* (New Zealand.)

5. L. PRÆNITENS, *Lehm.* and *Lindb.*, Fl. N.Z. ii., 145. Stems procumbent, alternately 2-pinnate. Leaves sub-imbricate, ½ vertical, obovate-cuneate, 4-fid, segments lanceolate. Stipules patent, transversely quadrate, 4-partite; lobes divaricate. Perianth sub-sessile, curved; mouth sub. 4-toothed. Syn. Hep. 206. Pl. xxiii.

Brown's River, *Oldfield*, (New Zealand, Lord Auckland's Group.)

6. L. GOTTSCHEANA, *Lindb*, Fl. N.Z. ii., 145. Stems procumbent, irregularly sub-pinnately branched. Leaves approximate, sub-horizontal, flat, obcuneate or quadrate, 4-fid, lobes subulate. Stipules remote, 4-partite. Perianth as in *L. prænitens.* Syn. Hep. 206.

This and the two preceding seem not essentially different. Hook. Handbook. N.Z. Pl. 521.

Tasmania, *Labillardiere*, amongst *Sarcomitrium cochleatum.* St. Patrick's River, *Gunn.* On dead wood, Grass Tree Hill, *Oldfield.*

7. L. LÆVIFOLIA, *Hook. f. and Tayl.* Fl. Antarct. 157, Fl. N.Z. ii., 146. Stems 1—2in. long, excessively pinnately branched; branches deflexed. Leaves yellow or olive-brown, sub-vertical, rather close-set, sub-

imbricate on the branches, ovate-cordate, 3-5 fid; lobes flat or incurved; involucre small. Stipules distant, spreading, ovate, cordate or orbicular, 4-fid. Perianth as in *L. prænitens*. Syn. Hep. 208. Pl. xxiii.

Back River Gully, with fruit, *Oldfield;* Cheshunt, *Archer;* Gullies, Mount Wellington, *R.A.B.*

8. L. PENDULINA, *Lindb.* Stems 2-3in. long, erect, 2-pinnate; branches pendulous, fascicled; tips capillary. Leaves imbricate, sub-verticle, obliquely secund; stipules orbicular-ovate, convex, deeply 4-fid; segments lanceolate, conniving, somewhat waved. Syn. Hep. 208; Lindb. and G. Sp. Hep. 49. t. 7. *Jungermannia pendulina*, Hook. Musc. Exot. t. 60. Pl. xxiii.

North-West Bay, Gully, and Castle Forbes Bay Rivulet, *Oldfield, Archer.*

From the Ploughed Fields, Mount Wellington, *R.A.B.* (New Zealand.)

Fig. 1, *L. pendulina*, nat. size. Fig. 2, portion of stem with leaves. Fig. 3, leaf. Fig. 4. stipule. Fig. 5, extremity of a leaf, to show the reticulation. Musc. Exot.

9. L. CENTIPES, *Tayl.; Lindb.* and *Gottsche.* Sp. Hep. *Lepidozia*, p. 29, t. 5; G. L. and N. Syn. Hep. p. 204. Very minute; light green. Pl. xxiv.

Tasmania, *Spence.* On damp ground, Kermandie Rivulet, South Huon, *Oldfield*, near Hobart. *R.A.B.*

10. L. GLAUCOPHYLLA, *Tayl.* Stems procumbent, bipinnate; branches attenuated on stems 1, 2, or 3in. long. Leaves approximate, ½ vertical, widely ovate-quadrate, quadrifid, laciniæ acuminate; stipules patulate, ovate-quadrate, quadrifid. Tayl. Lond. Journ. Bot. 1844. 580. Syn. Hep. p. 207. Pl. xxiv.

Pale glaucous green; leaves divergent, laciniæ short, acuminate; areolation minute, nearly opaque.

Readily distinguished from all allied species by its glaucous white colour. Fl. Tasm. ii., p. 231.

Tasmania, *Gunn.* Back River Gully, New Norfolk, Castle Forbes Rivulet, South Huon, *Oldfield.* Rivulet at Cheshunt, and amongst *Sphagna*, Western Mountains, *Archer.* Plains Rivulet, *R.A.B.*

11. L. LINDENBERGII, *Gottsche.* Stems creeping, 1-2 pinnately branched; branches crowded, spreading. Leaves pale yellow, green, distant, distichous, sub-vertical, spreading, obovate-quadrate; segments capillary, articulate, straight and incurved; involucre

unequally divided. Stipules orbicular-ovate, 3-5 partite. Perianth cylindric, elongate; mouth contracted, ciliate. Fl. N.Z. ii., 146; Syn. Hep. 213. G. L. and N. Sp. Hep. Lepidozia, 63. t. 12; Lindb. and G. Sp. Hep. 66. t. 11. *L. tetradactyla*, Fl. Antarct. 158.

A few slender stems creeping amongst *Chiloscyphus conjugatus*, Acheron River, *Gunn*. St. Crispin's Well, Mount Wellington, *R.A.B.* (New Zealand.)

L. CAPILLARIS, *Lindb.* Fl. NZ. ii., 146. Stems ½in. long, creeping, capillary, pinnately branched or decompound; branches diverging. Leaves vertical, sub-imbricate, obovate-quadrate; minute stipules 3-4 partite; segments lanceolate, subulate, incurved, obtuse; involucral shortly incised, ciliate, margins toothed. Perianth with the mouth ciliate. Hook. Handbook Fl. N.Z. 522; Syn. Hep. 212. *L. hippuroides*, Hook. F. and Tayl. Fl. Antarct. 159. t. 65. f. 7. *I. nemoides*, Tayl. in Hook. Lond. Journ. Bot. 1845, p. 84. Pl. xxiv.

Bare ground in bogs; Brown's River, *Oldfield*. Wellington Falls, *R.A.B.* (New Zealand, Lord Auckland's Group, Jamaica, South Africa.)

13. L. CUPRESSINA, *Lindb.* Forming dense cream-coloured cushions on ledges of rocks and trees. Stems distinctly and irregularly branched, or densely pinnately branched. Leaves cordate, quadrifid, with the lower tooth bent inwards. Stipules 4-toothed. Cook's Brit. Hep. 16. Pl. xxiv.

Tasmania, *Dumont d'Urville*, Herb. Montagne and Nees. (Ireland.)

14. L. PATENTISSIMA.—Stem minute, short, slender, ½in. long, creeping, tufted, sub-pinnately branched; branches short. Leaves olive-green, imbricate, rather close-set, obliquely spreading, cellular, obovate-quadrate; narrowed at the base, 3-5 fid; segments shortly ovate-subulate, straight or incurved. Stipules similar, minute. Hook. Handbook Fl. N.Z., 522; Hook. f. and Tayl., Fl. Antarct. i., 158 t. 65 f. t., Syn. Hep. 204. Pl. xxv.

Gullies, Mount Wellington, *R.A.B.* (Lord Auckland's Group.)

15. L. TENAX, *Lindb.* Stems pinnately compound or decompound; branches incurved; tips convolute. Leaves imbricate, vertical, ovate, concave, cauline appressed, 8-partite, sides lacerate and ciliate, those of the branches spreading, 3-4 fid; segments subulate. Stipules ovate, flat, 4 or 5 parted, ciliate and lacerate

at the base. Fl. Antarct., 158; Greville in Annals of New York Lyceum, i., 277, t. 23. Syn. Hep. 212; Hook. Handbook Fl. N.Z. 523.

With *Symphyogyna flabellata* and *Chiloscyphus laxus*, St. Patrick's River, *Gunn.* Brown's River, Castle Forbes Bay Rivulet, South Huon, *Oldfield.* Gully, Mount Wellington, *R.A.B.* (Lord Auckland's Group, Australia.)

16. L. ULOTHRIX, *L. albula*, Hook. f. and Tayl. Fl. Antarct. 47, p. 65, f. 6. Stems ½-1in. long, procumbent, subpinnately branched; branches decurved, narrowed to the tips. Leaves yellow or greenish-white, pellucid, densely imbricate, very broad, amplexical, spreading, very concave, cellular, obliquely-oblong, 4-fid, and deeply incised all round; dorsal margin dilated; laciniæ entire or 2-fid, incurved. Stipules large, orbicular, concave, irregularly deeply 6-8 toothed. Hook. Handbook Fl. N.Z. 523; Syn. Hep. 211. Pl xxv.

Tasmania, *Fraser.* North-West Bay Gully, and about Springs, Mount Wellington, *Oldfield.* Oven's Creek, *Archer.* Gullies, Mount Wellington, abundant, *R.A.B.* (Australia, Lord Auckland's Group.)

23. MASTIGOBRYUM, *Nees.*

Without an inferior lesser lobe.

Perianth leafy, fruit lateral.

Leaves and Stipules entire, or with apices truncate, dentate; perianth in the lower part of the stem; 3-gonous.

Stems creeping and rooting or ascending, large, sparingly branched, giving off numerous filiform leafless shoots. Leaves distichous, incubous, usually 3-fid at the apex. Stipules toothed, often connate with the leaves above them. Fruit (and antheridia) terminal, on short proper branches, arising from the bracts of the stipules. Involucral leaves small, narrow, incised at the apex. Perianth elongate, 3-angular; mouth 3-toothed. Calyptra membranous. Capsule globose, on a slender fruit-stalk; elaters with 2 spiral fibres. Antheridia 2, in the axil of each perigonial leaf.

A tropical and sub-tropical genus, rare in Europe and North America, most abundant in Australasia. The species are often broad and flat, some resembling *Lophocolea* in general habit, but the stipules are connate with the leaves above (not below) them.

1. M. DIVARICUM, *Gottsche*, L. and N. Sp. Hep. p. 19, n. 14, t. v. f. 1; Syn. Hep. 219, v. 16; *var Muellire*, Gottsche in Linn. t. t. 28, p. 556, n. 23. Frag. Phyt. Austral. Fv. m. p. 60.

Mount Wellington, Tasmania, (Australia.)

Stipules quite free from the leaves, leaves 2-dentate.

2. M. COLENSOANUM, *Mitten.* Fl. N.Z. p. 147, plate 100, f. 3. Small, stem 1in. long, procumbent, dichotomous, stoloniferous. Leaves pale green, membranous, spreading, flat, imbricate, oblong, 2-dentate, smaller tooth on the ventral side; sinus acute; dorsal margin arched, ventral straight. Stipules appressed, minute, 3-toothed Pl. xxvi.

Tasmania, *Oldfield*, (New Zealand, Australia.)

Stipules quite free from the leaves, leaves 3-dentate.

3. M. MONILINERVE, *Nees.* Fl. N.Z. ii., 148. Stems procumbent, dichotomous. Leaves approximate, ½ vertical, spreading, convex, obliquely oblong, 3-dentate; ventral margin with a band of large translucent cells. Stipules close-set, orbicular-ovate, crenulate. Perianth plicate above; mouth toothed. Syn. Hep. 223. Pl. xxvi.

M. ECHINATUM, *Gottsche*, L. and N. Syn. Hep. 218.

Tasmania, *Labillardiere.* The Snug, Huon, with *Lophocolea echinella*, *Oldfield.* (New Zealand, Australia.)

Stipules connate on both sides with the leaves above them, apex crenate.

4. M. INVOLUTUM, *Lindb.* Fl. N.Z. ii., 148. Large, stems 2-3in. long, forked; branches dense. Leaves densely imbricate, diverging and deflexed, obliquely oblong, concave; apex 3-dentate, incurved, or involute. Stipules sub-orbicular, repand; apex crenate, reflexed, connate with the leaves above them. Syn. Hep. 221. Montagne in Voy. au Pôle Sud. t. 18. f. 2.

Herpeteum involutum, *Montagne*, Cent. IV. N. 30.

Kangaroo Bottom, *Hooker.* Goat Hills, *Oldfield.* (New Zealand, Lord Auckland's Group.)

Stipules connate on both sides with the leaves above them, dentate or multifid.

5. M. NOVÆ HOLLANDIÆ, *Nees.* Fl. N.Z. ii., 148. Stems 2-3in. long, procumbent, dichotomous; branches equal, often recurved. Leaves imbricate, divergent, flat or convex, ovate-oblong, subfalcate, unequally serrulate, erose or dentate at the apex; involucral appressed, inciso-serrate. Stipules close set, orbicular-quadrate, dentate or multifid, usually connate with the leaves

above them. Perianth cylindric-ovate, narrowed upwards and plaited; mouth dentate. Syn. Hep. 221 and 717.

M. adnexum, *Lehm.* and *Lindb.* Mont. Voy. au Pôle Sud, 243. Pl. xxvi.

Var. α, Tasmania, *Fraser.*

Var. γ, St. Patrick's River, and near Yorktown, *Gunn.* Dense tufts on rotten wood; Goat Hills, New Norfolk; and Springs, Mount Wellington, Brown's River Gully, *Oldfield.* Cheshunt, *Archer.* Mount Wellington, *R.A.B.*

24. RADULA, *Nees.*

Leaves incubous, with inferior lobule.

Lobule plane, fruit terminal.

No Stipules.

Stems erect or creeping, pinnately branched. Leaves distichous, incubous, 2-lobed; ventral lobe small, inflexed, rooting at the base. Stipules 0. Inflorescence monoicous, Fruit in the fork or apex of short branches. Involucral leaves 2, 2-lobed. Perianth terete or compressed; mouth dilated, calyptra pyriform, persistent, bursting below the apex. Capsule on a short fruitstalk, ovoid; elators with 2 spiral fibres; spores large. Antheridia in the inflated bases of perigonial leaves.

1. R. BUCCINIFERA, *Hook. f.* and *Tayl.* Fl. N.Z. ii., 154. Stems 1in. long, prostrate, pinnate. Leaves yellow-green or brown, sub-imbricate, spreading, rounded at the apex, upper lobe obovate-orbicular, convex, its apex incurved, lower minute, trapezoid, appressed. Perianth at length axillary, very long, sub-cylindric, compressed above, mouth dilated, quite entire. Syn. Hep. 261.

   St. Patrick's River, *Gunn.* On rocks, Back River Creek and Brown's River, *Oldfield.* Rivulet at Cheshunt, *Archer.* Tasmania, *Stuart.* Ulverstone, N.W. Coast, *Miss Lodder.* Rivulet, Mount Wellington, *R.A.B.*

2. R. ANEURISMALIS, *Hook. f.* and *Tayl.* Stems slender, vaguely branched; branches short, slender, subsecund, leaves lax, erecto-patent, rotund, very concave, entire, inferior lobe tumid, apex incurved.

   Creeping, scattered, pale olive-brown. Stems scarcely ½in. long, branches very slender, their leaves minute. Leaves cup-shaped, with an obtuse angle at the point most distant from the stem. The lobule has a tumid base, whilst its top lies flat on the inner part of the leaf, and has a single angle pointing outwards. The perigonia occur in the course of the shoots, and are remarkably long and large in proportion to the size of the stems. The present is the minutest of the *Radulæ* yet observed, and is readily distinguished by its peculiar perigonia.—Dr. Taylor.

It is just possible that it is the male plant of *R. Novæ Hollandiæ*. Fl. Tasm. p. 235.

On *Metzgeria furcata*, *Hooker*.

3. R. NOVÆ HOLLANDIÆ, *Hampe*; G. L. and N. Syn. Hep., p. 254.

Tasmania, *Herb. Stuart*, *Gottsche (Plantæ Mullerianæ)*, Australia.

4. R. PHYSOLOBA, *Mont*, Fl. N.Z. ii., 154. Stems procumbent, rigid, flexuous, much pinnately branched. Leaves yellow-green or brown, sub-vertical, orbicular, convex, quite entire; apex inflexed; lobule large, inflated below the apex, retuse or emarginate. Perianth terminal or axillary, long, cochleariform, truncate. Syn. Hep. 254. Mont. Voy. au Pôle Sud. 256 t. 17 f. 4. *L. aquilegia*, Hook. f. and Tayl. in Lond. Jour. Bot., 1846, 291. Pl. xxvi.

Near Cumming's Head, Western Mountains, *Archer*. (New Zealand, Lord Auckland's Group.)

25. LEJEUNIA, *Libert*.

Incubous leaves with inferior lesser lobe.

Lobule plane, fruit terminal.

Perianth obovate, 3-6 plicate, mouth a tubular beak, *Mitten*.

Stems prostrate or creeping. Leaves distichous, incubous. Stipules usually present. Inflorescence diœcious. Fruit lateral or terminal on proper branches. Involucral leaves 2, 2-lobed. Perianth ovoid or obovoid, terete or angled; angles winged or crested; mouth 3-4 lobed. Calyptra obovoid, persistent, bursting below the apex. Capsule on short fruitstalk, globose, pale, 4-cleft halfway; elaters adhering to the valves, erect, upper end truncate with 1 spiral fibre. Antheridia as in *Frullania*, on proper branches.

A very large tropical and temperate genus, of which 236 species were published in the "Synopsis Hepaticarum" in 1844, and many have been added since. Hook. Handbook N. 2 Fl. 531.

The stipules are sometimes absent. *Mitten*.

Stipules rather large, conspicuous.

1. L. TUMIDA, *Mitten*, Fl. N.Z. p. 157. Pl. 103, f. 3. Stems very slender, $\frac{1}{4}$ to $\frac{1}{2}$in. long, much branched. Leaves bright green, loosely imbricate, cells pellucid, very convex, spreading, rather horizontal, obliquely ovate-oblong, rounded at the apex, quite entire; lobule small, inflexed, inflated; involucral with a longer obtuse lobule. Stipules orbicular, acutely 2-fid. Perianth obovoid, tumid, retuse, inflated and obscurely 5-angled at the summit. Pl. xxvii.

Tasmania, *Gunn.* Gullies, Mount Wellington, clothing the lesser twigs of trees with a mantle of green, *R.A.B.* Launceston, *Miss Oakden.* (New Zealand, Australia).

Stipules minute.

2. L. RUFESCENS, *Lindb.* Syn. Hep. 366; *L. implexicaulis, Hook* f. *Tayl.* Fl. Antarct. 165; Syn. Hep. 376; *L. mimosa* and *L. albo-virens, Hook* f. and *Tayl.* Fl. Antarct. 166. t. 66. f. 4; Syn. Hep. 377 and 387; Fl. N.Z. ii., 158. *L. implexicaulis.* Stems $\frac{1}{4}$ to $\frac{3}{4}$in. long, creeping, branched. Leaves olive-green, cellular, imbricate, spreading or sub-erect, oblong-obovate, orbicular-ovate or ovate, convex; apex incurved, obtuse sub-acute or truncate; lobule small, involute. Stipules usually narrower than the branch, more or less orbicular, acutely 2-fid. Perianth lateral, sessile, compressed, with one keel on the dorsal and two on the ventral side. Pl. xxvii. *L. implexicaulis, mimosa, albo-virens,* and *primordialis,* Lond. Journ. Bot. 1844, 397, 398, and 1845, 92 f.

Probably a very common Southern species (of which *L. primordialis* is an exceedingly small variety), and the representative of the European *L. serpyllifolia.* Hook. Handbook. Fl. N.Z. 533 N.

Creeping over *Hypnum extenuatum,* St. Patrick's River, *Gunn.* On rocks, north side of cataract, Launceston, *Archer.* (New Zealand, Lord Auckland's Group, Campbell's Island, Fuegia.)

Stipules half as large as the leaves.

3. L. GUNNIANA, *Mitten.* Stem creeping, vaguely branched. Leaves imbricate, oblong-ovate, obtuse, lobule small, apex involute, minutely bidentate. Stipules large, orbicular, bidentate, sinus acute. Lobule of the involucral, lanceolate, acute, stipule oblong-obovate. Perianth oblong, retuse, compressed, acute pentagonal; upper angles crenulate with the swollen cells. Pl. xxvii.

Dirty brown. Stem $\frac{1}{2}$in. long, tufty, areolation of the leaves, large, pellucid.

A small species, chiefly remarkable for its lax areolation, and for the minutely crenulate upper edges of the carinæ of its perianth. In size it resembles *L. rufescens*, but is much more flaccid, and all the specimens are of a dirty brownish colour.

Tasmania, *Gunn;* Brown's River, *Oldfield.*

Nearly allied to *L. tumida*, if not identical. Hook.

4. L. TASMANICA, *Gottsche.* Stems creeping, much branched. Leaves imbricate, ovate, obtuse, entire; lobule rather large, inflated, apex immarginate, truncate. Stipules 1-3rd as large as the leaves, ovate-cordate, erect, distant or near to the leaves, convex, bifid to about the middle, segments lanceolate. Gottsche, "Plantæ Mullerianæ."

Intermediate between *L. tabularis* and *L. serpyllifolia*, nearest to the former, smaller stature, and differing in respect of smaller stipules to the leaves.

This appears to be nearly allied to *L. tumida*, and may even be identical with it. Fl. Tasm. ii., 236.

Creeping amongst *Radula buccinata*, *Stuart.*

Lower lobe of leaf scarcely distinct from the larger.

5. L. SERPYLLIFOLIA, *Libert*, Syn. Hep. 374, of a compact habit, forming pale yellowish-green patches. Stems from $\frac{1}{2}$ to $\frac{3}{4}$in. in length, slender, irregularly branched. Leaves overlapping, arranged in two rows. The lower lobe resembling an overlapping base to the larger lobe, and is scarcely distinct from it. Stipules roundish, deeply notched at the apex. Calyx pear shaped, with five longitudinal angles; the mouth is small and protruding; capsule, spherical and white. Cook. Brit. Hep. 20. Pl. xxvii.

Cheshunt, or trees, *Archer.*

These specimens agree in all respects with European examples of the species, and possess the same property of staining the paper on which they are preserved of a dull leaden colour. Fl. Tasm. 236, n.

Stipule at the base of every leaf.

6. L. LYRATIFOLIA, *Hook. f.* and *Tayl.* Stems minute, scarcely 3 lines long, slender, procumbent, vaguely branched, branches few and irregular. Leaves lax, patent, sub-quadrate (harp-shaped), their outer margin recurved. Lobules oblong, involute; stipules bipartite, segments lanceolate, divaricate. Perigonia in

short terminal spikes. Perichætia of a pair of erect leaves with unequal acute segments, and an oblong bifid stipular one. Calyx exserted for half its length. Allied to *L. hamatifolia, Nees;* yet the acumination of one angle of the leaf is far shorter, and the leaves more patent and less imbricated. Pl. xxvii.

Patches of very pale brownish-olive. Lond. Jour. Bot. 1846, 393. Syn. Hep. 756. Fl. Tasm. ii., 236, p. 180, f. 4.

A minute species whose place is amongst those with a stipule at the base of every leaf, and generally with a few enlarged cells, giving their leaves a more or less regularly dotted appearance.

Tasmania, creeping over *Parmelia diatrypa, Hooker.*

7. L. LATITANS, *Hook. f.* and *Tayl.* Flor. N.Z. ii. 159. Stems minute, creeping, slender, 1-4th to 1-3rd in. long. Leaves pale green, distant, erecto-patent, ovate, acute, or acuminate; margins papillose; lobule ovate, involute, half the size of the leaf; involucral united with the obovate involucral stipule. Stipules minute, 2-fid; segments lanceolate, obtuse. Syn. Hep. 345. Fl. Antarct., 166.

Mount Wellington, *R.A.B.*

26. TRICHOCOLEA, *Nees.*

Leaves capillary, multifid.

Stems erect or inclined, tufted, much branched, very soft, white and woolly to appearance. Leaves incubous and distichous, but clothing the stem, deeply palmately divided, the lobes laciniated. Stipules present. Fruit in the forks of branches. Involucral leaves many, connate into a hairy tube, which is adnate with the calyptra, coriaceous, mouth truncate. Perianth 0. Capsule oblong, on a slender fruitstalk; elaters with 2 spiral fibres. Antheridia in the axils of leaves on the upper side of the stem.

A small genus of very beautiful *Hepaticæ*, with the leaves so much ciliate as to give the whole stem a woolly appearance. Hook. Handbbook Fl. N.Z. 527.

1. T. TOMENTELLA, *Nees.* Stems 2-5in. long, 3-pinnate. Leaves white, 2-partite; segments capillary, multifid; ventral lobe smaller, inclined forwards. Stipules subquadrate, 4-partite, capillaceo-multifid. Syn. Hep. 237. *T. mollissima,* Fl. Antarct. 161; Syn. Hep. 237; *T. tomentella, γ javanica,* Syn. Hep. 721. Pl. xxviii.

Growing in dense pale green patches, several feet in extent, stem from 2 to nearly 4in. in length and nearly erect, and very much branched. Leaves divided into two unequal portions, each of which is divided and sub-divided in a compound manner into thread-like branching segments. Stipules cleft into a number of narrow lobes. Fruit arising from the forks of the principal divisions of the stem. There are no true perichætial leaves. The calyx widens towards the mouth and is covered on the outside with minute slightly branched hairs. Cook Brit. Hep. 17.

Forest near Macquarie Harbour, *Gunn.* Port Arthur, *Oldfield.* Ulverstone, *Miss Lodder.* Launceston, *Miss Oakden.* Wellington Falls, *Rodway. R.A.B.* (Australia, New Zealand, Lord Auckland's Group, Campbell's Island, India, Europe, America.)

27. MASTIGOPHORA, *Nees.*

Leaves incubous, with an inferior lesser lobe, lobule plane, fruit lateral, perianth contracted at the mouth, compressed plicate. Quite different from *Sendtnera* in its lateral fruit, perianth not overlaid, and free calyptra; the habit is more that of *Madotheca.* Mitten in Hook. Handbook Fl. N.Z. 754.

1. M. FLAGGELLIFERA, *Sendtnera flaggellifera, Nees.* Stems 2-3in. long, erect, pinnately branched; branches attenuate, flaggeliform. Leaves greenish-brown, 2-farious, horizontal, unequally 2-fid; lobes conduplicate; dorsal larger, acute, often slightly toothed; ventral more lanceolate, entire or 2-fid. Stipules ovate, 2-partite, rarely 4-fid, toothed at the base. Syn. Hep. 242 Hook. Musc. Exot. t. 59. Fl. N.Z. ii., 153. Pl. xxi.

Tasmania, *Gunn.* Mount Wellington, *R.A.B.* (New Zealand.)

28. FRULLANIA, *Raddi.*

Fruit lateral, lobe inflated galeate. Perianth 3-6 plicate or terete, with a tubular beak, *Mitten.* Stems prostrate or creeping, flattened, usually purplish-brown. Leaves distichous, incubous, convex, quite entire, with a simple or rarely double lobule at or near the base, which is erect or appressed, club-shaped, lunate, trumpet-shaped, or inflated. Stipules sometimes rooting at the base, usually 2-fid.

Inflorescence diœcious. Fruit terminal on proper branches. Involucral leaves two or three, not auricled. Perianth ovoid or obovoid, terete or 3-4 angled; mouth contracted, tubular. Calyptra pyriform, persistent, bursting below the apex. Capsule on a very short fruitstalk, globose, 4-cleft half-way; elaters adhering to the valves, truncate, with one spiral fibre; spores large, irregular. Antheridia in the saccate bases of closely imbricate 2-lobed perigonial leaves. Pistillidia 2 or 4 in each perianth.

I. Lobule more or less falcate or acuminate.

* Stipules 2-fid.

1. F. falciloba.
2. F. deplanata.

** Stipules 2-fid, sub-dentate.

3. F. clavata.

*** Stipules 2-fid, dentate.

4. F. monocera.
5. F. proboscidiphora.
6. F. Hampeana.

II. Lobule clavate.

7. F. congesta.
8. F. megalocarpa.
9. F. diplota.

III. Lobule $\frac{1}{2}$ orbicular.

10. F. reptans.

Note.—No description of *F. Gaudichaudii* available.

1. F. FALCILOBA, *Hook. f. and Tayl.* Stems 1-2 inches long, branched. Leaves brown, ovate or orbicular-oblong, slightly incurved; lobule large, elongate, falcate; involucral 2-lobed; lobule much cut. Stipules orbicular-oblong, 2-dentate; involucral large, 2-fid, 1-dentate on each side. Perianth convex on the dorsal, and having a broad keel on the ventral face. Hook. Handbook Fl. N.Z., 536. Syn. Hep. 423. Pl. xxviii.

Patches wide, reddish rusty brown. Stems 3in. long, alternately branched; the branches bearing calyces shorter and more tumid. Leaves convex, closely imbricated. Perigonia are short obtuse spikes, sometimes almost round.

The curved tubular tops of the lesser lobes reach below the inferior margin of the upper lobes, which is a very distinctive mark, coupled with the short perigonia. Lond. Journ. Bot. 1844, 581.

Tasmania, *Gunn.* Penguin, and moist rocky banks, Risdon, *Hooker.* Dense mats on the south side of rocks, Johnny's Creek, rocks by the seaside, Southport, Kermandie Rivulet, and Mount Wellington, *Oldfield.* Jackey's Plain Creek, *Archer;* gathered also by *Stuart.* On rocks, Proctor's-road, Mount Nelson, Cascades Rivulet, and Springs, Mount Wellington, *Miss S. Gerard, A. J. Taylor, R.A.B.*

2. F. DEPLANATA, *Mitten.* Fl. N.Z. ii., 161, t. 104, f. 3. Stems 1in. long, pinnate. Leaves red-brown, diverging, imbricate, orbicular-ovate or oblong; apex rounded, incurved; lobule large, falcate, recurved, acuminate; involucral ovate, acute, entire or toothed, with a lanceolate toothed lobule. Stipules suborbicular, shortly 2-fid; involucral elongate, laciniate. Perianth obcordate, elongate, flattened at the top, retuse, mucronate, smooth. Hook. Handbook Fl. N.Z. 536, Pl. xxviii.

At the roots of trees, Brown's River Gully, and Johnny's Creek, *Oldfield.* Cheshunt, *Archer.* On trees, Mount Wellington, growing with *F. monocera*, from which it is at once distingnished by its flat, smooth perianth, *F. monocera* having a spiny one (*Pearson*), *R.A.B.* (New Zealand).

3. F. CLAVATA, *Hook. f.* and *Tayl.*, Lond. Journ. Bot., 1845-88, G. L. et. N. Syn. Hep. 428. Stems procumbent, vaguely subpinnately branched, branches thickened at the apices. Leaves imbricate, rotundo-oblong, convex, entire, inferior lobe large, galeate, acuminate, decurved. Stipules round, 2-fid, sub-dentate Calyx almost immersed, obovate, biplicate, apex tubular; perichœtial leaves toothed on the ventral margin.

Scarcely quarter of an inch long, pale green, sometimes brownish purple. Stipules large, their emargination shallow and rounded. Auricles large compared with the leaves. The calyx, rising little out of the perichætium, is widest near the mouth, below which it is rather suddenly contracted. The lateral perichætical leaves have, besides a segment corresponding to the auricle of the leaf, an inner one which is lanceolate and dentate. Allied to *F. trinervis* L. et. L., but this is of a dark brown colour, has a more exserted three nerved calyx, the auricles are less acuminated, and the stipules more entire. Tayl. in Fl. Tasm. n. p. 237.

On *Nephroma cellulosa* Tasmania, *Herb. Tayl.*

4. F. MONOCERA, *Hook. f et. Tayl.* Lond. Journ. Bot., 1845-89; Syn. Hep. 418. Stems entangled, prostrate, vaguely branched. Leaves oblong-ovate, roundish, plane, entire; inferior lobe galeate, deflexed spiniform.

Stipules ovate-acuminate, bifid, dentate. Perianth terminal, obcordate, trigonous, angles hairy, mouth tubular.

Small tufts, whitish green. Stems $\frac{1}{2}$in. long, branched irregularly. Leaves closely imbricate, patent, auricles horn-shaped, sub-reflexed. Involucral, erect, dentate, with lanceolate lobule in small branches, almost hiding the perianth; angles of the perianth spinous, curved various.

This description agrees, excepting the angles of the perianth, very nearly with *F. proboscidophora.* Fl. Tasm., 237.

Tasmania, amongst other Hepaticæ, *Hooker.* On trees with *F. deplanata,* Mount Wellington, *R.A.B.*

5. F. PROBOSCIDOPHORA, *Tayl.* Stems vaguely pinnately branched. Leaves rotundo-ovate, entire ; auricles lunate-galeate, acuminate, point decurved. Stipules orbicular, bifid; segments bi-tri-dentate; involucral ovate, acute, dentate; auricles acuminate, margins recurved to the base of the teeth, laciniate; stipules bipartite, laciniate, lanceolate, dentate. Perianth obovate, obtuse, apiculate, dorsal convex, ventral one-keeled, angles undulate. Lond. Journ. Bot., 1846, 402; Syn. Hep. 770. Pl. xxviii.

Brownish-red, whitish, scarious. Stems 1in., leaves of fragile texture. Auricles lunate-galeate from the margin, beaked. Stipules about 6-toothed. Perianth very fragile.

Very nearly allied to *F. Hampeana,* but a larger species, remarkable in the few specimens yet seen for the discoloration and scarious appearance of its leaves. Its habit appears to resemble that of *F. dilatata.* The perianth is everywhere smooth, except the angles, which are minutely undulate or sub-crispate. Fl. Tasm. 237 n.

On the bark of trees, Circular Head, *Hooker.* Cheshunt, *Archer.* On bark of trees, Mount Wellington, *R.A.B.*

6. F. HAMPEANA, *Nees.* Fl. N.Z. ii., 160. Stems pinnate. Leaves pale green, imbricate, $\frac{1}{2}$-vertical, sub-orbicular; lobule arched, deflexed, acuminate. Stipules sub-orbicular, 6-8 toothed, and 2-fid. Syn. Hep. 426.

Tasmania, *Hooker.* (Australia, New Zealand.)

7. F. CONGESTA, *Hook. f.* and *Tayl.* Stems tufty, procumbent, branched. Leaves imbricate, entire, ovate, sub-

apiculate. Lobule inflated, oblong. Stipules minute, ovate-rotund, bifid, not toothed. Perichætial leaves oblong, apiculate, entire, whitish at the tips.

The leaves have not enlarged cells at the base, as in *F. aterrima.*

Patches several inches wide, reddish-brown. Stems nearly 2in. long, irregularly yet somewhat pinnately branched; branches erecto-patent, curving upwards. Leaves concave, usually apiculate; the auricle reaches below the lower magin of the leaves, and is removed from contact with the stem. Stipules quite entire, with acutely bifid tops; they are scarcely wider than the stems. The barren perichætia have a rounded summit, which probably is altered in the calyciferous plant; the leaves are all erect, acuminate, and entire, the two lateral are oblong, each with an inner lobe whose margin is reflexed, the third or stipular leaf is divided deeply into two lanceolate, apiculate, entire segments.

The present is nearly allied to *F. aterrima,* which is, however, readily and exactly distinguished by its black colour, by its less acuminate perichætial leaves, and principally by its entire stipules. Lond. Journ. Bot. 1844. 396.

On the bark of *Fagus,* St. Patrick's River, *Gunn.* On trees, Oven's Creek, *Archer.* On cliffs, Mount Knocklofty; Sawpit Creek, Mount Wellington; Wellington Falls. R.A.B. (New Zealand, Lord Auckland's Group.)

8. F. MEGALOCARPA, *Hook. f.* and *Tayl.* Stems procumbent, loosely bi-pinnate. Branches slender. Leaves imbricate, oblong-ovate, acute, recurved, entire. Auricles oblong-clavate, parallel with the stem, a subulate style interposed between the auricle and the stem. Stipules minute, bifid. Perianth terminal, oblong, flat above, obtusely keeled below, mouth tubular; perigonia round, sessile.

Minute, scattered, brown. Stems scarcely 1in. long. Shoots of equal breadth. Both perigonia and calyces large in proportion to the shoots. It is more minute and slender than *F. exilis, Tayl.,* and readily distinguished by the style interposed between the auricle and the stem. Lond. Journ. Bot. 1846. 404.

Tasmania, on mosses; *Herb. Greville.*

9. F. DIPLOTA, *Tayl.* Lond. Journ. Bot. 1846. 405. Stems about 4 lines long, reddish, twisted, procumbent, sub-

pinnate, pinnules lax; leaves imbricate, amplexical, sub-quadrate-rotundate, entire, apices recurved, dorsal margin gibbous; very thin; auricle oblong from a narrow base, rising from the base of the leaf; a very short lanceolate style interposited between the stem and the auricle, the style scarcely more than half as long as the auricle. Stipules distant, rotundo-ovate, bifid, entire. The cells of the leaves near their junction with the stem are much larger than elsewhere. Pl. ii. f. 3. Pl. xxix.

On rocks, Proctor's Road, creeping amongst *F. falciloba*. *R.A.B.*

10. F. REPTANS, *Mitten*. Fl. N.Z. ii., 161. t. 104. f. 4. Stems small, slender, $\frac{1}{2}$in. long, creeping, pinnate. Leaves dark olive brown or red or blackish, loosely imbricate, spreading, orbicular-oboate; lobule very large, occupying the centre of the leaf and $\frac{1}{3}$ smaller, compressed, semi-orbicular, black; involucral with a lanceolate 1 dentate lobule. Stipules small, cuneate, 4 toothed; involucral 2-fid, 1-dentate on each side. Perianth oblong-obovate, mucronate; dorsal face flat, 2-keeled; ventral convex, 4-keeled; keels toothed above. Pl. xxix.

On very wet and rotten wood; Goat Hills, New Norfolk, *Oldfield*. On rocks Mount Nelson, *R.A.B.* (New Zealand.)

11. F. GAUDICHAUDII, *Mont.* Annals des Sc. Natur. 1836. p. 13, t. 2 f. 2; Syn. Hep. 435.

Tasmania, *Admiral d'Urville*, in *Herb. Montagne.*

29. POLYOTUS, *Gottsche.*

Fruit lateral, lobule inflated, galeate.

Involucral leaves overlying each other, adnate below.

Stems prostrate, pinnately branched. Leaves incubous, closely imbricate, auricled, the auricle often spinous, with a lamina of various shape between it and the blade of the leaf. Stipules usually 4-fid, the middle lobes clavate. Fruit lateral or axillary. Involucre of many confluent leaves. Perianth 0. Calyptra confluent with the involucre, its apex free, bearing sterile pistils near the apex. Capsule oblong, on short fruitstalk; elaters with 2 spiral fibres. Antheridia solitary in the axils of terminal perigonial leaves.

A small Australian, New Zealand, and Antarctic genus, not found in the Northern Hemisphere. Hook. Handbook, 528.

Leaves yellow-brown, stipules 4-partite.

1. P. CLAVIGER, *Gottsche.* Stem creeping, 3-4in. long, 2-pinnately branched. Leaves yellow-brown, closely imbricate, plane or convex, ovate-cordate, acute or apiculate, quite entire or more or less toothed; auricles clavate, with a large triangular lamina. Stipules 4-partite; segments with revolute margins, entire or toothed, 2 intermediate, often saccate. Involucre cylindric-ovoid, rough, with the adnate involucral leaves. Hook. Handbook, 529; Fl. N.Z. ii., 152; Syn. Hep. 215; Hook. Musc. Exot. t. 70. Pl. xxix.

Var. γ *Taylori*, cauline leaves toothed, spinous on the ventral margin. *P. Taylori*, Syn. Hep. 246.

St. Patrick's River, *Gunn.* Fork Creek, Mount Wellington, *Rodway.* (New Zealand, Campbell's Island, on alpine rocks).

Leaves dark purple, stipules 4-partite.

2. P. BRACHYCLADUS, *Gottsche.* Stems 3-4 inches long, 2-pinnate; branches very short. Leaves dark purple-brown, orbicular-cordate or broadly ovate, ciliate; auricles club-shaped, with no spine, saccate, purple, rarely flat and ciliate. Cauline stipules 4-partite, segments entire, toothed or cut, those of the branches with 2 intermediate auricles. Involucre conical, cariaceous, leafy; leaflets spinous-ciliate. Hook. Handbook, Fl. N.Z. 529; Syn. Hep. 247; Fl. Tasm. ii., 234 t. 180, f. 2. Pl. iii. f. 4; Pl. xxix.
Tasmania, *Neill*, 1824. *Spence* (*Herb. Greville*).

Cauline stipules 2-fid.

3. P. MAGELLANICUS, *Gottsche.* Stems creeping, 3-pinnate. Leaves brown-purple, imbricate, ovate-orbicular, spinous-ciliate; cauline auricles variable, clavate, saccate, setigerous or plane, with laciniate segments; laminæ larger, 3-angular, sometimes sub-cucculate. Cauline stipules orbicular-ovate, 2-fid, entire or ciliate, those on the branches 2-fid, lacerate or clavate. Involucre very large; leaves convolute, ciliate. Hook. Handbook Fl. N.Z., 529; Syn. Hep., 248; Hook. Musc. Exot. t. 115; Fl. N.Z. ii., 153. Pl. xxix.

St. Patrick's River, in great profusion, and finely fruiting, *Gunn.* Mount Wellington and Kermandie River, South Huon, *Oldfield.* Cheshunt, *Archer.* Gullies, Mount Wellington, abundant, *Rodway, Taylor, R.A.B.* (Australia, New Zealand, Campbell's Island, Fuegia.)

30. FOSSOMBRONIA, *Raddi.*

Complete perianth on upper side of frond ; leaves angular.

Frond prostrate, creeping, lobed pinnately ; lobes succubous, distichous, quadrate, 3-5 lobed, flaccid. Stipules 0. Fruit terminal, or lateral by the growth of the stem. Involucre of subulate leaves, adnate to the perianth, which is campanulate ; mouth large, lobed. Calyptra pyriform. Capsule on a short fruitstalk, globose, irregularly 4-valved ; elaters short, with 2-3 spiral fibres. Antheridia naked on the upper surface. Intermediate between the truly foliaceous and the frondose Hepaticæ.

1. F. PUSILLA, *Nees.* Minute ; stems $\frac{1}{4}$in. long, simple or forked. Leaves obliquely spreading, lower waved and lobed, upper crisped, 3-4 lobed or angled. Perianth obconic, toothed. Hook. Handbook, Fl. N.Z., 539 ; Syn. Hep. 467 ; Fl. N.Z. ii., 163. Pl. xxx.

Either detached or in tufts or patches. Stems prostrate, about a $\frac{1}{4}$in. in length, thick in proportion to their size, and unbranched, rooting from the under surface. Leaves closely set in two opposite rows, squarish and crisped or waved, with the extremity cut into from two to four irregular notches. Calyx large and campanulate, with a cleft in the margin, and the border lobed and waved. Five erect thread-like filaments surround the base.

Moist banks. Fruits in Autumn and Spring. Cook's Britt. Hep. 22.

Damp ground ; hillside, Woodburn, near Richmond, and wet crevices of rocks ; gully by Brown's River, *Oldfield.* Gathered also by *Mr. Archer.* Launceston, *Miss Oakden.* (Australia, New Zealand, America, Great Britain, Canary Islands, South Africa, Kerguelen's Island.)

2. F. INTESTINALIS, *Tayl.* Frond simple, prostrate, linear, flexuous. Lobes imbricate, ascending, alternate, tumid, convolute, incised and lobed ; perianth campanulate, crenate.

Fronds 3-4 lines long. Roots purple. Lobes when moistened, are very tumid, and have their incurved margins concealed. Capsule spherical, bursting irregularly. Seeds muricate, very black. Elaters longer than in *F. pusilla, Nees* ; besides the calyx is far smaller, and the convoluted lobes give to our plant a peculiar habit. Lond. Journ. Bot. 1846. 408 ; Syn. Hep. 469. 785.

Cheshunt, *Archer.* (New Zealand.)

31. ZOOPSIS, *Hook. f.* and *Tayl.*

Frond continuous, with alternate lateral projections.

Frond very slender, tufted, creeping, rigid, silvery green, almost capillary, sparingly branched, of large tumid, hexagonal cells; midrib stout, margins waved. Fruit lateral. Involucre of a few lanceolate scales. Perianth large, pedicelled, obvate-oblong, deeply laciniate. Hook. Handbook, Fl. N.Z. 540.

1. Z. ARGENTIA, *Hook. f.* and *Tayl.* Fl. N.Z. ii., 164. Fronds $\frac{1}{4}$ to $\frac{1}{2}$in, long. 1-20th in. broad, of 2 lateral and 1 antero-posterior series of cells surrounding a central cord of filiform cells; each of the marginal cells stands out like the tooth of a saw, and is sometimes terminated by a bristle. Syn. Hep. 473. 785. Journ. Linn. Soc. xiii., 188. Pl. xxx.

   The Bedchamber, New Norfolk, *Oldfield.* Frequent, intermixed with mosses and Hepaticæ, *Archer, R.A.B.* (Australia, New Zealand, Lord Auckland's Group.)

2. L. LEITGEBIANA, *Carr. et Pears.* *Cephalozia* (*Zoopsis*) *Leitgebiana.* For a complete illustration and description of this interesting plant, see communication from Messrs. Carrington and Pearson, in the current year's proceedings. Pl. xxx.

   Creeping amongst *Gottschea Lehmaniana*, Gully, Mount Wellington, *R.A.B.*

32. PODOMITRIUM, *Mitten.*

Complete perianth from the under side of a continuous frond.

Fronds erect from a creeping rhizome, stalked, oblong, with a stout midrib, membranous entire. Inflorescence diœcious. Involucre from the base of the frond on the ventral surface, shortly pedicelled, with a few scales at the base. Perianth tubular, much longer than the involucre. Calyptra included, bearing a few barren pistils, sub-campanulate; mouth lacerate. Capsule on a long fruitstalk, ovoid, 4-valved; elators filiform. Antheridia crowded on short pedicelled spikes.

The only species known; it is almost impossible to distinguish its barren fronds from those of the British *Steetzia Lyallii* and *Symphyogyna subsimplex.* *Mitten*, in Hook. Handbook Fl. N.Z. 540.

P. PHYLLANTHUS, *Mitten.* Fl. N.Z. ii., 164. Fronds 1in. high, oblong-lanceolate, dull green, obtuse, quite entire. Hook. Handbook Fl. N.Z. 541; *Symphyogyna*, Fl. Antarct. 167. *Jungermannia* Hook. Musc. Exot. t. 95. *Steetzia Phyllanthe* Nees. Syn. Hep. 478. Pl. ii., f. 4. Pl. xxxi.

Diplolæna cladorhizans, Hook., f. et Tayl. Patches loose, wide, very pale green in the younger parts, pale olive in the older. Fronds a little more than an inch long, lanceolate acuminate into an elongated point consisting almost entirely of the nerve, and radicating at the summit, and thence in the following season, sending out new fronds. The nerve is whitish and stout, though slender. The perichætium or outer calyx occurs at the base of the frond, and on its inferior side it is attached to the nerve; there are often three together, its exterior scales are rotund and deeply toothed, the interior scales are united at their bases, and have setacious cilia which are jointed; from the centre of these issues the true calyx, large in proportion to the size of the frond, slightly bent upwards, pale flesh-coloured, its mouth laciniated, and the lacinæ elongato-ciliate. Lond. Journ. Bot. 1844. 570.

St. Patrick's River, *Gunn.* South Huon, *Oldfield.* West-end Rivulet, *Archer.* Ulverstone, *Miss Lodder.* Mount Wellington, *Rodway, R.A.B.*

33. STEETZIA, *Lehmann.*

Complete perianth on upper side of a continuous frond.

Frond linear, more or less dichotomously branched, with a midrib. Inflorescence diœcious. Involucre at first terminal, dorsal by the subsequent elongation of the frond, seated on the midrib, cup-shaped, torn. Perianth tubular; mouth toothed. Calyptra as long, torn at the apex. Capsule on a slender fruitstalk, ovoid; elaters free, with 2 fibres. Antheridia dorsal, on the midrib, covered by minute fimbriated leaves. Hook. Handbook. p. 541.

1. S. pisicolor, *Hook. f. et. Tayl.* Crypt. Antarct. 138. Pl. 160, f. 7.

Diplolæna, Nees. Fronds erect, in loose tufts, dichotomous. Lobes linear, concave, obtuse, emarginate, nerved.

Fronds nearly 3in. high, pea-green in the younger and upper part, blackish below, two or three times dichotomous; the nerve in the dried state is very thin and whitish, but when the frond is thoroughly moistened, it swells and becomes of the same colour as the rest of the frond, while the lobes become concave or channelled, the branches separate at an acute angle. New fronds issue from the sides of the old by a bursting of the latter; such new shoots have rounded bases, which immediately send down roots, probably they separate in time and continue an independent existence. Lond. Journ. Bot., 1844, 479.

The fructification of this very distinct species has not yet been seen, but the fronds agree with those of *Steetzia* or *Symphyogynee.* Fl. Tasm. ii., 238.

York Town Rivulet and St. Patrick's River, *Gunn.*

2. S. LYELLII, *Nees.* Frond 2-3in. long, oblong or linear, crenulate or subserrate.

Blyttia, Syn. Hep. 475 (Steetzia 785); Hook. Britt. jung. t. 77; Fl. N.Z. ii., 165; Hook. Handbook Fl. N.Z. 541. Pl. xxxi.

Blyttia Lyellii. End growing in small loose patches. Frond about an inch in length, and scarcely a quarter of an inch in width, with a few short side lobes, or forked at the extremity, waved at the margins, occasionally slightly toothed, with a distinct midrib or nerve prominent on both sides. Fruit seated upon the nerve on the upper side near the middle of the frond. Calyx double, the outer shortest, much notched at the margin, the inner or true calyx, cylindrical, slightly toothed at the mouth, and torn on one side. This species is readily known from *Morckia hibernica*, by the presence of a decided nerve. Cook's Britt. Hep. 22.

Gullies on the sides of Mount Wellington, in crevices by the sides of rivulets, and Wellington Falls, *Rodway*, *R.A.B.* (Australia, New Zealand, America, Europe.)

34. SYMPHYOGYNA, *Mont. and Nees.*

No Perianth.

Calyptra on upper side of often stipulate frond; nerve narrow.

Fronds membranous, linear, dichotomously or flabellately branched, stalked, arising from a creeping rhizome, midrib stout. Inflorescence monœcious, or diœcious. Fruit from the nerves, usually at the forks. Involucre a toothed scale. Perianth 0. Calyptra smooth, exserted, coriaceous, fimbriated at the apex by abortive pistillidia. Capsule on a slender fruitstalk, 4-valved; valves often cohering by their apices; elaters with 2 spiral fibres. Antheridia in the midrib; perigonial leaves imbricate, tumid, incised, membranous.

1. S. FLABELLATA, *Montagne.* Stems 1 to 3in. high. Frond orbicular or reniform, 3-5 partite, in a fan-shaped manner, ½ to 1in. broad, segments linear, 2-fid, nerved, obtuse. Fruit in the forks. Involucral scales 2-lobed. Fl. N.Z. ii., 165; Syn. Hep. 481; *Jungermannia*, Hook. Musc. Exot. t. 13; Labil. Fl. Nov. Holl. t. 254. f. 1. Pl. xxxi.

St. Patrick's River, *Gunn.* Back River Gully, *Oldfield*, *Archer.* Ringarooma, *Shepherd.* Wedge Bay, *Clark.* Launceston, *Miss Oakden.* Sawpit Creek, Mount Wellington, *R.A.B.* (New Zealand, Lord Auckland's Group.)

2. S. HYMENOPHYLLUM, *Montagne.* Stipules 1-2in. high. Frond, flat, erect, dark green, obtruncate or obovate, twice or thrice 2-fid; segments linear, serrate, emarginate. Fruit at the union of the laciniæ; involucral scale orbicular, toothed. Calyptra cylindric. Fl. N.Z. ii., 166; Syn. Hep. 480; *Jungermannia*, Hook. Musc. Exot. t. 14. Pl. xxxii.

Fern Tree Gully, Mount Wellington, *R.A.B.*

3. S. RHIZOBOLA, *Nees.* Stipes short. Frond procumbent, lanceolate, sub-divided, dark green, serrate, attenuated and rooting at the apex. Fl. N.Z. ii., 166; Syn. Hep. 483; *Jungermannia*, Hook. Musc. Exot. t. 14. Pl. xxxii.
S. obovata, Lond. Journ. Bot. 1844, 581; *S. pulchra*, Lond. Journ. Bot. 1846, 410.

The *S. obovata*, *Hook. f.* and *Tayl*, corresponds with what is understood as the fertile state of *S. rhizobola*, the attenuations of the apices of the divisions of the fronds being absent. The specimens gathered by Dr. J. D. Hooker are finely in fruit, and the fertile stems are mixed with others corresponding in structure, but differing in habit, being prostrate and rooting at the apices, like the plants figured in Musci Exotici. See note Fl. Tasm. ii., 239.

Tasmania, *Gunn.* On the ground in very wet places, in dense shade. St. Patrick's River, Back River Gully, and Mount Wellington, *Oldfield.* West End Rivulet, *Archer.* St. Crispin's Well and Wellington Falls, *R.A.B.* (Australia, New Zealand, Bourbon.)

4. S. LEHMANNIANA, *Mont. et Nees*, Syn. Hep. 483; *Mitten*, Tasmania, *Archer*; in Fl. Tasm. ii., 239, n. 3.

There are no specimens of this or the succeeding species in Archer's collection, Royal Society's Library, Tasmania.

5. S. RHODINA, *Hook. f. et Tayl.* Frond minute, oblong, dichotomous, tender, pellucid, costate. Calyptra very long, linear, roseate. Capsule linear, oblong. Lond. Journ. Bot. 1845, 93; Syn. Hep. 487.

Frond 2-3 lines long, calyptra much shorter. Involucral scales about the base of the calyptra 4 or 5 dentate, apices setacious, erect. The spores and elators frequently emitted from a lateral cleft in the capsule, or in an indefinite number of valves, the apices of the divisions always cohering. The whole plant is rose-coloured.

Sufficiently different from any other Tasmanian species. From the description of the capsule it may be doubtful if it truly belongs to this genus. Fl. Tasm. ii., 239.

Tasmania, *Archer*.

35. METZGERIA, *Raddi*.

No Perianth.

Calyptra on under side of continuous frond.

Fronds more or less branched, flat, linear; midrib distinct. Inflorescence diœcious. Fruit from the lower surface of the frond, on the midrib. Involucre a ventricose 2-lipped scale. Perianth 0. Calyptra ascending, obovoid, rather fleshy. Capsule on a long fruitstalk, ovoid; elators adhering to the tips of the valves, with one spiral fibre. Antheridia 1-3 from the midrib beneath the frond, in a 1-leaved involucre. Ovoid buds occur on the narrow tips of the fronds.

1. M. FURCATA, *Nees.* Fronds $\frac{1}{2}$ to 3in. long, tender, linear, forked or dichotomously branched, glabrous, the margin and costa beneath setulose or naked. Calyptra ascending from the side, hairy and setose. Fl. N.Z. ii., 166; Syn. Hep. 502; Fl. Antarct. 167 and 445; Fl. Tasm. ii., 239; Pl. ii. f. 5, Pl. xxxii.

Var. β. 1. *major*: St. Patrick's River, *Gunn.*

Var. β. 2. *minor*: running over the surface of rocks, Launceston, *Gunn.*

Var ε. *prolifera*: Tasmania, *Gunn.* Back River Gully, *Oldfield.* Cheshunt, *Archer.*

On trees, in gullies, Mount Wellington, *R.A.B.* (Cosmopolitan.)

2. M. ERIOCAULA, *Gottsche.* See *Sarcomitrium eriocaula.* Pl. xxxii.

36. SARCOMITRIUM, *Corda* (Aneura).

No perianth.

Calyptra lateral; frond composed almost entirely of thickened nerve.

Frond pinnatifid or 2-pinnate, sinuate, rather thick, with a broad undefined nerve or 0. Inflorescence diœcious. Fruit from the margin of the frond underneath. Involucre short, cup-shaped, torn. Perianth 0. Calyptra subcylindric, fleshy. Capsule ovoid or oblong, on a slender fruitstalk; elaters attached to the tips of the valves, each with a single broad fibre. Antheridia immersed in marginal receptacles.

In Hooker's Handbook to Fl. N.Z., this genus is named *Aneura*, and the following note occurs:—In the New Zealand Flora Mr. Mitten adopted the generic name of *Sarcomitrium* in preference to that of *Aneura*, because the fronds have a nerve or thickened axis, and indeed consist of little else than axis. Names are, however, as often founded on appearances as on facts, and if the appearance is obvious, as in this case, the name should be retained. A considerable genus, more common in the Southern than in the Northern hemisphere.

Flor. Nov. Zeal. ii., 167 n. This genus contains all the *Aneuræ* and part of the *Metzgeriæ* of the Syn. Hep. where the fronds have been described as nerveless, though consisting of very little beside nerve. In *S. pingue* and the wider lobed species there is but a single row of cells on each side of the nerve to represent the leafy tissue of the plants; *Aneura* being, therefore, inapplicable, *Sarcomitrium* has been adopted as the better generic name.

Margin remotely toothed.

1. S. alternilobum.

Branches palmately divided.

2. S. palmatum.

Branches pectinately divided.

3. S. multifidum.

Frond narrow at base, swollen, vaguely lobed, margins lobed.

4. S. pinguis.

Frond erect, linear, pinnate.

5. S. alcicorne.

Frond rigid, brown or blackish green, pinnate.

6. S. crassum.

Frond simple or pinnatifid, branches dilated at the apex.

7. S. pinnatifida.

Frond long, pinnatifid, pubescent.

8. S. eriocaula.

Frond short, fleshy; lobes cochleate, concave.

9. S. cochleatum.

1. S. ALTERNILOBUM, *Hook. f. et Tayl.* (*Aneura*). Frond dark green, 3-4in. long, flattened, vaguely branched; branches alternate, 1-6th in. broad, obtusely lobed, crenate, tips rounded; margin minutely and remotely toothed. Calyptra setulose. Hook. Handbook Fl. N.Z. 543; Syn. Hep. 496.

Blackish green. Frond 2in., vaguely branched, narrow, procumbent, apex rounded and crenulate. Calyptra covered with pale setæ. Capsule linear-oblong; pedicel 1in. Distinct from *S. pingue* (*Linn*) in its more regularly alternately lobed fronds, which have their margins remotely denticulate, and which appear to be of a thinner texture. Fl. Nov. Zeal. ii., 167.

Fronds sparingly branched, crossing one another but scarcely matted together, about 3in. long and 2 lines wide, of the colour of dried specimens of *J. multifida*, L., having a pinnate appearance from the short, alternate, obtuse lobes, each of which is truly bilobate at the summit with a very shallow sinus; the margin exhibits very minute teeth pointing in various directions. The substance of the frond is very thin, yet along the longitudinal axis it is carnose and has the cells indistinctly separated, which is by no means the case near the margin. Beneath there are brownish-white rootlets limited to the central parts of the frond and its lobes.

This species belongs to the section of the genus with nerveless fronds. By the greater breadth and shortness of its lobes, as well as by the sinus at the summit of each, it is at once distinguished from the broadest specimens of *J. multifida*. Lond. Journ. Bot. 1844, 572.

St. Patrick's River and Acheron River, *Gunn.* Clayey banks of the Kermandie Rivulet, North-West Bay Gully and elsewhere, on very wet banks, *Oldfield.* (New Zealand.)

2. S. PALMATUM, *Mitten.* *Aneura palmata Nees.* Syn. Hep. 498; *Jungermannia palmata*, Hedwg. Theor. gen. ed. i. t. 18. f. 93-95. Fronds pinnate, primary flat, procumbent; branches ascending, pinnatifidly palmate; segments linear, truncate or obtuse. Fruit lateral; involucre shallow, torn. Calyptra tubercled. Hook. Handbook. Fl. N.Z. 543. Pl. xxxiii.

Fronds usually crowded, two to three inches high, divided palmately into narrow lobes, sometimes creeping. Calyptra clad with tubercles. In old bogs. Cook's Britt. Hep. 24.

Cheshunt, *Archer,* Distillery Creek, Launceston, *Miss Oakden.* Wellington Falls, *Rodway,* Gullies Mount Wellington, *R.A.B.* (New Zealand, Europe.)

3. S. MULTIFIDUM, *Mitten.* *Aneura multifida, Dumart.* Syn. Hep. 496; *Jungermannia multifida,* Linn. ed. 2. 1,602. Frond pinnately multifid or decompound; primary bi-convex, rigid; branches pectinate, horizontal, linear; involucre lateral in the primary or secondary branches, turbinate, fleshy. Calyptra tubercled. Hook. Handbook, Fl. N.Z., 543; Hook. Brit. Jung. t. 45; Fl. Antarct. 167 et 444. Pl. xxxiii.

Generally growing in thick crowded tufts. Fronds from $\frac{1}{2}$ to $1\frac{1}{2}$in. long, usually erect, but sometimes prostrate, much divided in an irregular manner, nerveless, fleshy, and of a pale green colour. Fruit rising from beneath the margin, but not at the apex. Calyx very short, cup-like, and toothed at the edge. Capsule large, brown, and furrowed. Very variable. Wet places. Fruits in spring. Cook's Britt. Hep. 24.

St. Patrick's River, *Gunn.* Mount Wellington, *R.A.B.* (Australia, New Zealand, Lord Auckland's Group, Campbell's Island, Europe, America, India, Fuegia.)

4. S. PINGUE, *Mitten.* *Aneura pinguis, Dumart.* Syn. Hep. 493; *Jungermannia pinguis,* Linn. Sp. Pl. ed. 2. ii., p. 1,602.

Growing in loose patches. Fronds one or two inches long, often overlapping, and of an oblong figure, narrowest at the base, either simple or with one or two large lobes, the margins of all cut into smaller lobes, swollen in substance but nerveless. Fruit arising from the under surface of the frond near the edge. Calyx nearly hemispherical, expanded at the mouth and fringed. Capsule red-brown and furrowed. Damp ravines and bogs. Fruits in summer. Cook's Britt. Hep. 23. Pl. xxxiii.

Springs, Mount Wellington, and on muddy banks, *Oldfield,* (Australia, Europe.)

5. S. ALCICORNE, *Mitten.* Fl. Antarctica, 139 pl. 160, f. 8; *Aneura alciornis,* Hook. f. et. Tayl. Lond. Journ. Bot. iii., 479. Cæspitose. Frond erect, linear, alternately and bi-pinnately lobed; lobes linear, sharp, subtruncate. Calyptra lateral, linear, whitish, scabrous, apex lacerate. Pl. xxxiii.

Fronds tufted among other Hepaticæ, or Musci, about 1in. high; the younger parts of a lively grass-green, the lower and older brownish, and turning black in drying. The lobules rise to nearly the same level, consequently the lower branches have a dichotomous appearance; the lobes are widest when they are about to divide into lobules; these are linear, short, and end abruptly. The Calyptræ issue from the sides of the plants, and rise to such a height that their tops came on a level with the tufts of the fronds; the calyptræ are very long, pale, carnose, and rough with projecting points. Pedicel about ½in. long. Capsule cylindrical.

This species is allied to *L. palmata (Hoffm.)*, but is far more compounded in its divisions, which are pinnate and not palmate, the lobules are far narrower, and the calyptræ are born higher up on the frond.

On rocks and in slowly-running streams, Mount Wellington and elsewhere. *Oldfield*, *Archer*.

6. S. CRASSUM, (*Schwægr*, *Mitten* in Fl. N.Z. 167.) *Aneura crassa*, *Nees*; Syn. Hep. 500. Frond thick and leathery, almost horny, blackish-green, procumbent, pinnatifid; segments obtuse.

Of a very rigid and opaque texture, and of a brown or blackish-green colour; the stems are branched in a pinnate manner, and when dry the plants are almost horny. Fl. Nov. Zeal. 167.

Acheron River and Arthur's Lake, *Gunn*. Cheshunt, *Archer*. Wellington Falls, *R.A.B.* (New Zealand.)

7. S. PINNATIFIDUM, *Mitten*. *Aneura pinnatifida Nees*, Syn. Hep. 495. Frond simple or pinnatifid, flat or channelled; branches horizontal, dilated at the apex, 2-pinnatifid, or toothed, obtuse. Calyptra smooth, puberulous. Hook. Handbook, Fl. N.Z. 543. Pl. xxxiv.

St. Patrick's River, and in a rivulet at an altitude of 5,000ft., Western Mountains, *Gunn*. Oven's Creek, *Archer*. Mount Wellington, *R.A.B.* (Australia, New Zealand, Europe, America, Bourbon, India, Malay Islands.

8. S. ERIOCAULUM, *Mitten*. *Metzgeria eriocaula*, Syn. Hep. 505; *Jungermannia eriocaula*, Hook. Musc. Exot. t. 72. *Aneura eriocaula*. Fronds 3-6in. long, flexuous, pinnatifid, pubescent; primary, creeping, compressed; branches alternate, ovate, 2-pinnatifid; divisions linear, obtuse. glabrous, costate, brown. Calyptra sub-axillary, oblong-cylindric, fleshy, glabrous, rather rough. Easily distinguished by its short pubescence. Pl. xxxii.

Back River Gully, *Oldfield*. (New Zealand).

9. S. COCHLEATUM *Mitten.* *Riccia cochleata*, Crypt. Antarct. 56, Pl. 66, f. 5, Hook. f. and Tayl. Lond. Journ. Bot. iv. 96. Frond short, very thick and fleshy, loosely cæspitose, procumbent, creeping, pinnatifidly irregularly lobed; lobes ovoid, cochleate, concave, very thick and fleshy, with upturned or connivent margins, 2-lobed at the apex, loosely cellular and spongy internally. Calyptra fleshy, cylindric, setulose. Hook. Handbook Fl. N.Z. 544. Pl. xxxiv.

This species seems always recognisable by the pale, slightly thickened row of marginal cells. Fl. Tasm. ii., 240, n.

The Falls, Cheshunt, *Archer.* Lord Auckland's Group.

37. RICCIA, *Micheli.*

Often floating on water, fruit embedded in substance of frond.

Small, frondose, terrestrial or aquatic, often of thick consistence. Fronds simple or divided, usually orbicular or oblong, often stellate. Inflorescence monœcious or diœcious. Perianth 0. Fruit immersed in the frond. Involucre 0. Calyptra cohering with the globose capsule, and crowned with a persistent styliform apex; columella and elaters 0. Spores angular; antheridia imbedded in the frond.

R. NATANS, *Linn.* Fl. N.Z. ii., 173. Fronds floating pale yellow above, bordered with dull purple, obcordate, channelled, simple or proliferous from the notches, with long purple serrate fimbriæ below; substance, cavernous. Syn. Hep. 606. Pl. 1.

Different from the usual British states of the species, being much more thickly covered beneath with much elongated almost black purple fimbriæ. The upper surface is pale yellow green, bordered with deep purple.

Floating on Black Lagoon near Tamar Heads, *Miss E. Oakden.* (Australia, New Zealand, Europe, America).

38. TARGIONIA, *Micheli.*

Fruit terminal on the under side of the frond.

Involucre 2-valved.

Fronds appressed to the ground, rooting, thick and coriaceous, linear, forked, porous on the upper surface, scaly on the lower. Involucre at the apex of the frond, 2-valved. Perianth 0. Calyptra persistent, enclosing the capsule, breaking away from over it, its bulb immersed in the frond; style deciduous. Capsule on a very short fruit-stalk, membranous, irregularly torn; elaters with 2 or 3 spiral fibres. Antheridia in lateral disc-like receptacles, on proper branches. Gemmæ 0.

T. HYPOPHYLLA, *Linn.* sp. pl. ii., 1,604. *T. Michelii, Carda;* Syn. Hep. 574. Frond linear-obovate, or cuneate, rigid, with an undefined midrib, pores equal; scales densely imbricate, outer reaching the margin. Hook. Handbook Fl. N.Z. 547. Pl. xxxiv.

Fronds forming large patches, overlapping and flat, very deep green, purplish at the edges, oblong, with numerous radicles on the under surface. Fruit originating from the underside of the frond near the extremity. Capsule never elevated beyond the globose calyx, splitting into several unequal segments. Banks, in moist exposed situations. Cook's Britt. Hep. 26.

Brown's River, *Oldfield.* Cheshunt, *Archer.* Tamar Heads, *Miss E. Oakden.* (Australia, New Zealand, Europe, N. Africa, N. America.)

39. MARCHANTIA, *Linn.*

Fruit in stalked peltate receptacle. Perianth opening downwards.

Frond broad, growing flat on the ground, branched, thick, with a broad ill-defined midrib or none, covered below with coloured imbricating scales and tubular rootlets. Inflorescence diœcious, on the surface of the frond. Receptacles pelate, stalked, rayed, fruiting on the under surface. Involucres pendulous, alternate with the rays, 2 valved, lacerate, each with 3-6 3-cleft perianths. Capsules stalked, pendulous, dehiscing at the apex by revolute valves; elaters slender; spores smooth. Antheridia immersed in the under surface of male receptacles. Gemmæ occur abundantly in sessile cups on the surface of the frond.

1. M. TABULARIS, *Nees.* Fl. N.Z. ii., 168. Patches large, oblong, lobed; terminal lobes toothed, nerveless, peduncles 1-4in. long. Female receptacles with 8-9 star-like rays; involucres with 2-4 perianths, 1-4th shorter than the ray, tumid, white, 4-fid; segments lacerate; central beard slender, fibrillose; fruitstalk

short. Male receptacles on separate plants on shorter peduncles, orbicular, 4-lobed; lobes crenate; anthers in 8 radiating lines. Syn. Hep. 525. *M. polymorpha*, Fl. Antarct. 168 and 446, not of Linnæus. Pl. xxxiv. xxxv.

Marchantia polymorpha, *Linn.*, is stated by Dr. Gottsche in " Plantæ Muellerianæ " to occur in Tasmania, but all the specimens yet observed appear to belong to *M. tabularis*, *Nees*, which differs more in appearance than in any decided character from the European species.

Tasmania, common in wet places where there have been fires, also on tops of hills, *Gunn*, *Hooker.* Back River Gully, *Oldfield*; elsewhere, *Archer*, *Miss E. Oakden*, *R.A.B.* (Australia, New Zealand, Lord Auckland's Group, Campbell's Island, South Africa, Fuegia, Falkland Islands, Kerguelen's Land).

M. PILEATA, *Mitten*, in Fl. N.Z. ii., 169. Frond 3in. long, glaucous green, $\frac{1}{4}$in. broad, dichotomous, linear, flat, smooth; pores minute, margined with white; margins entire; underneath dark purple. Female receptacle sub-eccentric, hemispherical, tuberculate, naked below, margin crenate; peduncle $\frac{1}{2}$-in. long, smooth, purple; margin of the involucres torn. Male plant, receptacle on short peduncle, 4-5 lobed, orbiculate, obtuse.

The latter peduncle 2-3 lines long, sealed at the base; receptacle 2 lines wide, margin crenulate.

Only one female receptacle has been seen which has the peduncle inserted either in or very near its centre; it is hemispherical. The plant referred to this species corresponds so nearly in the size, colour, and areolation of its fronds that there seems little reason to doubt its being the male of that described as above from Fl. N.Z. Pl. Tasm. ii., 240, n.

On the ground with *M. tabularis*, *Hooker*, *Archer.*

3. M. FOLIACEA, *Mitten* in Fl. N.Z., 168. Frond 2-3in. long, subcariaceous, flat, smooth, glossy above; pores small, pale; below deep purple; margin entire, undulate. Female receptacle eccentric, convex, umbovate, about 8-lobed; peduncle 1in. long, with purple scales; lobes dilated, foliaceous, sub-crenate; involucres pale, lacerate, ciliate. Cups with gemmæ, funnel-shaped, with toothed ciliate margins.

The surface of the frond is nearly as glossy as that of *M. nitida* of New Zealand.

Tasmania, *Archer.* (New Zealand).

40. REBOULIA, *Nees.*

Fruit in stalked peltate receptacle, no perianth, involucre opening by 2 valves.

Frondose, growing on rocks and earth; habit of *Marchantia;* midrib strong, broad. Female receptacle peduncled, flat, conical, or hemispherical, 1-6 lobed, almost to the middle; lobes thick, their margins forming a 2-valved involucre, containing one capsule. Perianth 0. Calyptra ovoid, soon rupturing, leaving a cup at the base of the capsule. Capsule exserted, sub-globose, membranous, lacerate, or sub-operculate; elaters with 2 spirals; spores tubercled. Male receptacle sessile, discoid.

R. HEMISPHÆRICA, *Raddi.* Frond dichotomous, with innovations that are rounded and emarginate at the apex, green above, purple below; receptacle variable in shape; hairs at its base very slender. Hook. Handbook. Fl. N.Z. 546. Syn. Hep. 548. Pl. xxxv.

Fronds prostrate, flat, overlapping, from one to three inches long, generally forked, and waved at the margin, of a dark green colour. Midrib prominent. Fruitstalk 2-4in. long. Receptacle cut at the margin into from four to ten equal lobes, covering as many involucres, which are not toothed. It is easily distinguished by the deeply divided 4-5fid receptacle, which is barbate beneath and at the base of the peduncle. Cook's Britt. Hep. 26.

Like the British species, these have the fronds frequently constricted in an articulate manner.

Tasmania, *Hooker.* Gully, Mount Wellington, *R.A.B.* (Australia, New Zealand, Cosmopolitan.)

41. FIMBRIARIA, *Nees.*

Fruit in stalked peltate receptacle. Perianth split into bands, cohering at their apices.

Frondose, habit of Marchantia; midrib keeled. Inflorescence monœcious. Female receptacle hemispherical, concave below; margins expanding and forming 4 campanulate, pendant, 1 capsuled involucre. Perianth projecting beyond the involucre, oblong, splitting into many laciniæ at the mouth. Calyptra fagacious. Capsule sessile, globose, bursting transversely; elators short, with 1 or 2 spirals; spores muricate. Antheridia not on receptacles but immersed in the frond.

1. F. Drummondii, *Tayl.* Syn. Hep. 566, 791; Fl. N.Z. 169. Frond 1-1½in. long, linear-elongate, green or purplish. Female receptacle conical, obtuse, papillose with vesicular cells, almost naked below; perianths white and purplish, broadly ovate, sub 12-fid; segments broad, flat, cohering at the apex; peduncle 2in. long, slender, black-purple.

Its fronds in size and appearance resemble those of *Reboulia hemispherica*, *Raddi*, and are generally stained above of the deep purple that prevails on the under surface of its *congeners*.

Tasmania, *Gunn.* Cheshunt, *Archer.* Brown's River, *Oldfield.* (Australia, New Zealand.)

2. F. Australis, *Hook. f.* and *Tayl.* Fl. N.Z. ii., 170. Fronds 1in. long, linear, dichotomous, tender, 2-lobed at the apex, below purple, with a few small lanceolate obtuse scales. Female receptacle conico-hemispherical, tubercled, sub-4-lobed, bearded below with long hairs; perianths ovate, 12-14 fid, pale segments cohering by thin tips. Hook. Handbook, 547.

Frond nearly 2in. long, 2 or 3 times dichotomously divided, narrow base, pale green. Scales beneath frond on each side of midrib, semi-lanceolate, obtuse, purple. Female receptacle conico-hemispherical, divided into 4 blunt lobes, each covering base of a calyptra, receptacle wrinkled. Calyptra obconical acute, tipped with a style, opening by slits. No calyx. Capsule smaller than calyptra, globose, spores angulato-rotundate, spiral filaments as long again as spores. Peduncle thick or opaque below, pellucid above, brownish below, 3 longitudinal grooves. The male receptacle an elevated lenticular disc, dusky purple, rough with prominent cells, cells divided by membranous partitions. Parts of fructification disproportionately small, differs from *F. Drummondii* by greater size, more divided lobes, smaller and more minutely corrugated female receptacles, absence of purplish tinge in calyptra or on the scales of the indusium, fineness of indusial scales, deeper situation of peduncle, and less conical female receptacle. Abridg. Lond. Journ. Bot. 1846, 574.

Brown's River, *Oldfield.* Launceston, *Miss E. Oakden.* (New Zealand.)

3. F. tenera, *Mitten.* in Fl. N.Z. ii., 170. Frond ½in. long, ⅙in. broad, green, dichotomous; divisions oblong or obcardate, deeply 2-fid, very tender, veined, fertile

cuneate; below green or brownish. Female receptacle small, rather convex, 3-4 lobed, naked below, rugulose; margin crenulate; perianths small, shortly conic, 8-fid; segments pale brown, ovate-lanceolate, separate at the apices. Pl. xxxv.

The deep purple colour so common in these plants is almost absent in this species, the older specimens of which become pale brown.

Tasmania, *Archer*. (New Zealand.)

42. ANTHOCEROS, *Micheli*.

Frond fleshy, without scales beneath.

Fronds growing flat on the ground, more or less orbicular, radiating, thick or opaque, green. Margins lacerate or crenate. Inflorescence monœcious. Fruit on the upper surface of the frond. Involucre tubular. Perianth 0. Calyptra conical. Capsule pedicelled, of 2 narrow linear erect lobes; columella filiform; elaters flexuous; spiral fibres imperfect or 0; spores muricate. Antheridia sessile, in cup-shaped involucre. Gemmæ also immersed in the substance of the frond.

1. A. LÆVIS, *Linn.* Fl. N.Z. ii., 171. Frond 1-2in. long, flat, radiately branched; lobes crenate, smooth, nerveless, tender; involucre cylindric; mouth obliquely truncate, with broad scarious edges. Syn. Hep. 586. *Dendroceros leptohymenius*, Hook. f. et. Tayl. in Lond. Jour. Bot. 1844, 575; Syn. Hep. 580; *Pellia carnosa*, l.c. 576; Syn. Hep. 490. *A. punctatus* (?) Hook. f. et. Tayl. in Fl. Antarct. i. 168. Pl. xxxv.

Near Campbell Town, *Gunn*. In very wet places, under dripping water; Back River Gully, *Oldfield*. West End Rivulet, *Archer*. Wellington Falls, *R.A.B.* (Australia, New Zealand, Campbell's Island, Europe, America).

2. A. DENTICULATUS, *Lindenberg*. *Lehm.* pug. Pl. Nov. x. p. 25; Muell. Frag. Phyt. Austral., p. 69.

Tasmania, Mount Wellington, *Gulliver*.

3. A. LONGISPIRUS, *Carr et Pear.* See description and illustration in the current proceedings of the Royal Society, Tasmania. Pl. ii. f. 7. Pl. xxxv.

St. Crispin's Well, Mount Wellington, *R.A.B.*

INDEX.

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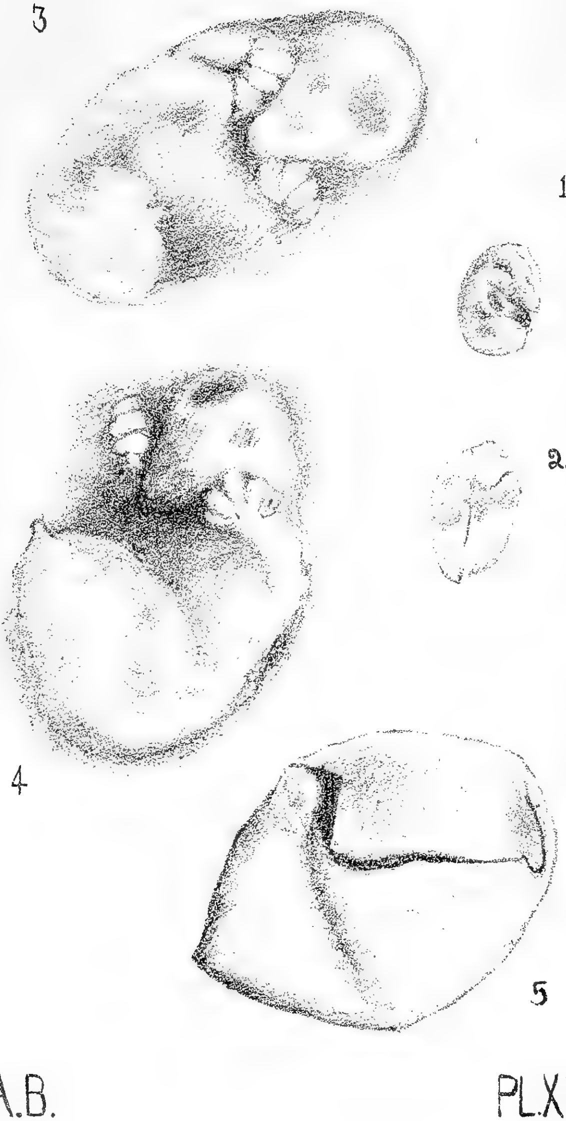
The names printed in *italics* are either *synonyms* or species to which references are made in the preceding descriptions.

NOTES ON THE EGG OF THE *ECHIDNA SETOSA*.

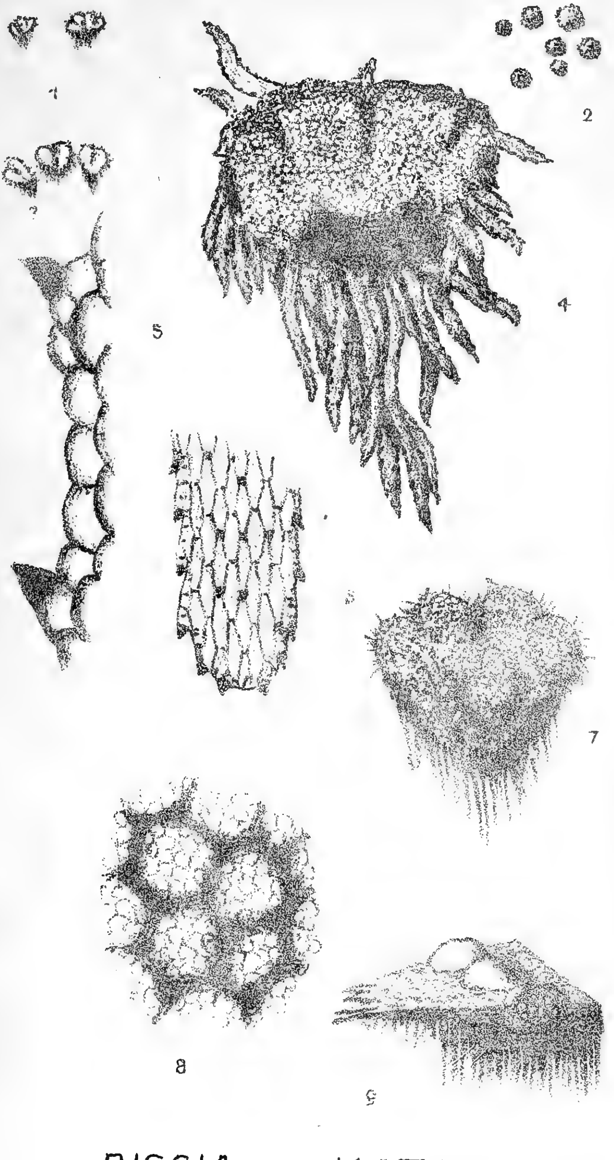
By Alexander Morton.

(Plate XLV.)

For many years past, and even to the present time, grave doubts have existed in the minds of many as to the mode of breeding in connection with the Platypus and the Echidna. To the scientific world Mr. Caldwell, in 1883, set at rest any doubt as to the question whether this peculiar order of animals was viviparous or oviviparous, by securing a large number of specimens of the Echidna and the Platypus in various stages of development. It is not recorded, however, that the egg of the Echidna had ever been found in Tasmania, and, therefore the specimen I have much pleasure in submitting to the Fellows this evening will doubtless be of great interest. This important discovery was made known to me by Mr. Fletcher, residing in the Campbell Town district, who stated that while riding in that district his horse put his foot into a small hole; on placing his hand in the hole he found an Echidna had burrowed some eighteen inches or two feet in the soft soil, on lifting the animal out a small white egg fell to the ground, the fall broke the egg and revealed a small fœtus of the Echidna. Mr. Fletcher carefully secured the broken shell and the fœtus, kindly presenting both specimens to the museum. The egg is about three-quarters of an inch in length. I am indebted to Mr. R. A. Bastow, F.L.S. for the sketch taken shortly after arrival at the museum. Plate XLV, Fig. 1, natural size of the animal; Fig. 2, egg shell; Figs. 3, 4, enlarged size of the animal; Fig. 5. ditto of egg case.



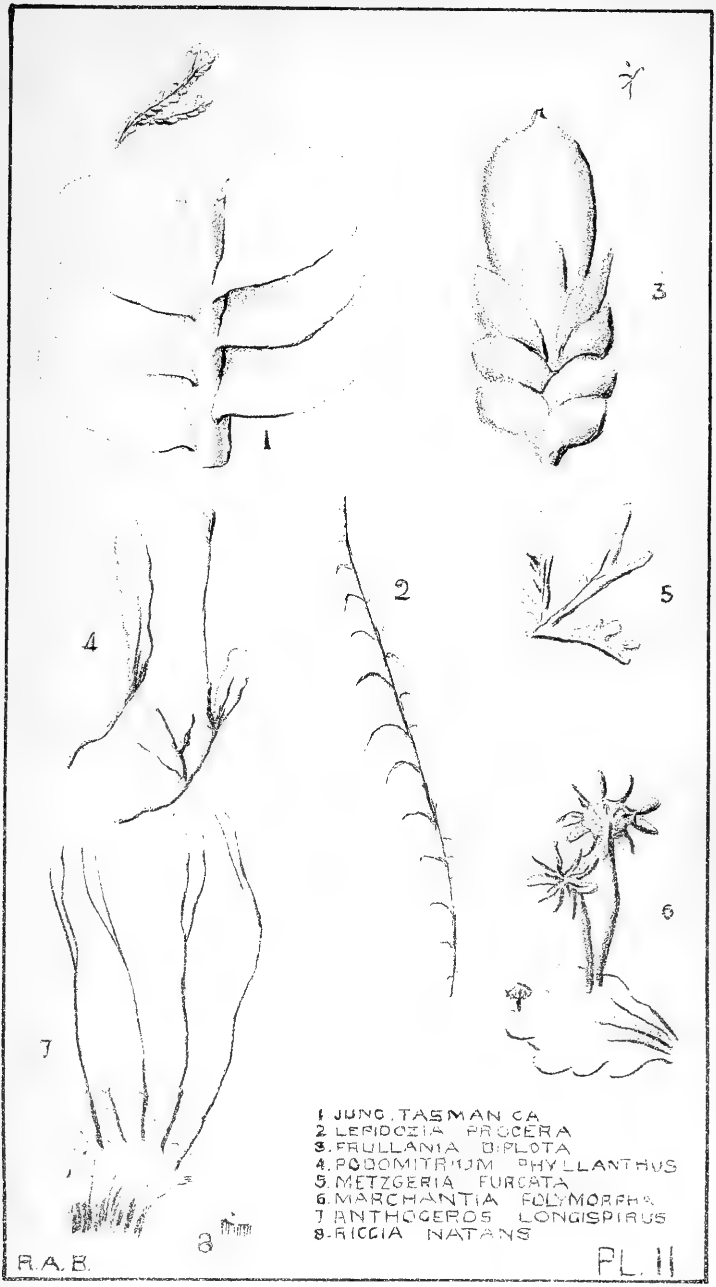
R.A.B. PL.XLV.



RICCIA NATANS

R.A.B.

PL. I



1. JUNG. TASMANICA
2. LEPIDOZIA PROCERA
3. FRULLANIA DIPLOTA
4. PODOMITRIUM PHYLLANTHUS
5. METZGERIA FURCATA
6. MARCHANTIA POLYMORPHA
7. ANTHOCEROS LONGISPIRUS
8. RICCIA NATANS

PL. II

1

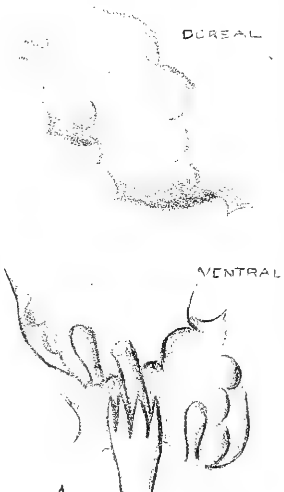
PLAGIOCHILA STROMBIFOLIA

2

LOPHOCOLEA BICILIATA

3

ISOTACHIS GUNNIANA

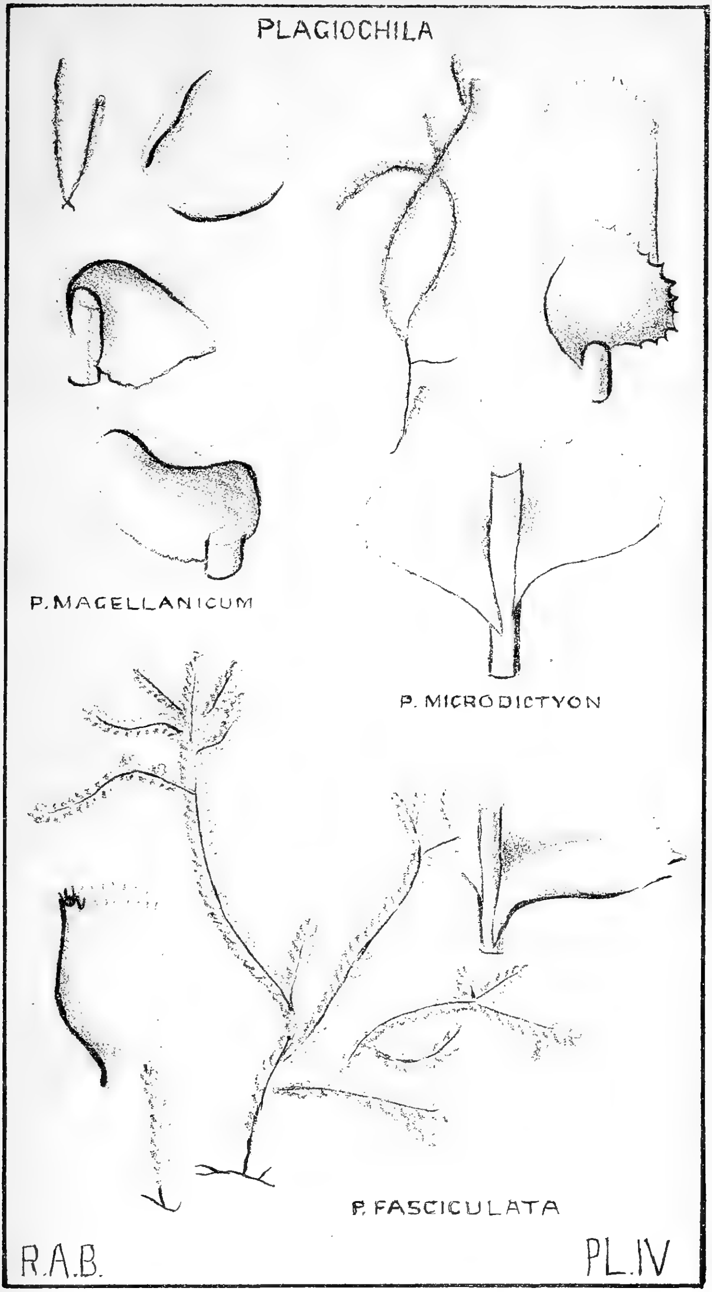


4

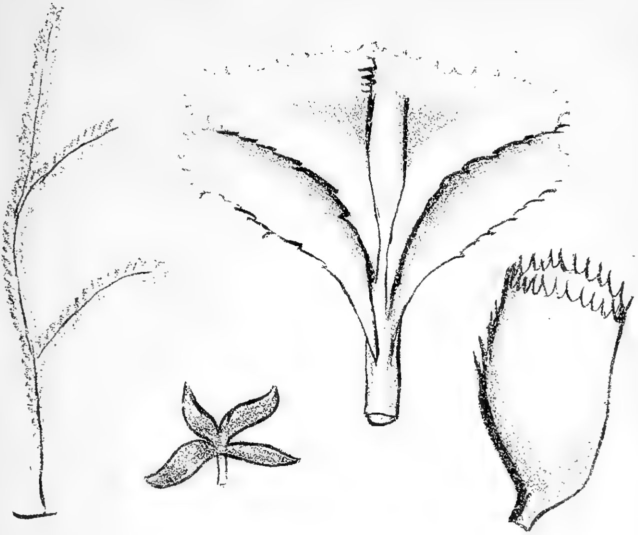
POLYOTUS BRACHYCLADUS

R.A.B

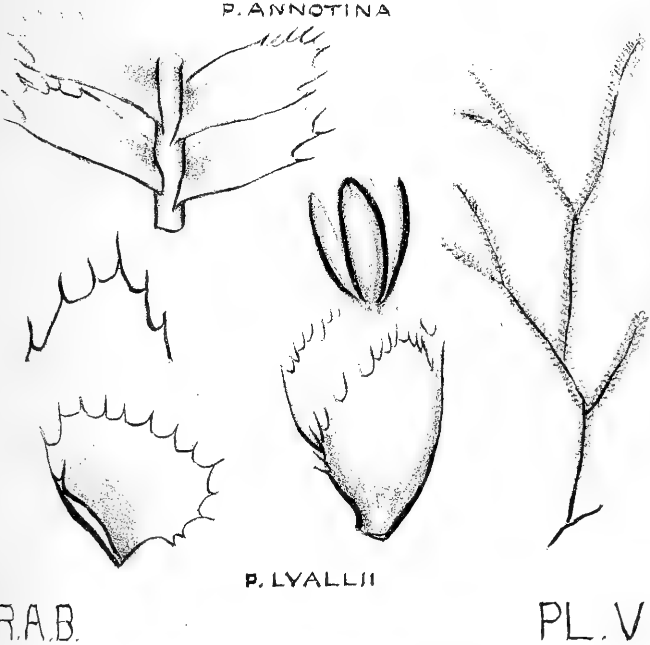
PL III


PLAGIOCHILA
P. MAGELLANICUM
P. MICRODICTYON
P. FASCICULATA
R.A.B.
PL. IV

PLAGIOCHILA

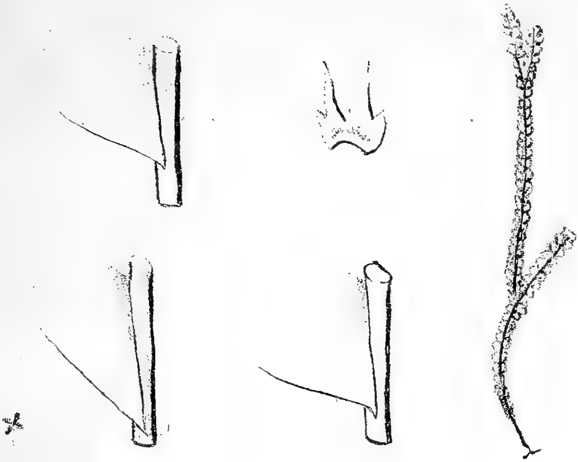


P. ANNOTINA



P. LYALLII

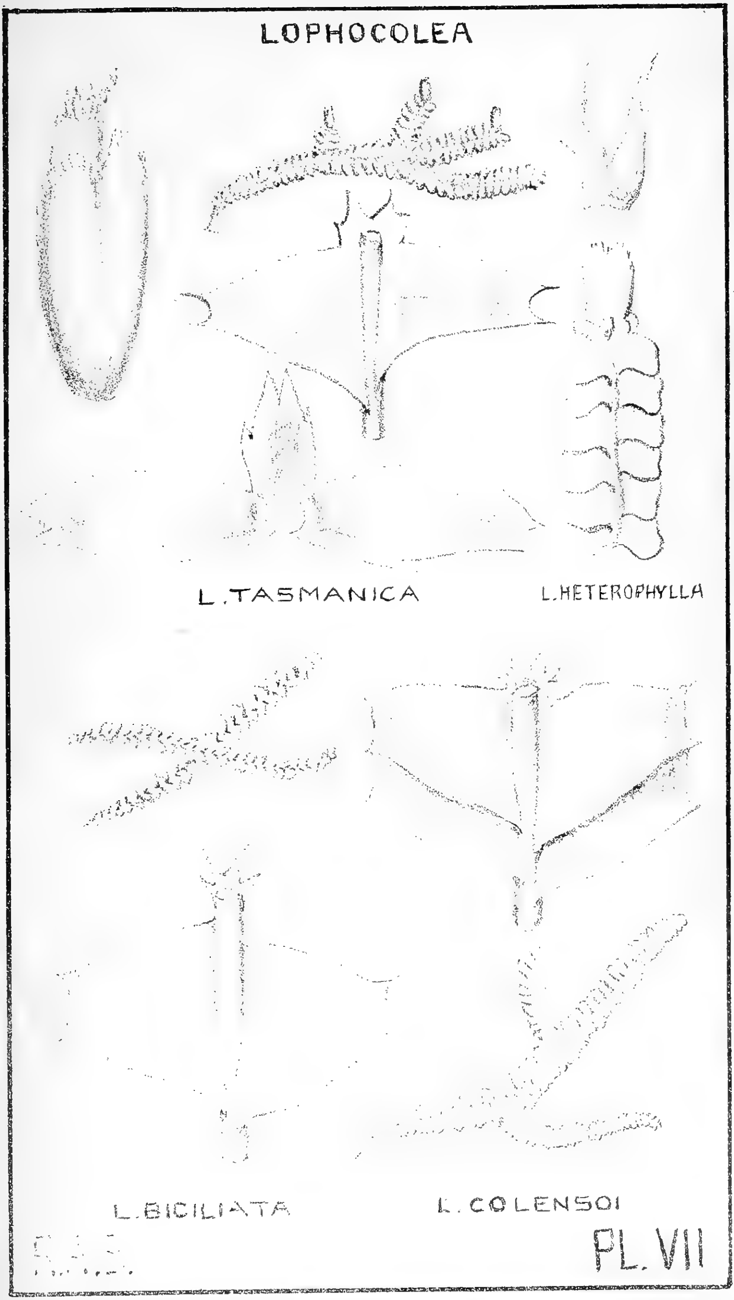
R.A.B. PL. V

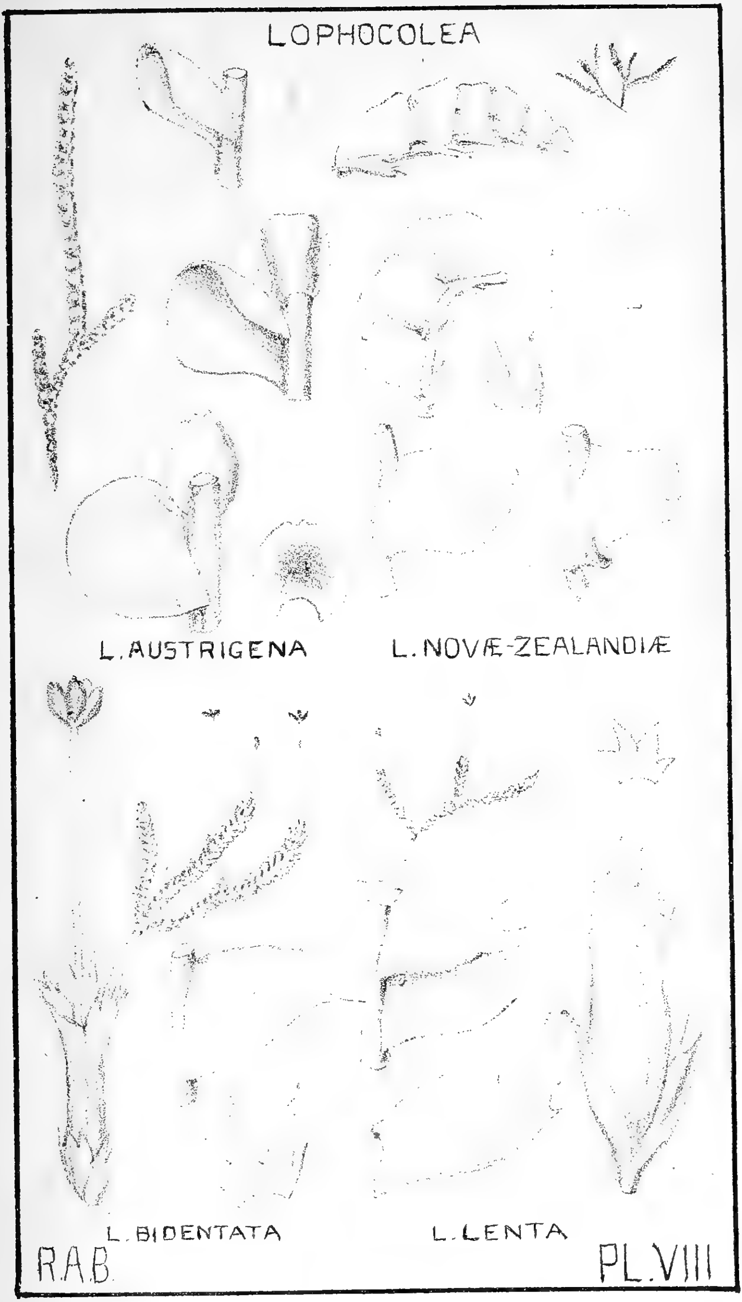


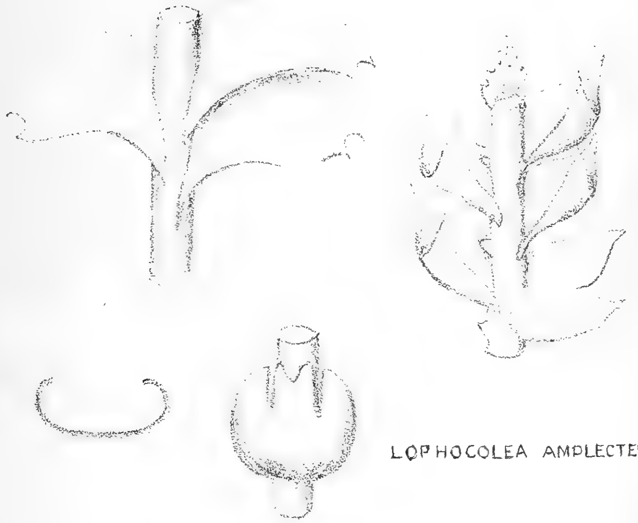
LEIOSCYPHUS CHEILOSCYPHIOIDES

TEMNOMA PULCHELLA

R.A.B. PL. VI


LOPHOCOLEA
L. TASMANICA
L. HETEROPHYLLA
L. BICILIATA
L. COLENSOI
PL. VII


LOPHOCOLEA
L. AUSTRIGENA
L. NOVÆ-ZEALANDIÆ
L. BIDENTATA
L. LENTA
R.A.B.
PL. VIII

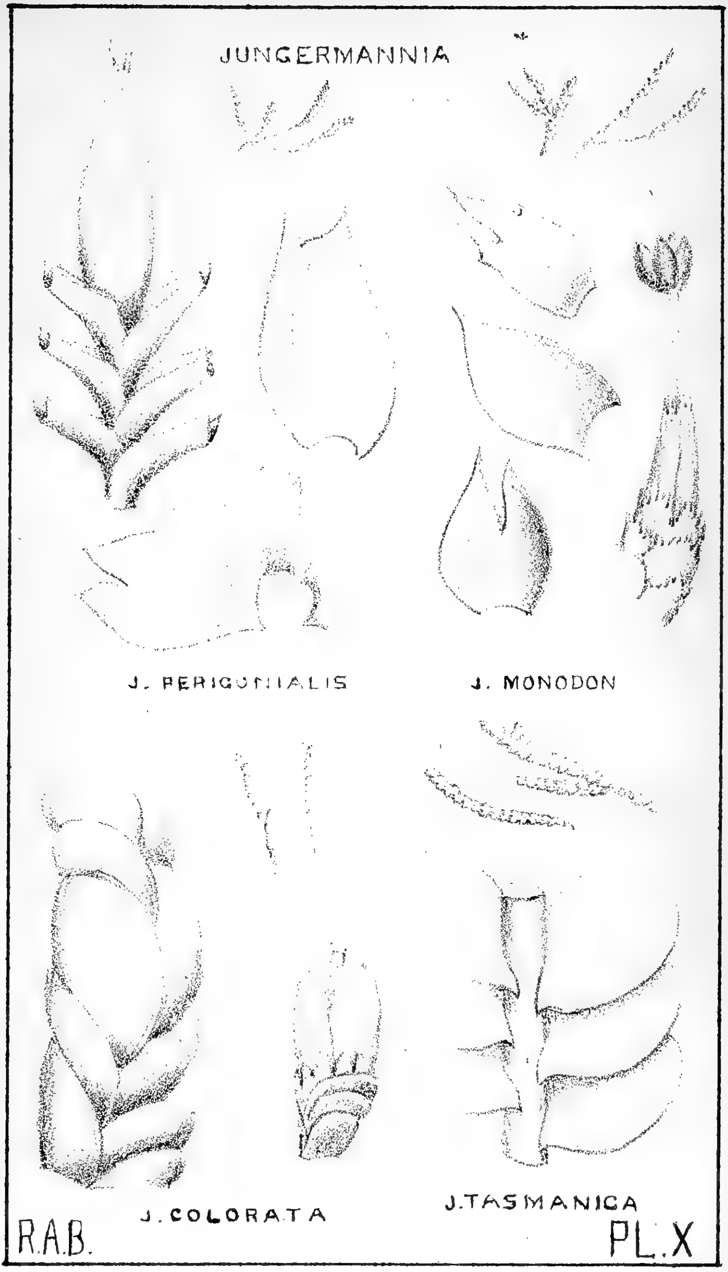


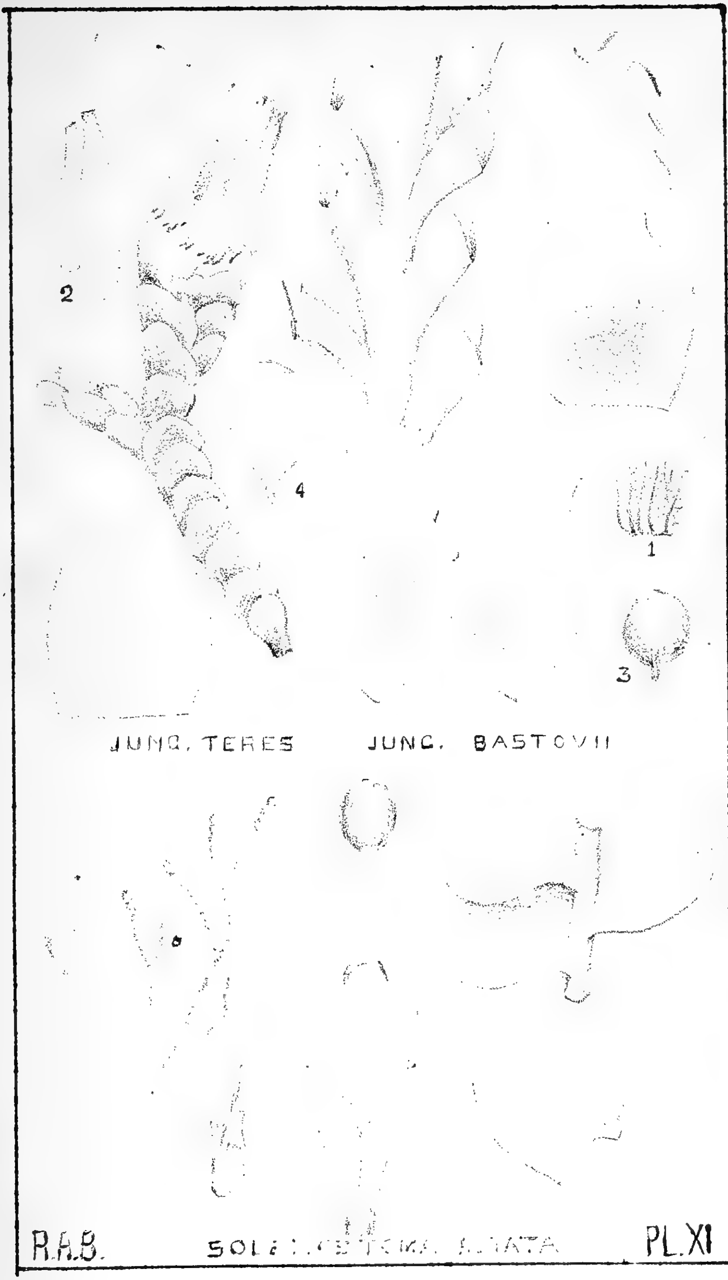
LOPHOCOLEA AMPLECTENS

LOPH. DECURVA

TRIGONANTHUS DENTATA

R.A.B. PL.IX


JUNGERMANNIA
J. PERIGONIALIS
J. MONODON
J. COLORATA
J. TASMANICA
R.A.B.
PL. X


2
4
1
3
JUNC. TERES
JUNC. BASTOVII
R.A.B.
PL. XI

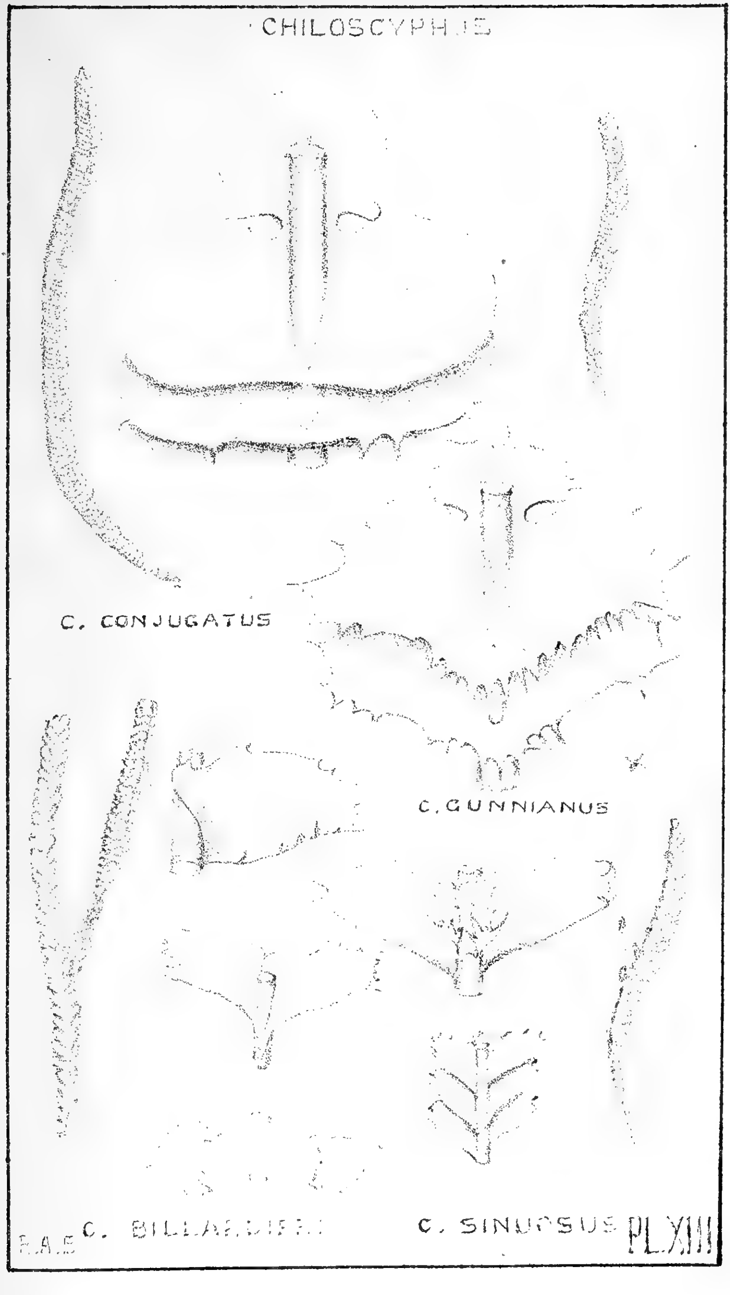
JUNG. EMARGINATA

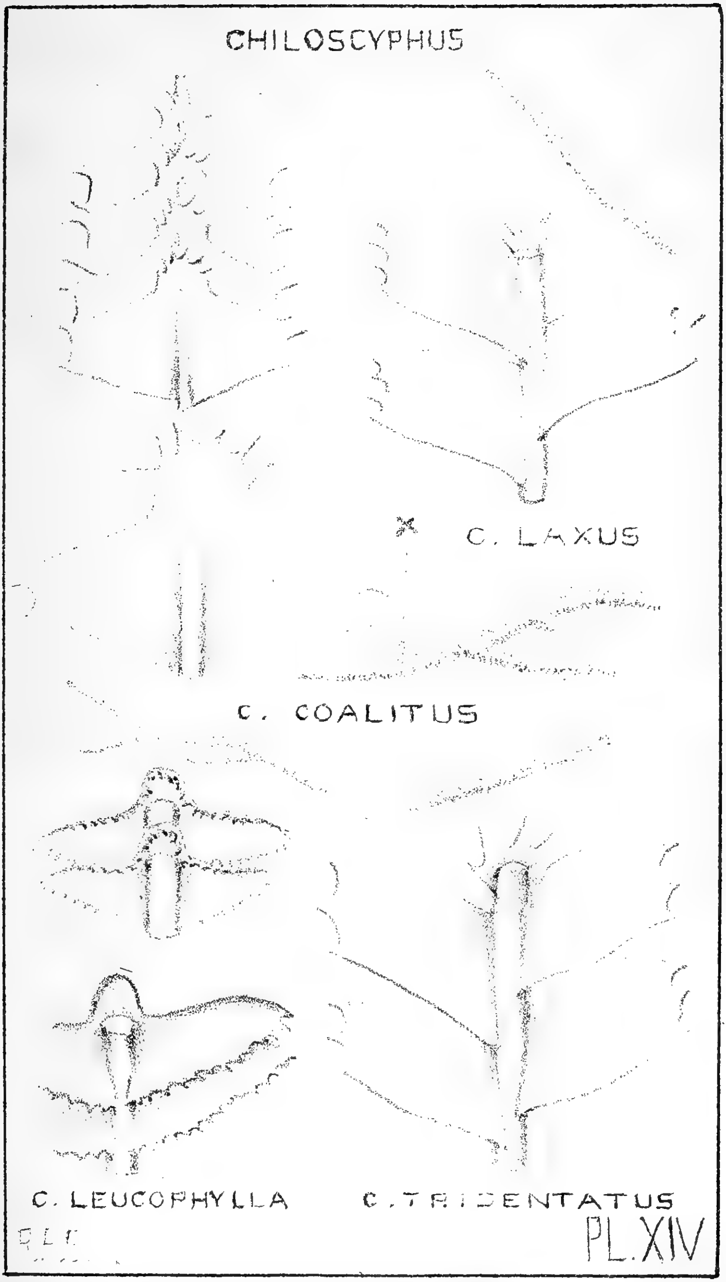
CESIA EROSA

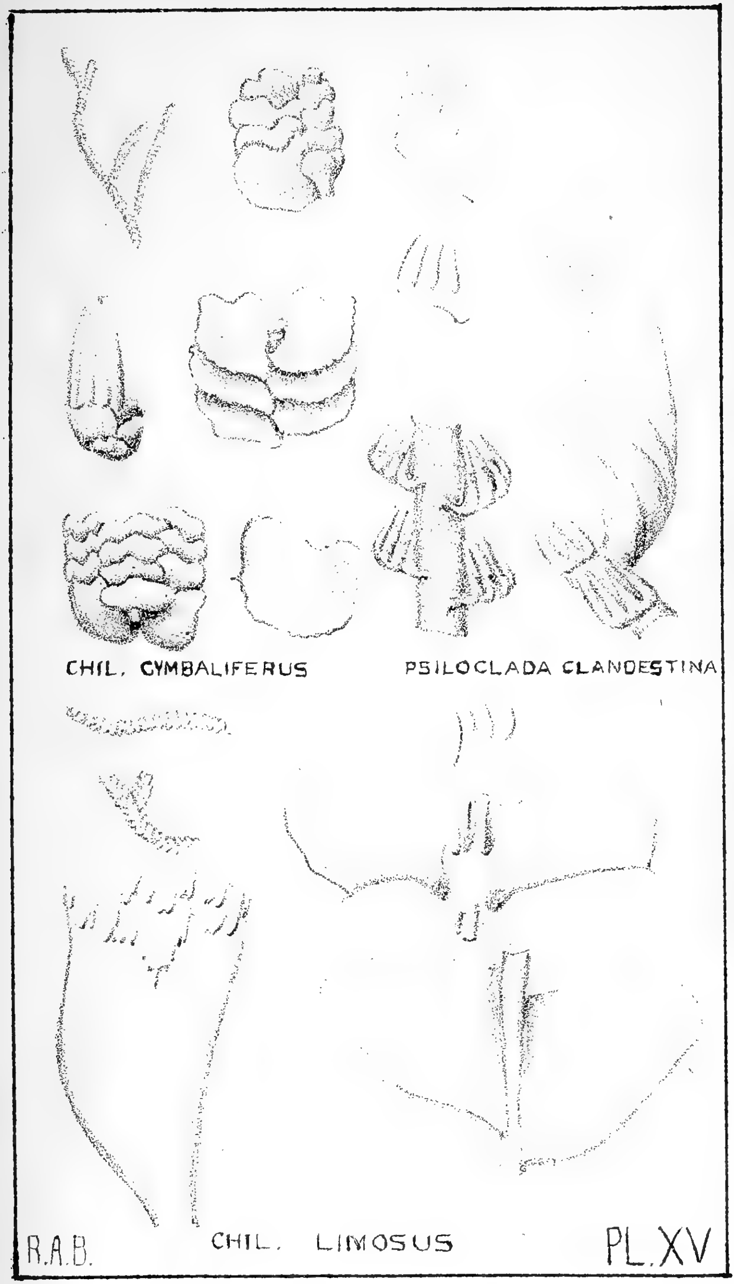
ADELANTHUS FALCATUS

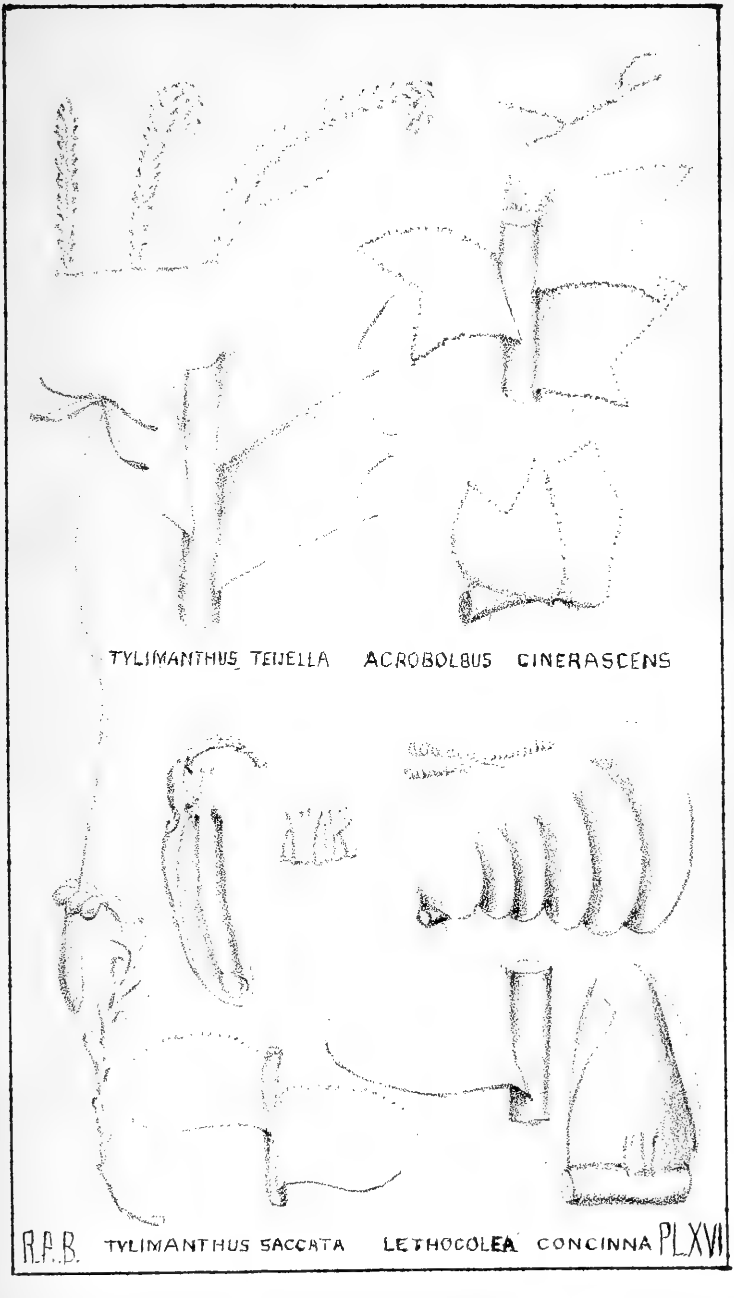
R.A.B.

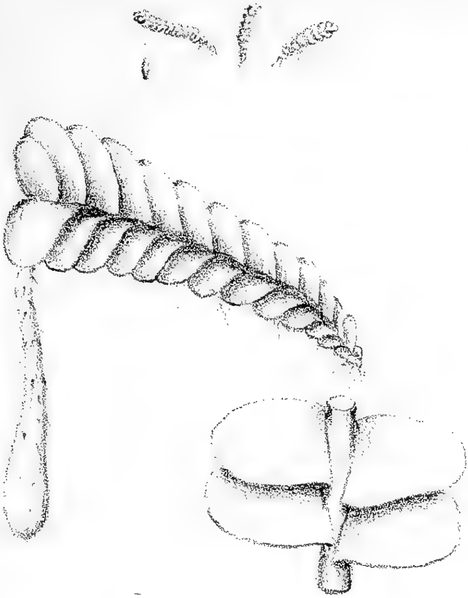
PL.XII


CHILOSCYPHUS
C. CONJUGATUS
C. GUNNIANUS
F.A.E
C. BILLARDIERI
C. SINUOSUS
PL. XIII

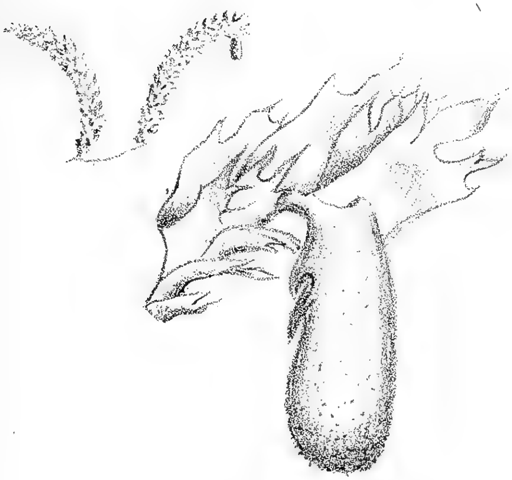

CHILOSCYPHUS
C. LAXUS
C. COALITUS
C. LEUCOPHYLLA
C. TRIDENTATUS
PL. XIV


CHIL. CYMBALIFERUS
PSILOCLADA CLANDESTINA
R.A.B.
CHIL. LIMOSUS
PL. XV

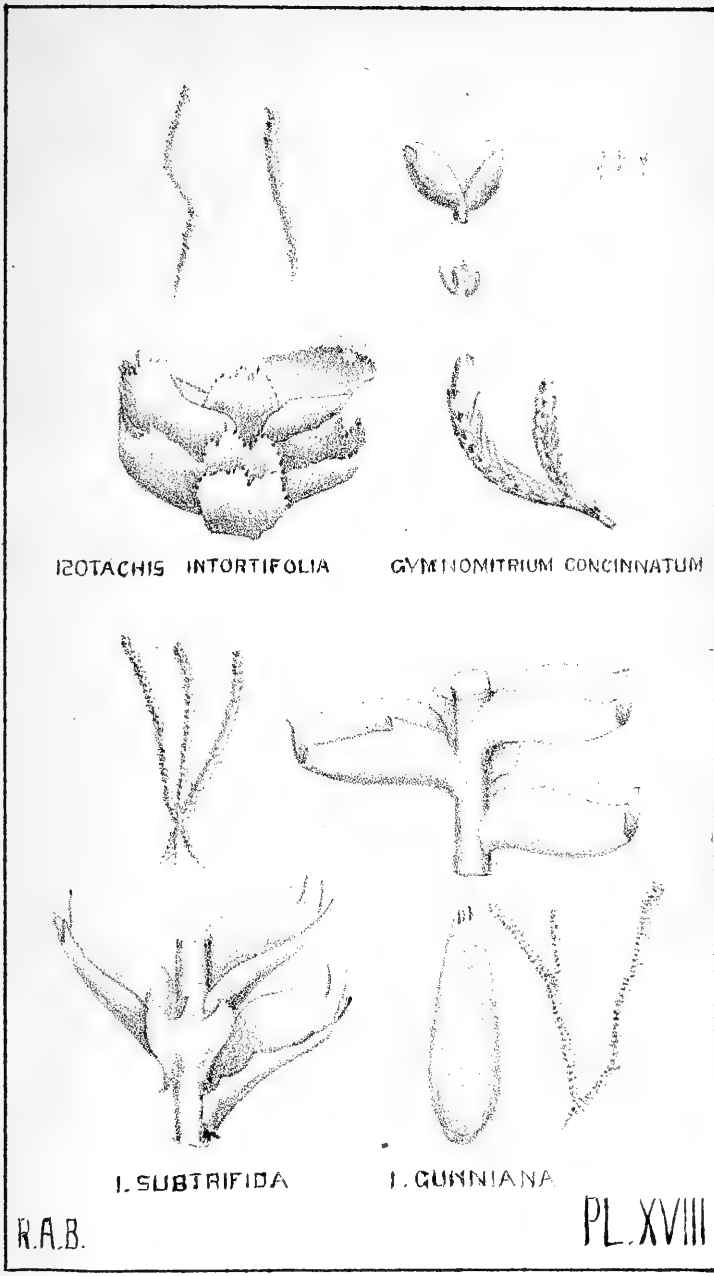

TYLIMANTHUS TENELLA
ACROBOLBUS CINERASCENS
R.A.B.
TYLIMANTHUS SACCATA
LETHOCOLEA CONCINNA
PL XVI

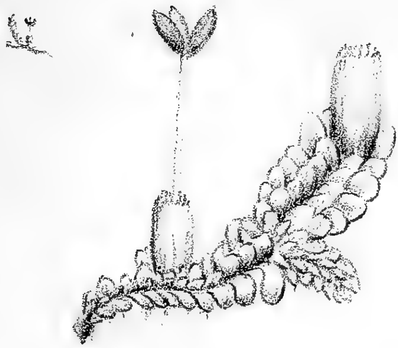


LETHOCOLEA DRUMMONDII

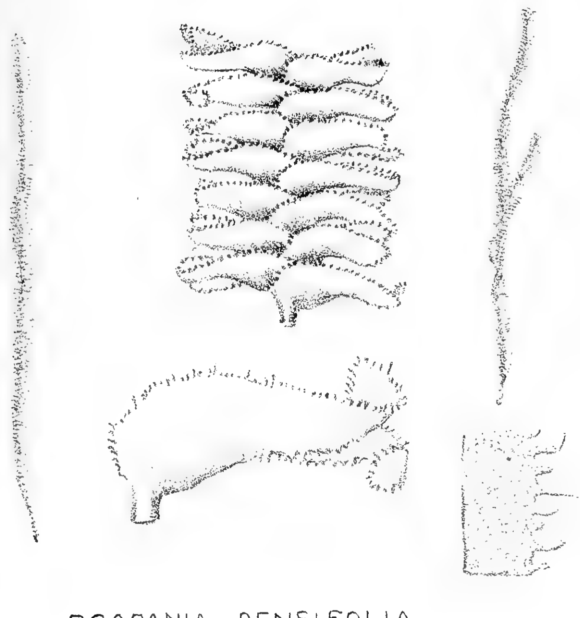


R.A.B. BALANTIOPSIS DIPLOPHYLLA LXVII


IZOTACHIS INTORTIFOLIA
GYMNOMITRIUM CONCINNATUM
I. SUBTRIFIDA
I. GUNNIANA
R.A.B.
PL. XVIII



SCAPANIA OBTUSIFOLIA

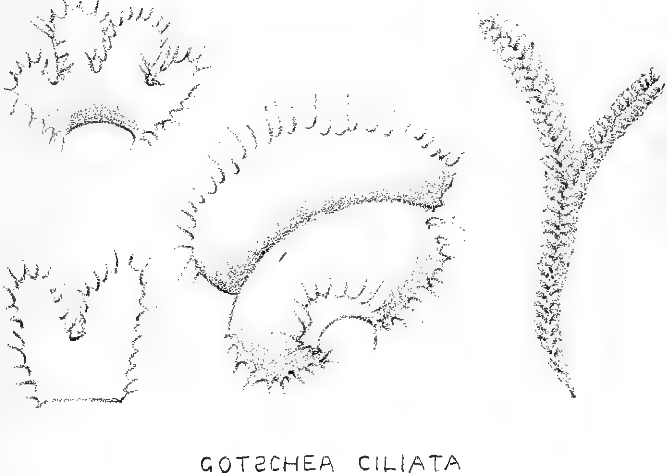


SCAPANIA DENSIFOLIA

R.A.B.

PL. XIX

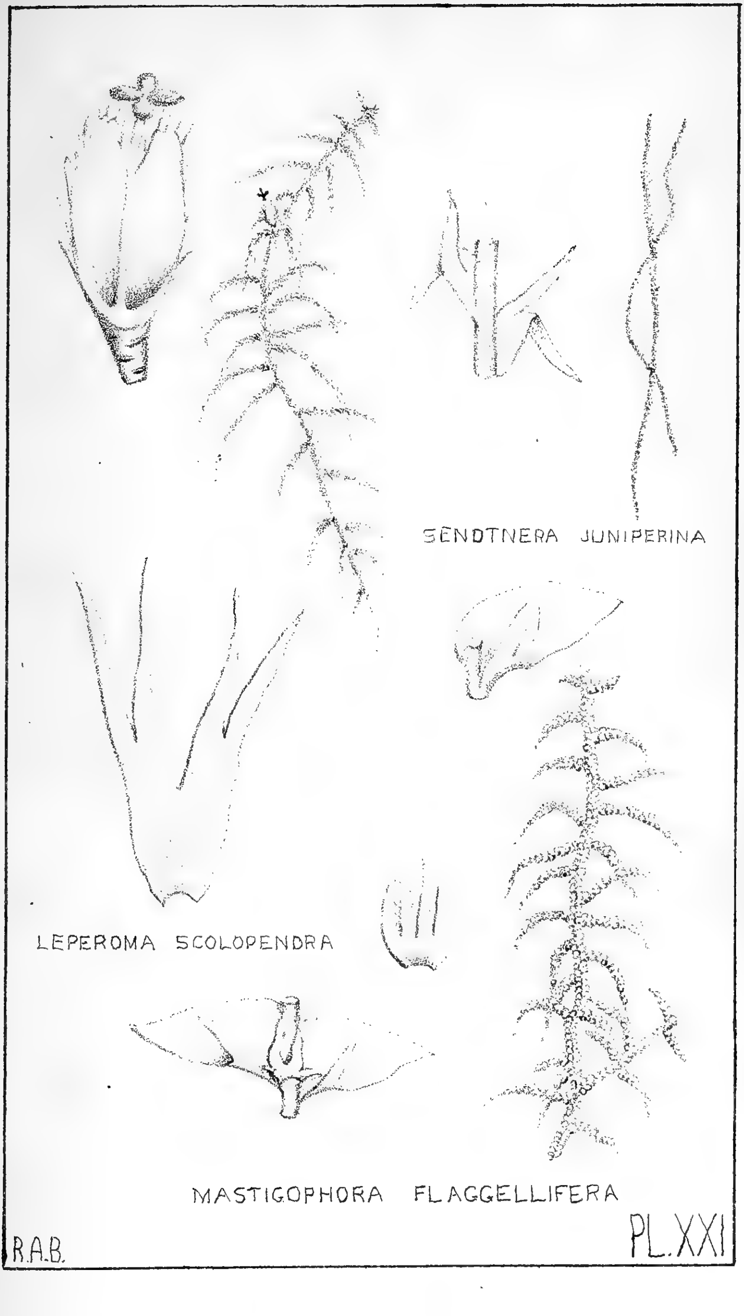
GOTSCHEA PINNATIFOLIA

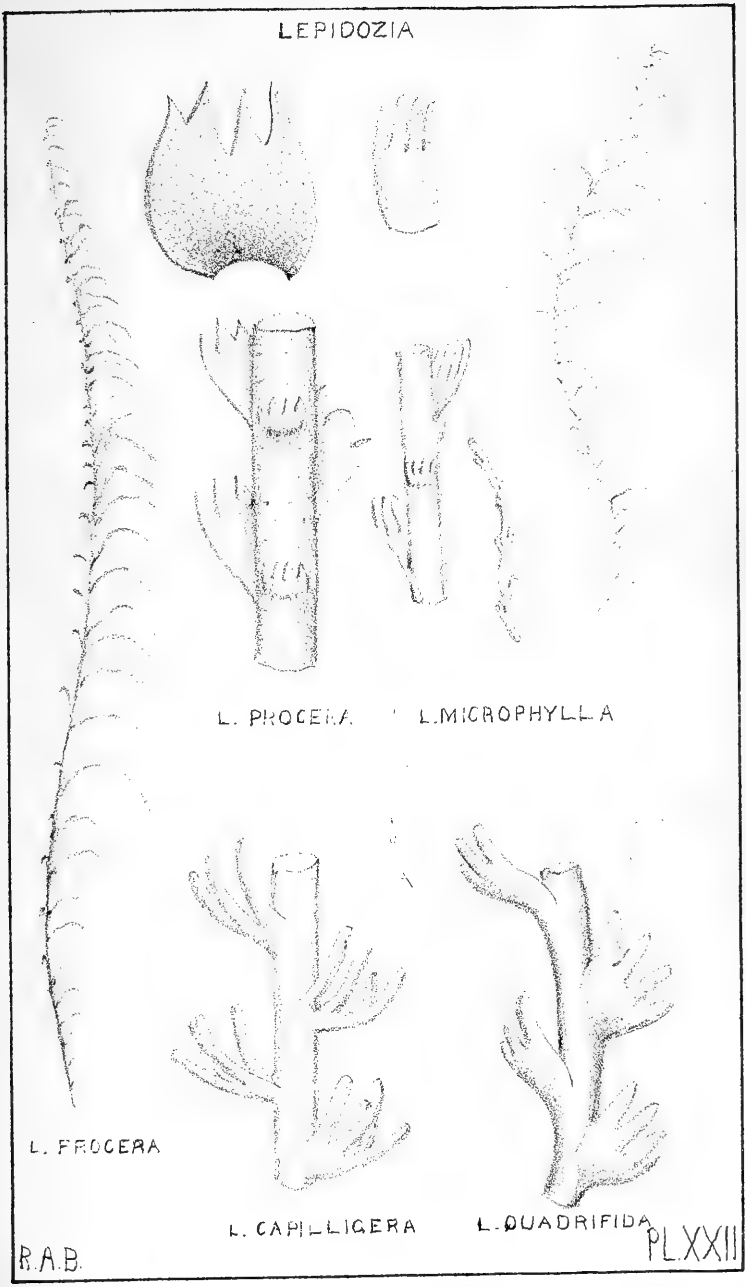


GOTSCHEA CILIATA

R.A.B.

PL. XX


SENDTNERA JUNIPERINA
LEPEROMA SCOLOPENDRA
MASTIGOPHORA FLAGGELLIFERA
R.A.B.
PL. XXI


LEPIDOZIA
L. PROCERA
L. MICROPHYLLA
L. PROCERA
L. CAPILLIGERA
L. QUADRIFIDA
PL. XXII
R.A.B.

L. PRÆNITENS

L. LÆVIFOLIA

L. PENDULINA

R.A.B.

PL. XXIII

L. CENTIPES

L. GLAUCOPHYLLA

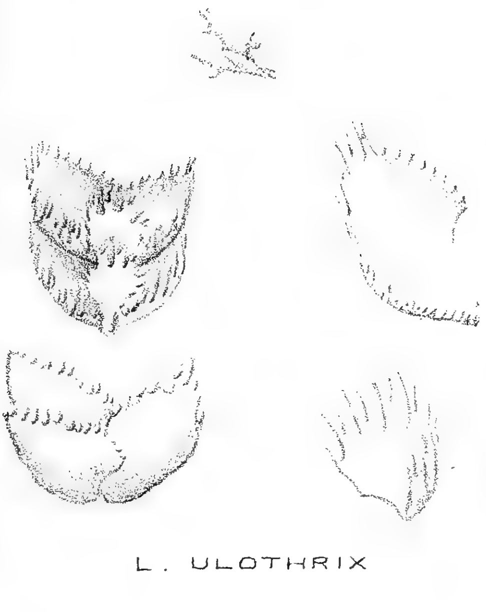
L. CAPILLARIS

L. CUPRESSINA

PL. XXIV

R.A.B.

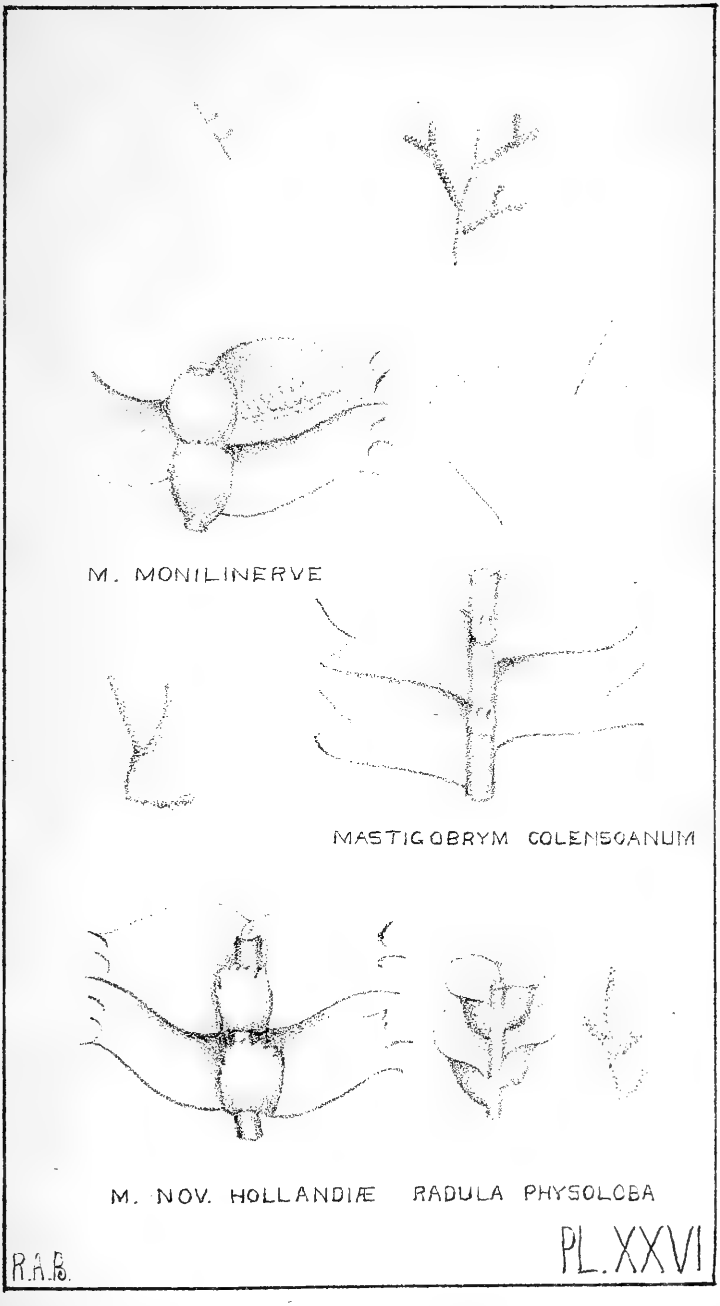
L. PATENTISSIMA



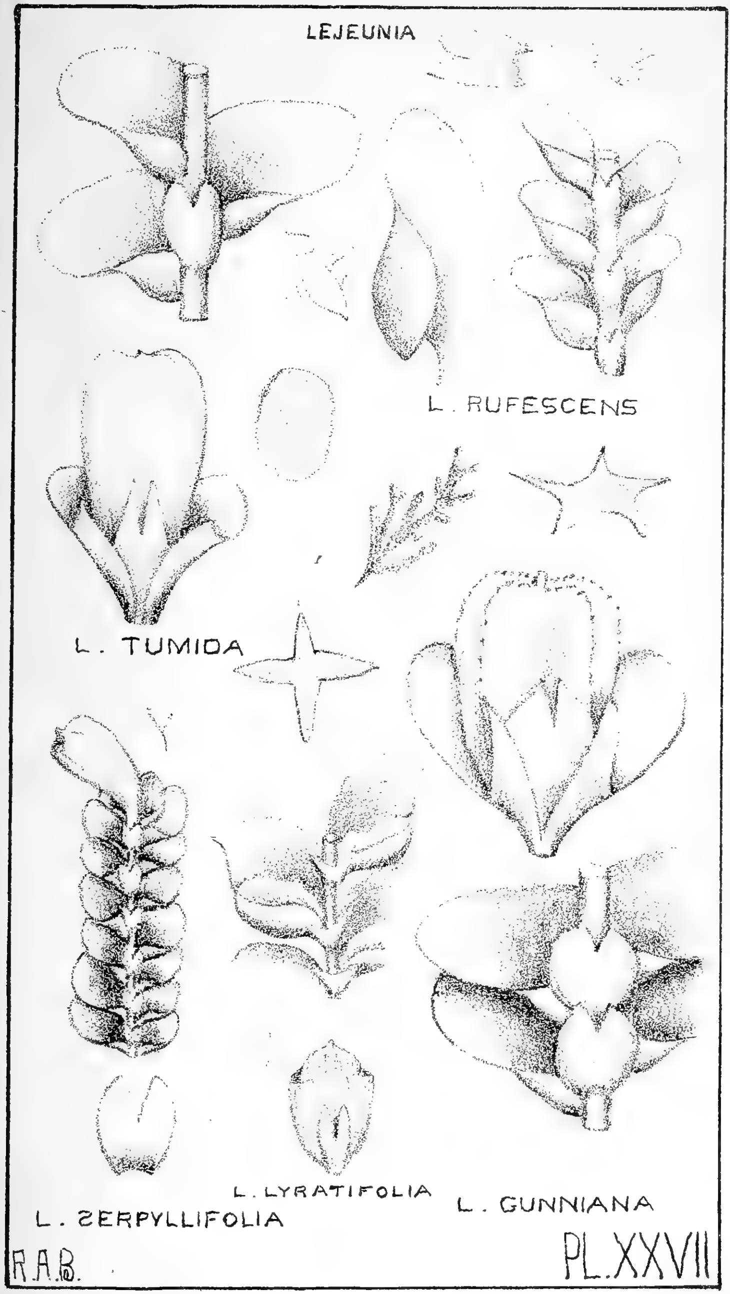
L. ULOTHRIX

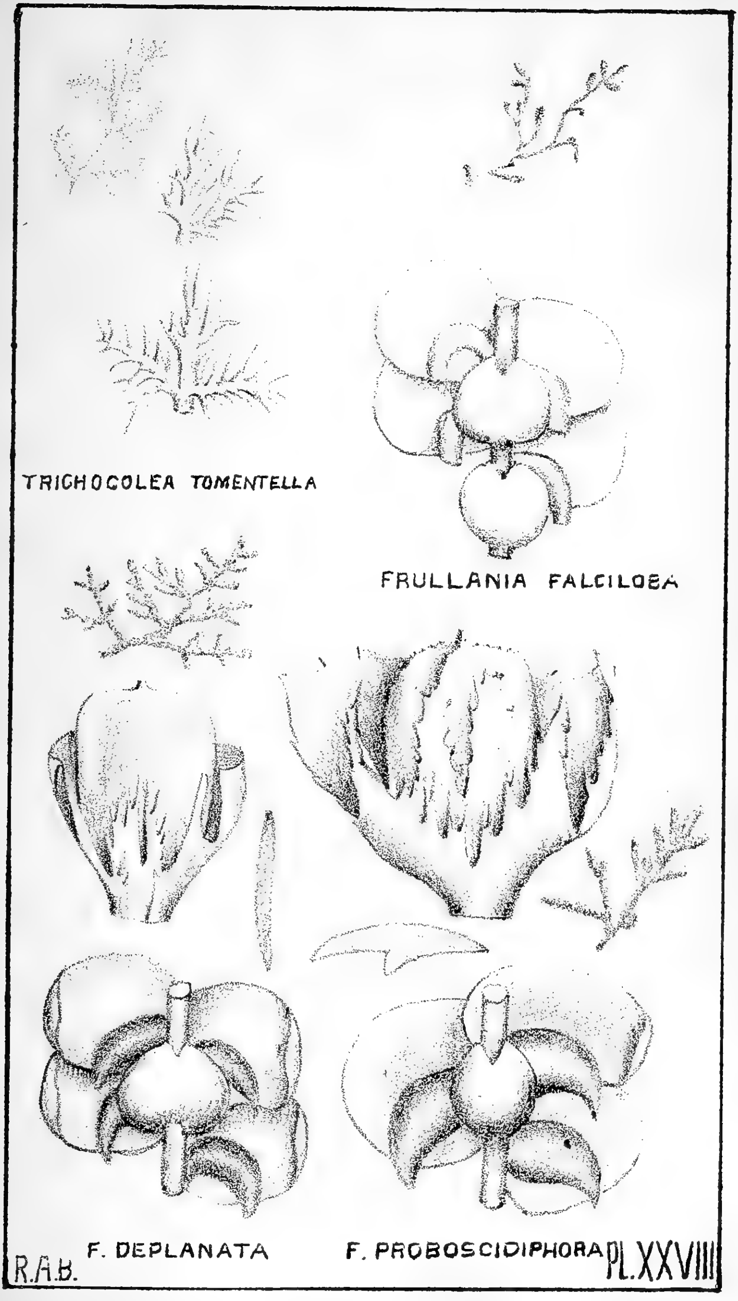
PL.XXV

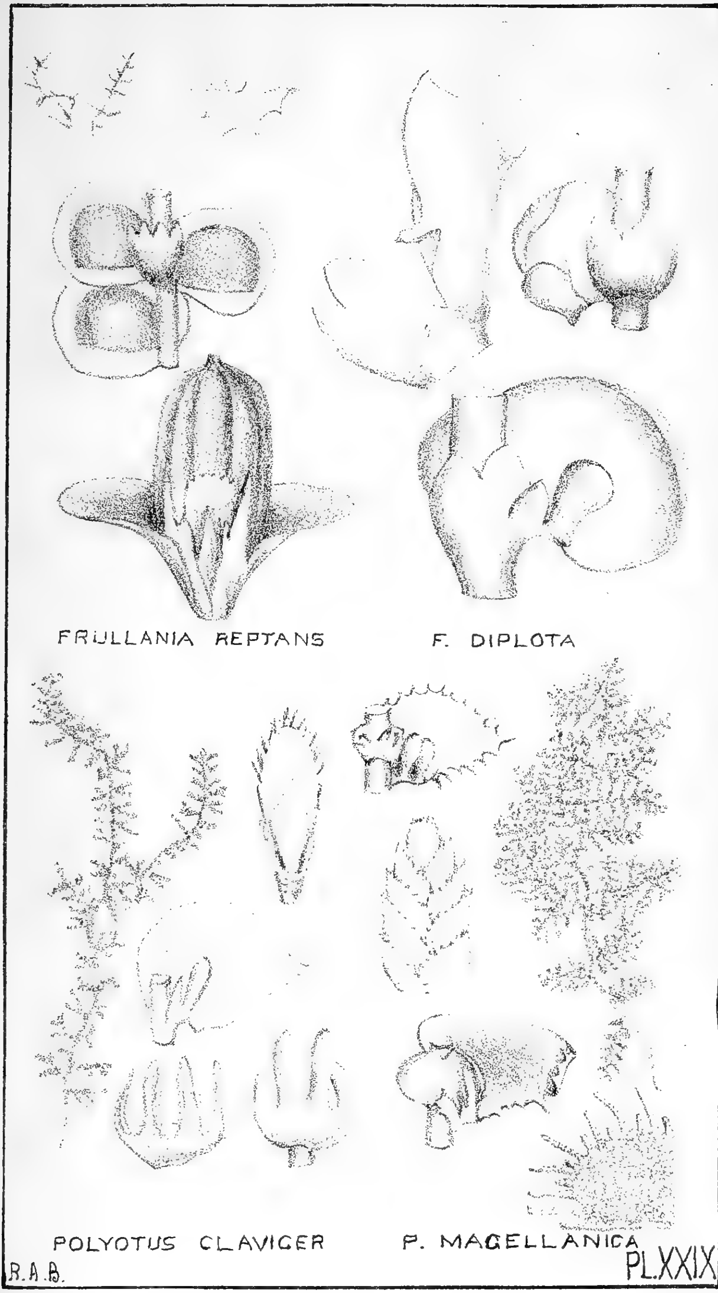
R.A.B.


M. MONILINERVE
MASTIGOBRYM COLENSOANUM
M. NOV. HOLLANDIÆ
RADULA PHYSOLOBA
R.A.B.

PL. XXVI

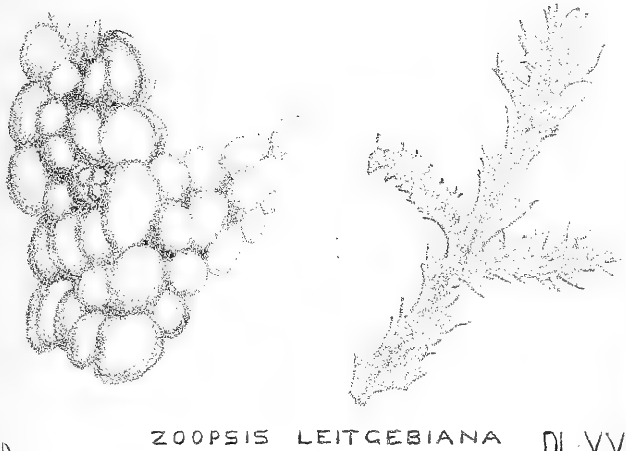

LEJEUNIA
L. RUFESCENS
L. TUMIDA
L. LYRATIFOLIA
L. GUNNIANA
L. SERPYLLIFOLIA
R.A.B.
PL. XXVII


TRICHOCOLEA TOMENTELLA
FRULLANIA FALCILOBA
R.A.B.
F. DEPLANATA
F. PROBOSCIDIPHORA
PL. XXVIII


FRULLANIA REPTANS
F. DIPLOTA
POLYOTUS CLAVIGER
P. MAGELLANICA
R.A.B.
PL.XXIX

FOSSOMBRONIA PUSILLA

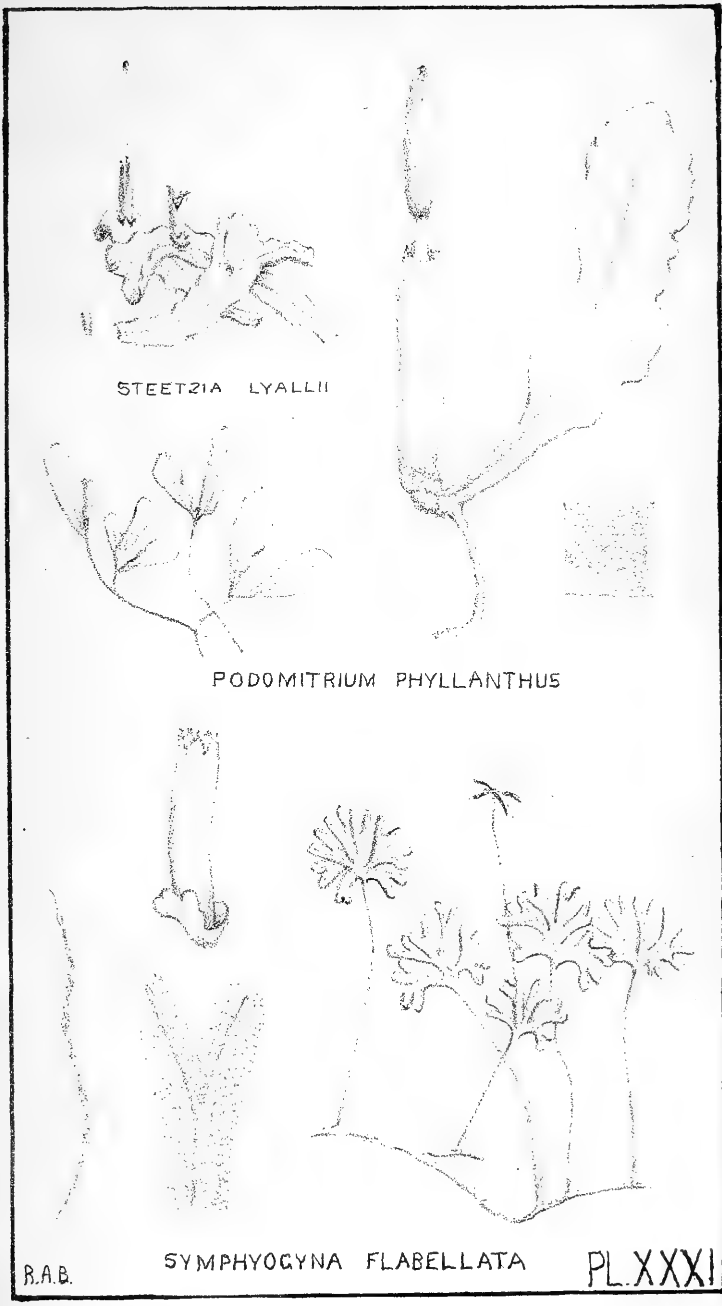
ZOOPSIS ARGENTIA

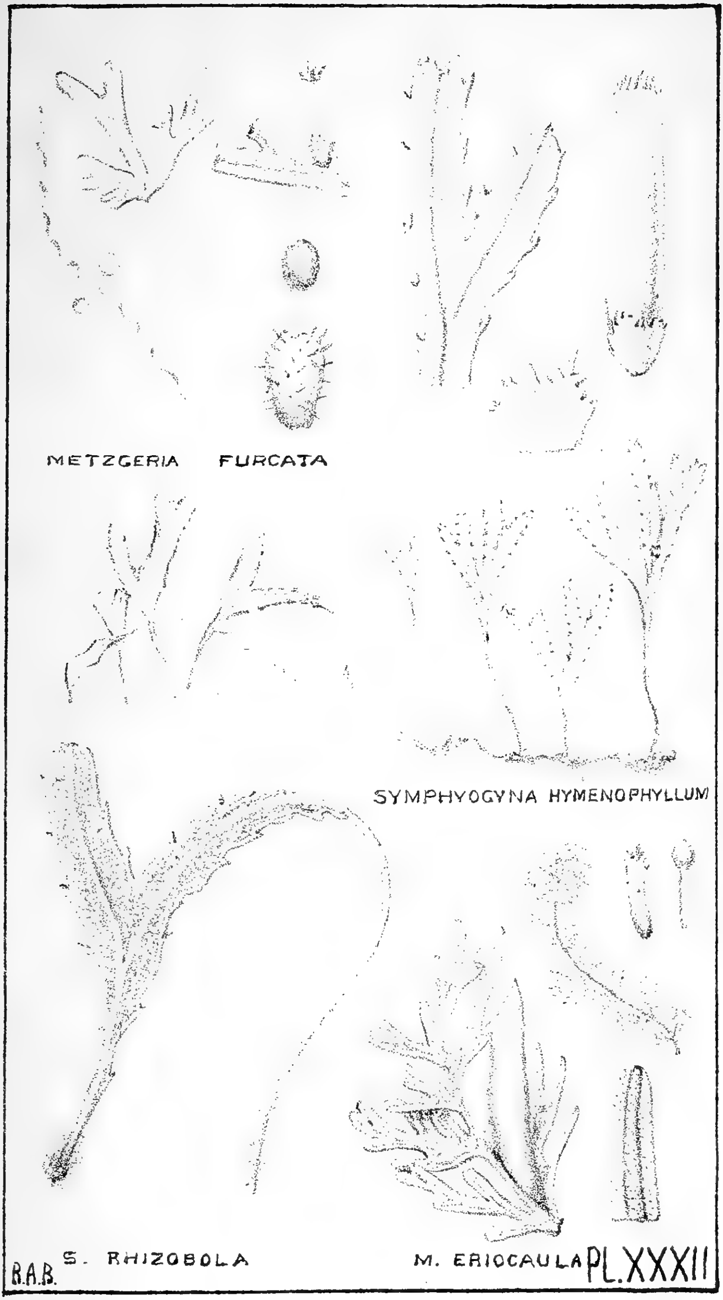


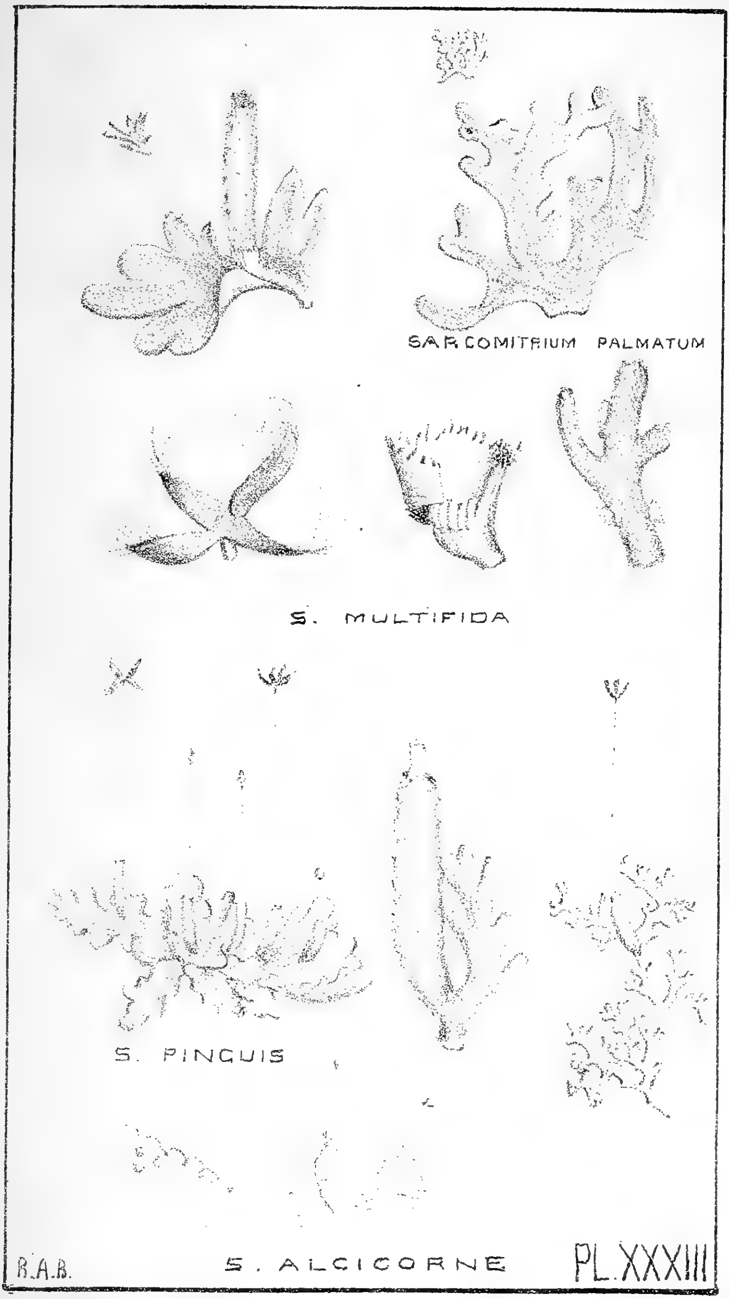
ZOOPSIS LEITGEBIANA

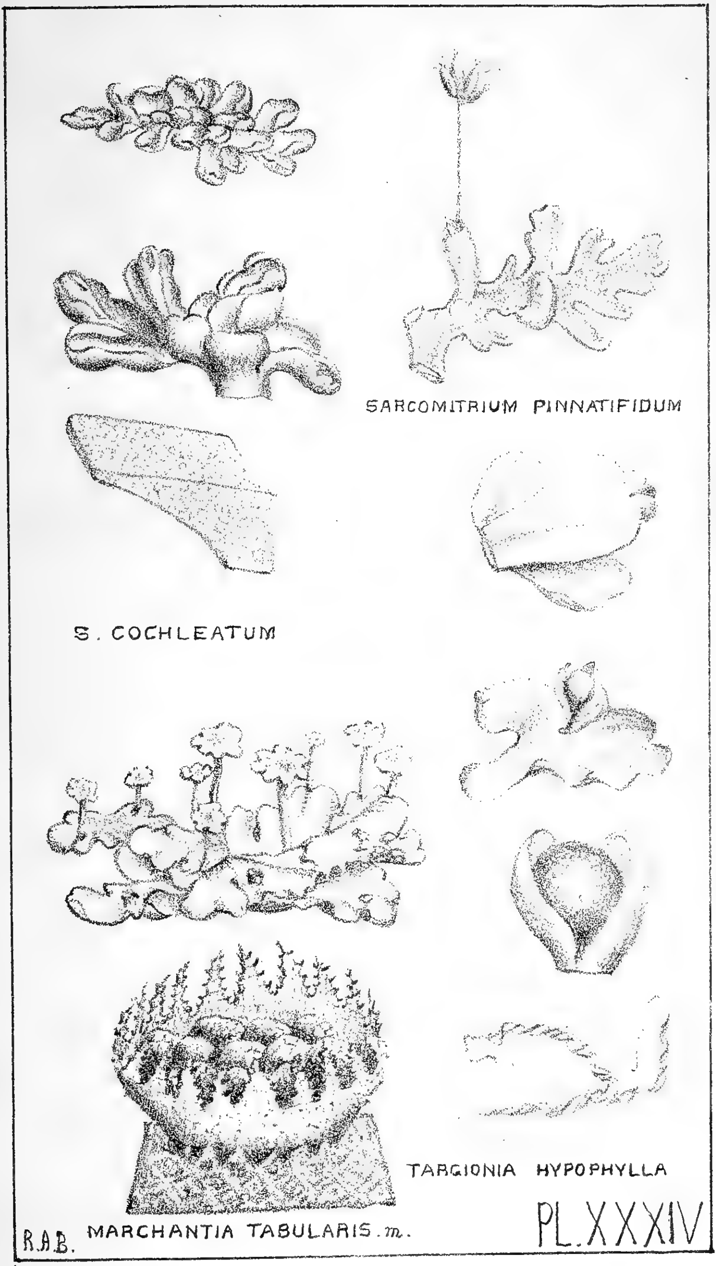
R.A.B.

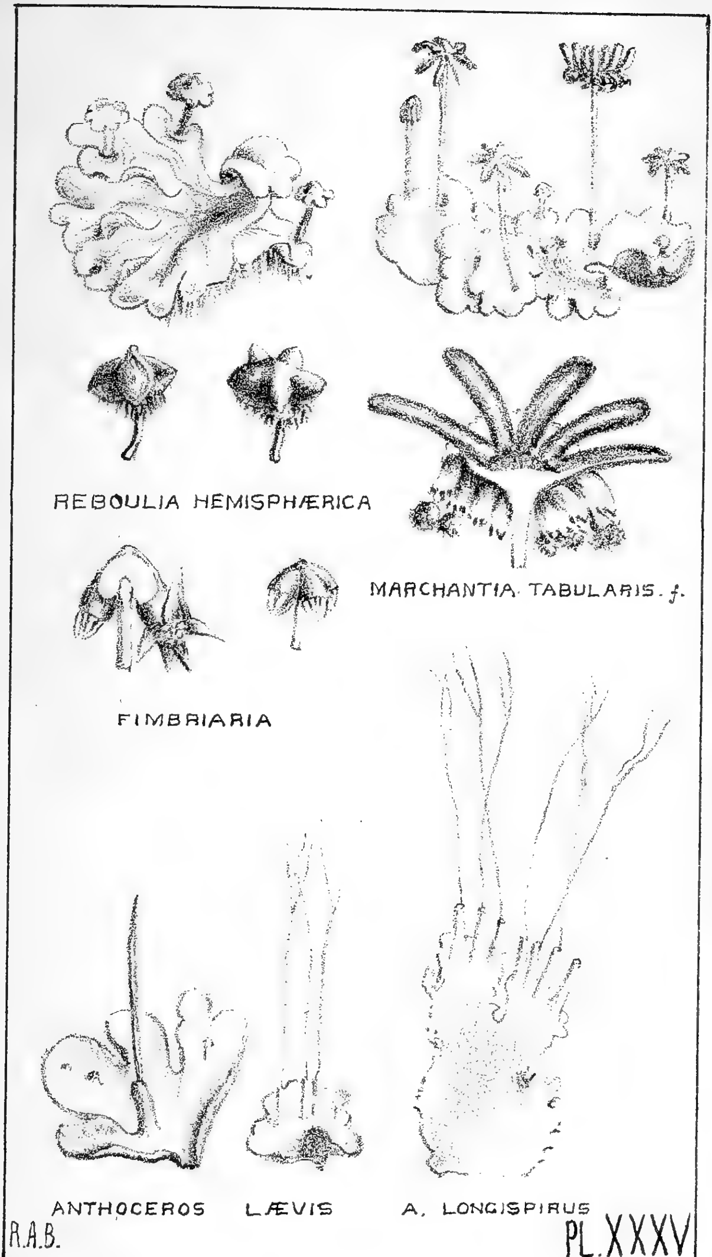
PL. XXX

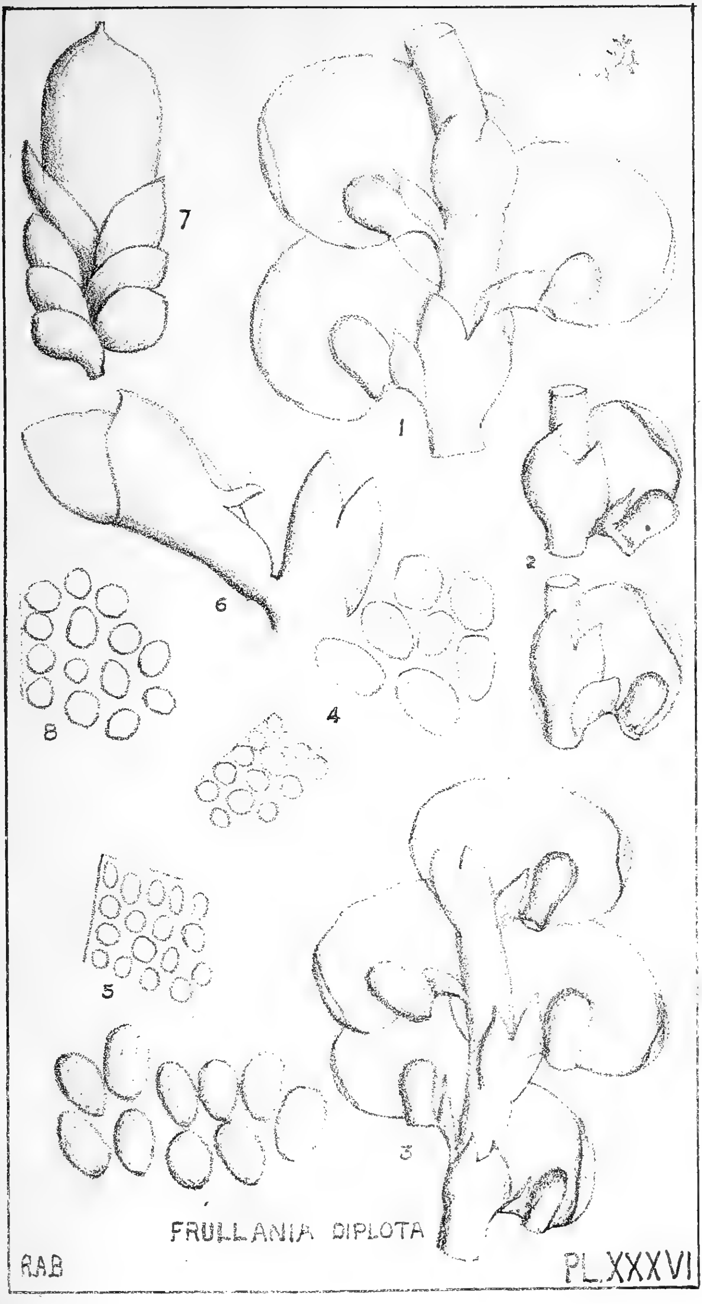

STEETZIA LYALLII
PODOMITRIUM PHYLLANTHUS
SYMPHYOGYNA FLABELLATA
R.A.B.
PL. XXXI


METZGERIA FURCATA
SYMPHYOGYNA HYMENOPHYLLUM
R.A.B.
S. RHIZOBOLA
M. ERIOCAULA
PL. XXXII


SARCOMITRIUM PALMATUM
S. MULTIFIDA
S. PINGUIS
R.A.B.
S. ALCICORNE
PL. XXXIII


SARCOMITRIUM PINNATIFIDUM
S. COCHLEATUM
TARGIONIA HYPOPHYLLA
R.A.B. MARCHANTIA TABULARIS. m.
PL. XXXIV


REBOULIA HEMISPHÆRICA
MARCHANTIA TABULARIS. f.
FIMBRIARIA
ANTHOCEROS LÆVIS
A. LONGISPIRUS
R.A.B.
PL. XXXV



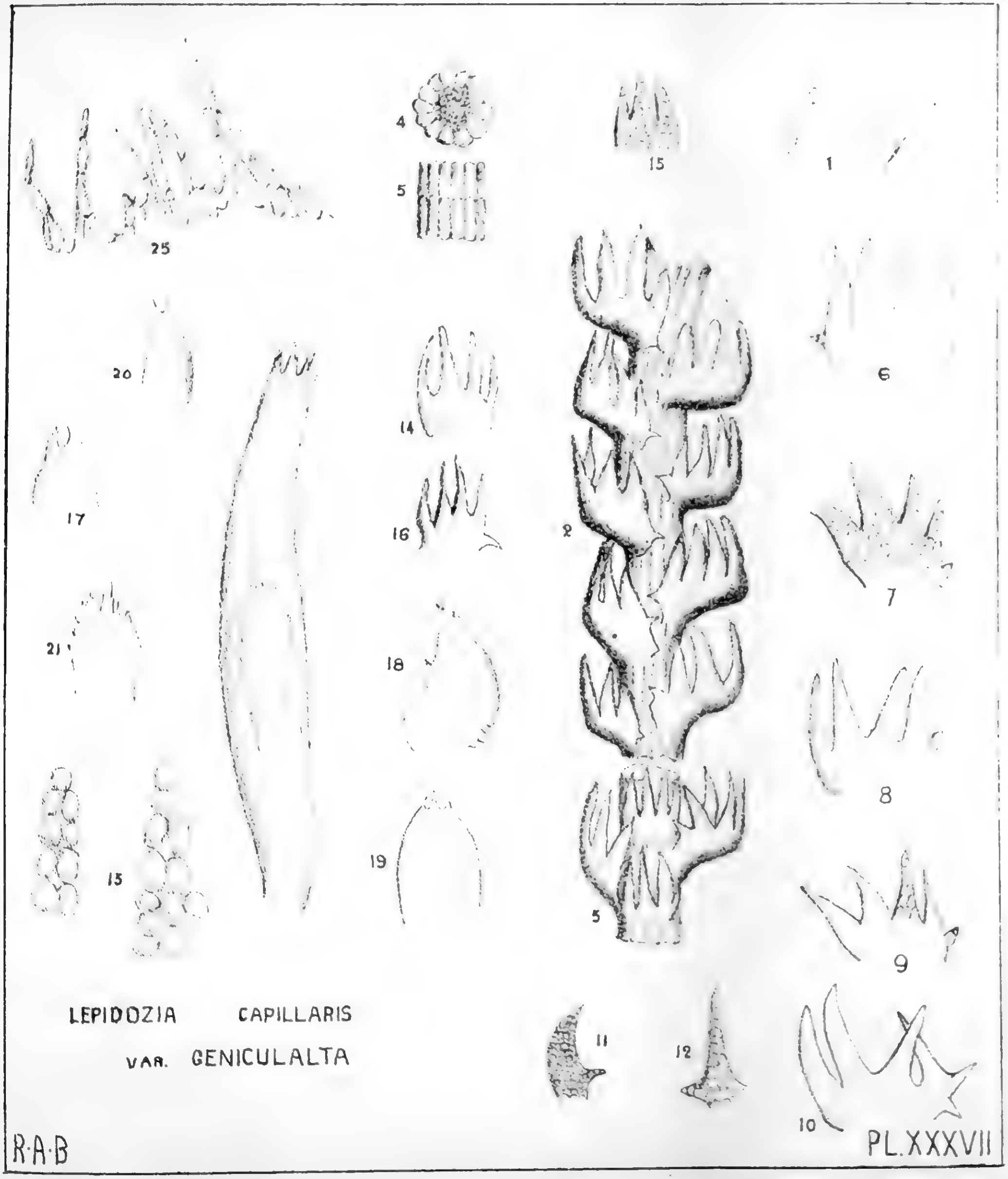
FRULLANIA DIPLOTA

PL. XXXVI

LEPIDOZIA CAF

VAR. GENICU

R·A·B


25
4
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19
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9
LEPIDOZIA CAPILLARIS
VAR. GENICULALTA
11
12
10
R·A·B
PL. XXXVII

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12

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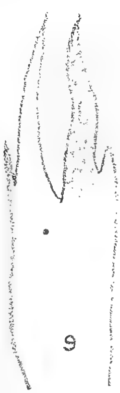

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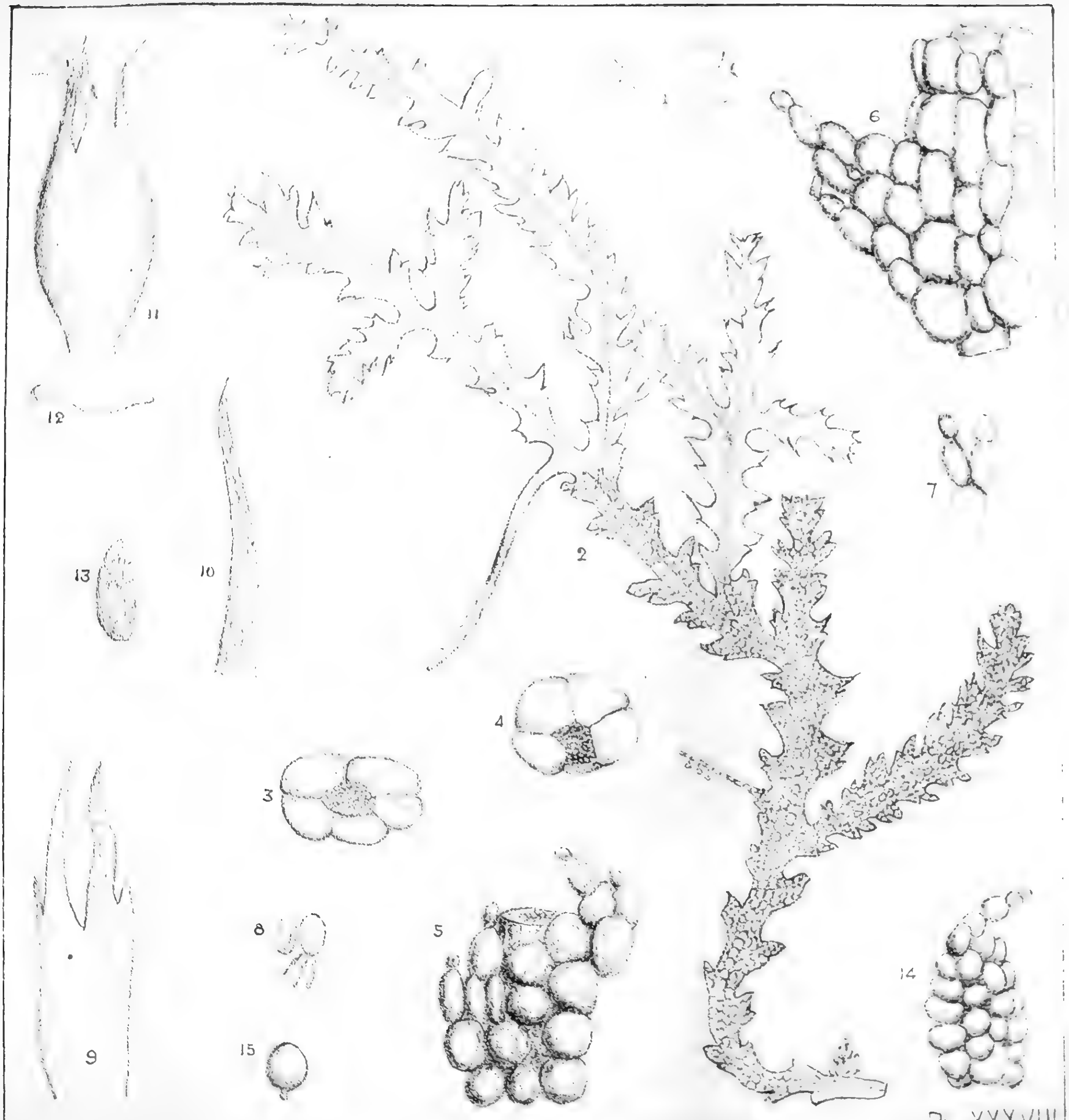
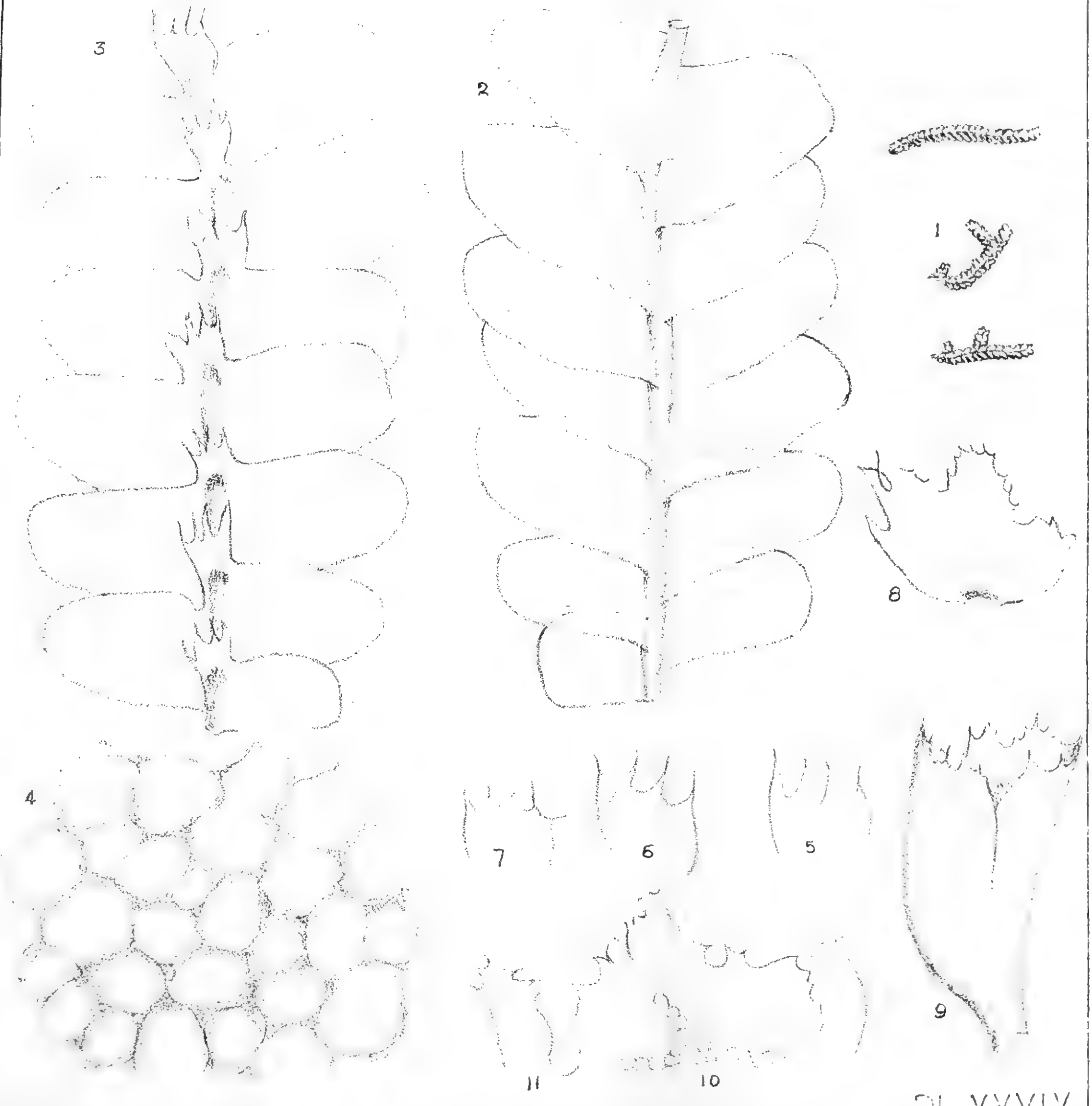
R·A·B



R·A·B CEPHALOZIA (ZOOPSIS) LEITGEBIANA PL. XXXVIII

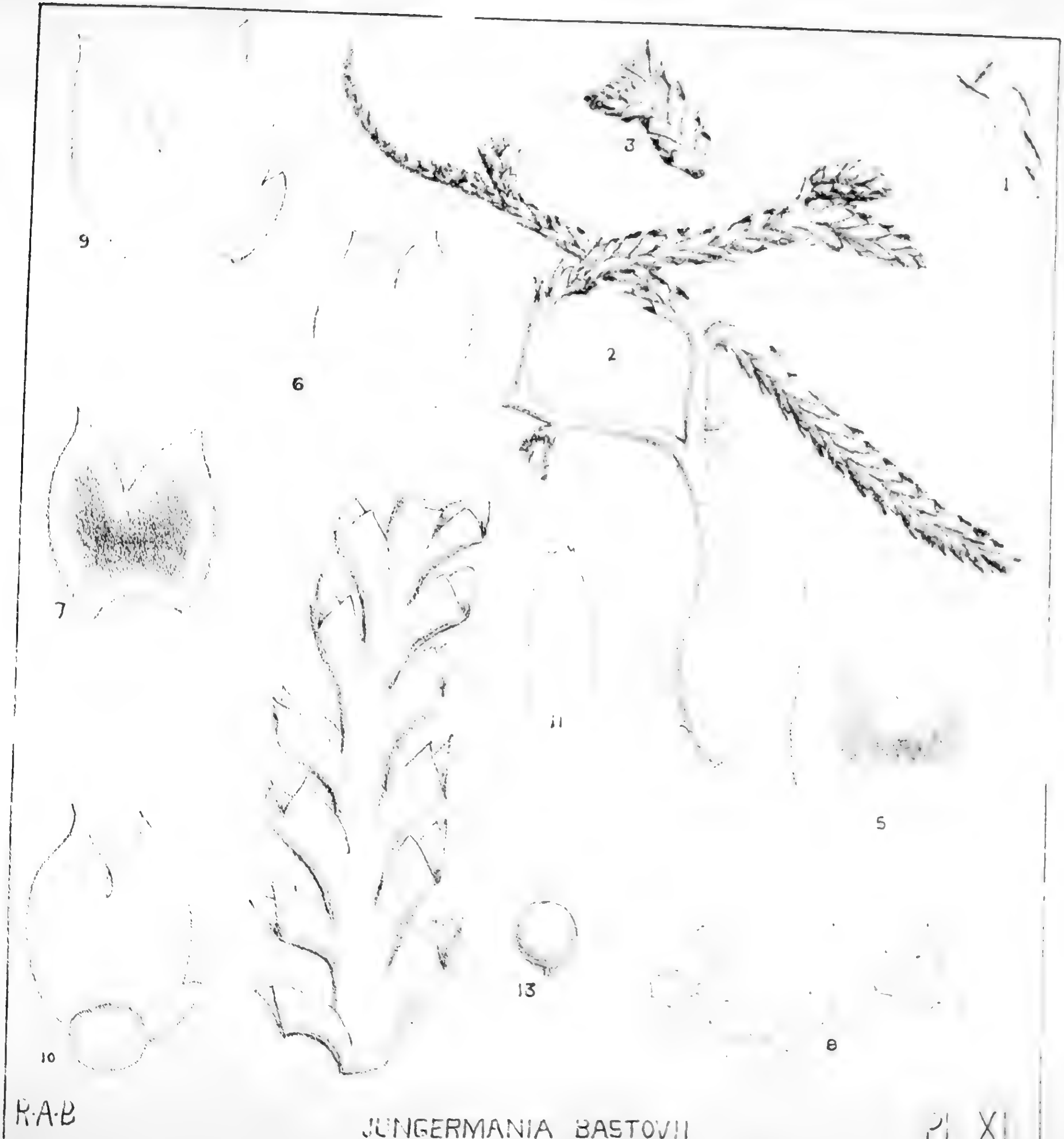
4

R.A.B.



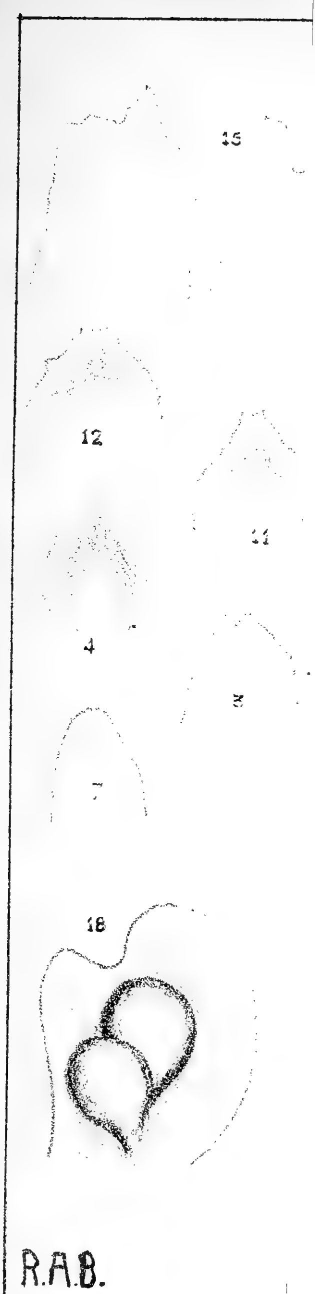
R.A.B. CHILOSCYPHUS LIMOSUS PL. XXXIV.

R.



JUNGERMANIA BASTOVII

PL. XL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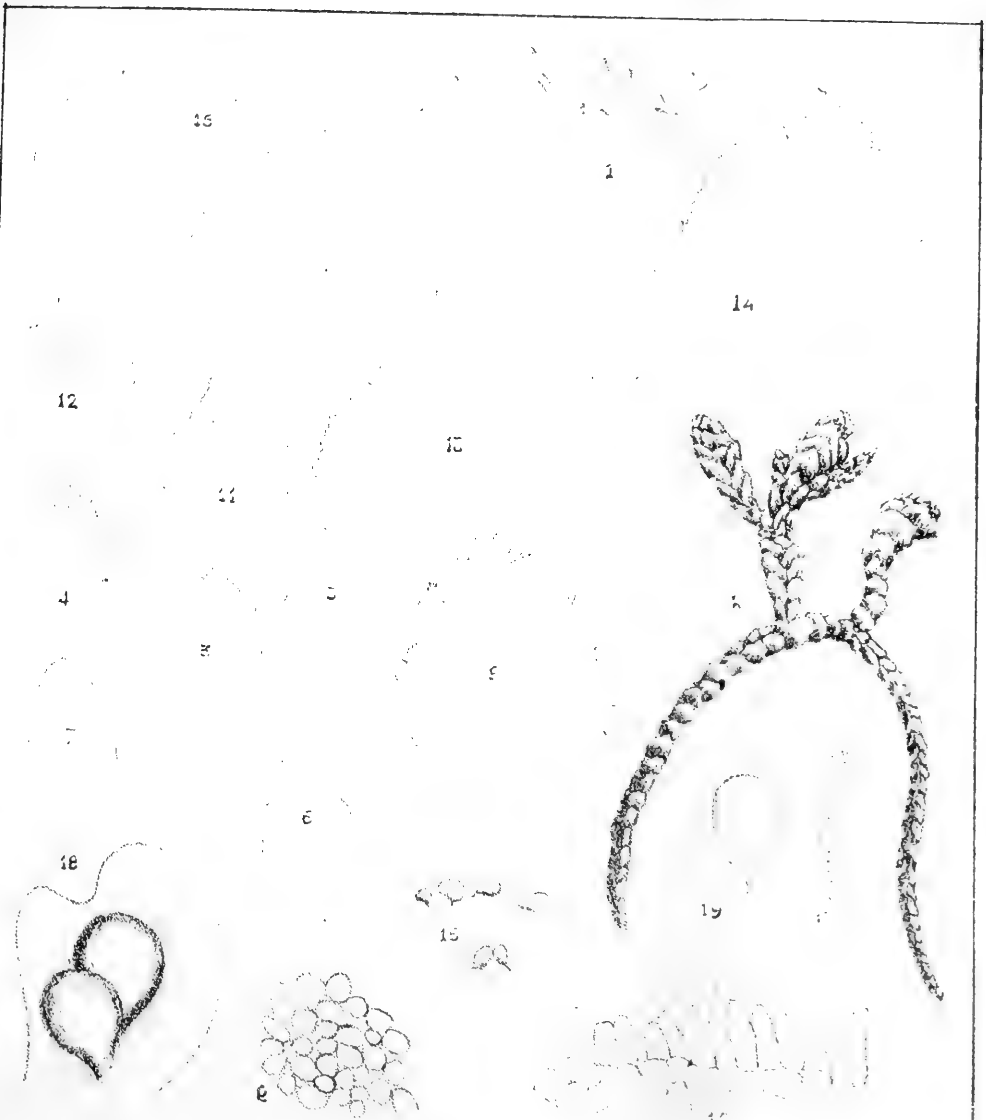
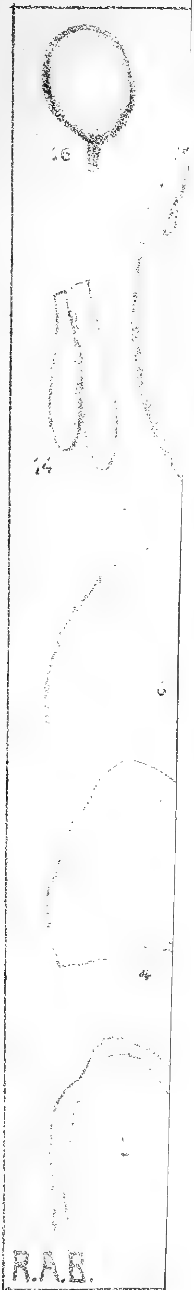
R.A.B.



R.A.B. CESIA EROSA PL. XLI


16
14
R.A.B.

R.A.E. JUNGERMANIA (JAMESONIELLA) TERES PL. XLII

R·A·B ANTHOCEROS LONGISPIRUS PL.XLIII