# TRANSACTIONS AND PROCEEDINGS

AND

# REPORT

OF THE

# PHILOSOPHICAL SOCIETY

OF

# ADELAIDE, SOUTH AUSTRALIA,

FOR 1877–78.

ADELAIDE:
Printed at the Advertiser General Printing Office.

1878.

# Philosophical Society of Adelaide.

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HIS EXCELLENCY SIR W. F. D. JERVOIS, G.C.M.G., C.B., &c.

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MR. A. MOLINEUX.

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# Philosophical Society of Adelaide,

*FOR 1877-78.*

## ABSTRACT OF PROCEEDINGS.

ORDINARY MEETING, 27TH NOVEMBER, 1877.

Professor TATE, F.G.S., V.P., in the chair.

THE HON. SECRETARY laid on the table "The Statute Index of Tasmania for 1876."

Mr. A. Adamson, jun., was elected an ordinary member.

The CHAIRMAN read a letter referring to the supposed bones of a whale visible in the Murray Cliffs, near Blanchetown.

Mr. D. C. F. MOODIE (visitor) read a paper on "The Non-introduction of Diseased Cattle," which was followed by a discussion.

ORDINARY MEETING, 18TH DECEMBER, 1877.

J. S. LLOYD, Esq., Hon Treasurer, in the chair.

The Rev. W. R. FLETCHER, M.A. (member), read a paper on "The Exploration of Palestine," which was followed by a discussion.

ORDINARY MEETING, 5TH FEBRUARY, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The following gentlemen were elected ordinary members :—Messrs. W. Townsend, M.P., S. Knevett, J. J. Stuckey, M.A., and A. Ringwood.

Professor TATE, F.G.S., V.P., exhibited a piece of rock from Hallett's Cove, which showed a polished and scratched surface, indicative of glacial action.

Dr. SCHOMBURGK (member) read a paper on "Plant-fragments found in the Tombs and other Monumental Buildings of the Ancient Egyptians," which was followed by a discussion.

Mr. T. D. SMEATON, P.V.P., took the chair while Professor TATE read a paper communicated by Mr. Otto Tepper on "The Decrease of many Species of Insects and the Increase of some in South Australia," which was followed by a discussion.

ORDINARY MEETING, 26TH FEBRUARY, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The CHAIRMAN announced that the Council had received the resignation of Mr. W. C. M. Finniss as Hon. Secretary, and that Mr. Walter Rutt would act as Hon. Secretary *pro tem.*

The CHAIRMAN exhibited a selection of fossils, obtained from the Murray Cliffs at Glenforslan, near Blanchetown, in which the original shell is replaced by selenite. He considered these shells to be Eocene, and that our South Australian Tertiary-beds were of older date than had been suspected. A discussion upon the subject ensued.

ORDINARY MEETING, 19TH MARCH, 1878.

Professor TATE, F.G.S., V.P., in the chair.

Mr. Thos. Harry was elected an ordinary member.

Notice of motion was given by Messrs. Tate, Ingleby, Smeaton, Wilson, and Todd, proposing alterations in the Rules, and it was resolved that the same should be printed and circulated.

[SICHERO] Messrs. D. B. Adamson, A. W. Dobbie, J. Macgeorge, and B. H. Babbage, Professor Lamb, and Dr. Schomburgk, with the Council, were appointed a Committee to arrange for a Conversazione ; Mr. W. Rutt to act as Hon. Secretary.

Mr. T. D. SMEATON took the chair while Professor TATE read a paper communicated by Mr. Gavin Scoular, on "The Origin of Mineral Veins, with special reference to the Barossa District."

The HON. SECRETARY *pro tem.* read a paper communicated by Mr. H. H. Hayter, F.S.S., Government Statist of Victoria, on "Infantile Mortality in South Australia." A discussion followed, which was adjourned to the next ordinary meeting.

CONVERSAZIONE, 15TH APRIL, 1878.

The Conversazione was held in the Town Hall, Adelaide, which was filled with philosophical instruments, collections of natural history, and other objects of scientific interest, as well as illustrated works upon natural history, and a few specimens of the fine arts. Numerous experiments were performed with the apparatus, and two or three telephones were in operation throughout the evening.

ORDINARY MEETING, 21ST MAY, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The HON. SECRETARY *pro tem.* laid on the table a copy of a paper "On the motion of a screw in an infinite mass of liquid," by Professor

Lamb, and of "A catalogue of the plants in the Botanic Garden, Adelaide," and of "The Annual Report of the Botanic Garden for the year 1877," by Dr. Schomburgk. Copies of the last two works were distributed among the members present.

The following gentlemen were elected ordinary members:—Messrs. Geo. Brunskill and W. L. Ware.

The cordial thanks of the Society were presented to those gentlemen not being members of the Society who had assisted by sending exhibits to the late Conversazione.

The existing Rules were repealed, and a new code, as proposed by the Council, was passed with a few verbal amendments.

The adjourned discussion upon Mr. Hayter's paper on "Infantile Mortality in South Australia" was continued.

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ORDINARY MEETING, 18TH JUNE, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The following officers were elected for the remainder of the session:—As Honorary Secretary, Mr. Walter Rutt, C.E.; as Vice-President, Mr. T. D. Smeaton; as Member of Council, Mr. D. B. Adamson.

The HON. SECRETARY laid on the table "The Statistical Register for Victoria for 1876," and "Statistics of Friendly Societies for Victoria for 1876."

Mr. C. A. WILSON (hon. member) drew attention to the recent discovery of two more planetoids.

The HON. SECRETARY read a paper, communicated by Mr. Otto Tepper, on "The Habits and Description of a new South Australian Beetle (*Melolontha destructor*)," which was followed by a discussion.

The HON. SECRETARY read a paper, communicated by Mr. W. T. Bednall, on "Australian Trigonias and their Distribution," which was followed by a discussion.

Professor TATE, F.G.S., V.P., read abstracts of two papers on "Recent South Australian Marginellidæ" and on "Fossil Australian Marginellidæ."

Specimens in illustration of the foregoing papers were exhibited.

Mr. T. D. SMEATON, V.P., exhibited the imago and chrysalides of a large brown and white butterfly, which had within the last few years established itself in South Australia. A discussion followed, in which it was asserted that the species was *Danais Archipus*, that its original habitat was the United States of America, and that it had been observed in Queensland, New South Wales, Victoria, and elsewhere in the Southern Hemisphere.

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ORDINARY MEETING, 16TH JULY, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The following gentlemen were elected:—As Corresponding Members—Messrs. H. H. Hayter, F.S.S., Gavin Scoular, and Otto Tepper as Ordinary Members—Mr. A. Adamson, Colonel Biggs, and Dr. Verco, M.D., M.R.C.S.; as Associate—Mr. Stirling Smeaton.

The HON. SECRETARY laid on the table a "List of Land Shells collected on Fitzroy Island," by Mr. John Brazier, C.M.Z.S.

The CHAIRMAN exhibited specimens illustrative of a paper recently presented by himself to the Linnæan Society of New South Wales on "Three new species of Helices;" also corals, including one new species, illustrative of a paper presented to the same Society by the Rev. J. E. T. Woods, F.L.S., F.G.S., honorary member of this Society, on "The extra-tropical corals of Australia."

The HON. SECRETARY read a paper by Mr. Otto Tepper, corresponding member, on "Whirlwinds," which was followed by a discussion.

ORDINARY MEETING, 20TH AUGUST, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The CHAIRMAN referred to his having found near the Murray Mouth a sandpiper, whose foot was clasped by a large Donax shell, which it had probably carried from the Middleton beach. This incident illustrated by analogy Darwin's suggestion that the wide distribution of fresh-water animals and plants was due to the agency of aquatic birds.

Mr. SAMUEL HIGGS, F.G.S. (visitor), read a short abstract of "A list of minerals found in South Australia," which he was compiling for presentation to the Society; and the paper was followed by a discussion.

Mr. CHARLES TODD, C.M.G., F.R.A.S., M.S.T.E., member of Council, read a paper on "The Telephone and the Microphone," followed by experiments.

ORDINARY MEETING, 17TH SEPTEMBER, 1878.

Professor TATE, F.G.S., V.P., in the chair.

The HON. SECRETARY laid upon the table "The Statistical Register of Victoria for 1877; parts 1 and 2;" several volumes of "The Bulletin of the Signal Service of the United States for 1874;" "Smithsonian Report for 1876;" and "Transactions of the Royal Society of Victoria, vols. 13 and 14."

Mr. E. P. Nesbit, jun., was elected Auditor.

Mr. R. Ingleby, Q.C., drew attention to the sympathy existing between the weather in the Southern and that in the Northern Hemisphere. In the latter there had occurred successively a stormy, a dry, a hot, and a wet season. The two former we had already experienced here, and he anticipated a hot summer, and probably a wet November and December.

The CHAIRMAN stated that the old rocks of our hills had hitherto been supposed to be destitute of fossils. He exhibited specimens of a palæozoic limestone obtained by Mr. O. Tepper, corresponding member, near Maitland, which showed possible traces of organic remains. Mr. Tepper had written that he had since found more decisive evidences of fossils.

Mr. Smeaton, V.P., having taken the chair, Professor TATE read a paper by the Rev. J. E. T. Woods, honorary member, on "The Fossil Corals of Aldinga."

Professor TATE then read some supplementary notes on "The Correlation of the Tertiary Strata of South Australia, with a list of species of Tertiary Corals."

Specimens in illustration of the foregoing papers were exhibited.

The Hon. Secretary read a paper on "Subterranean Water Supply in the Interior," by Mr. T. Rawlinson, C.E., communicated through Mr. C. Todd, C.M.G., which was followed by a discussion.

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Annual Meeting, 8th October, 1878.

Professor Tate, F.G.S., V.P., in the chair.

The following gentlemen were elected:—As Honorary Member—Mr. W. Macleay, F.L.S.; as Ordinary Member—Mr. William Thow.

The Hon. Secretary laid on the table the "Statistical Register for Victoria for 1877; part 5," the "Meteorological Observations recorded at the Adelaide Observatory for 1876," and the same for the first three months of 1878.

The Rules adopted upon the 21st May, 1878, were confirmed.

Mr. C. Todd, C.M.G., M.S.T.E., exhibited a new insulator designed by himself for use with iron poles. The porcelain umbrella was protected by an iron shield, and was screwed on to an iron pin, which penetrated to within one-eighth of an inch of the iron shield, being prevented from touching it by an annular distance piece of ebonite. The pin acted as a lightning discharger, and would obviate the difficulty arising from the constant fracture of the ordinary insulators when placed upon iron poles.

Mr. C. A. Wilson laid on the table copies of the *Garden and Field*, containing an article written by himself on "The American Butterfly." He also exhibited two ancient deeds of the 14th and 15th centuries.

The Annual Report and Balance-Sheet were read by the Hon. Secretary and adopted, and it was resolved that they should be printed and published in the transactions of the Society.

The anniversary address having been delivered by the Chairman, it was resolved that the address be printed in the transactions of the Society.

The Chairman announced that His Excellency the Governor had accepted the position of Patron of the Society, and it was resolved that the Hon. Secretary communicate to His Excellency the thanks of the Society.

The following gentlemen were elected as Officers and Council for the ensuing year:—

President—Professor R. Tate, F.G.S.

Vice-Presidents—R. Ingleby, Q.C., and C. Todd, C.M.G., F.R.A.S., M.S.T.E.

Treasurer—T. D. Smeaton.

Honorary Secretary—Walter Rutt, C.E.

Members of Council—D. B. Adamson, F. S. Chapple, B.A., B.Sc., Jas. Macgeorge, and S. J. Magarey, M.B.

It was resolved that an Assistant Secretary be appointed, the appointment and the remuneration to be left to the Council.

The thanks of the Society were accorded to the retiring Treasurer (Mr. J. S. Lloyd), and to Mr. C. A. Wilson, who retired from the Council; and a similar vote was passed to the other officers and members of Council for the past year.

# REPORT OF THE COUNCIL

OF THE

# ADELAIDE PHILOSOPHICAL SOCIETY

FOR THE YEAR ENDING SEPTEMBER 30TH, 1878.

In presenting to the members of this Society the twenty-fifth Annual Report of its proceedings, the Council have pleasure in stating that the papers which have been laid before the members during the past year have been of a character worthy of the Society, embodying the results of a considerable amount of original research; and it is a cause of regret that the attendance of members and their friends at our meetings has not, as a rule, been so large as might reasonably have been expected from the quality of the matter submitted. The following is a list of the papers laid before the Society during the year:—

"The Non-introduction of Diseased Cattle," by Mr. D. C. F. Moodie.

"The Exploration of Palestine," by Rev. W. R. Fletcher, M.A.

"Plant-fragments found in the tombs and other monumental buildings of the Ancient Egyptians," by Dr. Schomburgk, Dr. Ph., &c.

"The Decrease of many species of Insects, and the Increase of some, in South Australia," by Mr. Otto Tepper.

"The Origin of Mineral Veins, with special reference to the Barossa District," by Mr. Gavin Scoular.

"Infantile Mortality in South Australia," by Mr. H. H. Hayter, F.S.S.

"The Habits and Description of a new South Australian Beetle (Melolontha destructor)" by Mr. Otto Tepper.

"Australian Trigonias and their distribution," by Mr. W. T. Bednall.

"Recent Australian Marginellidæ," by Professor Tate, F.G.S.

"Fossil Australian Marginellidæ," by Professor Tate, F.G.S.

"Whirlwinds," by Mr. Otto Tepper.

"A list of Minerals found in South Australia," by Mr. Samuel Higgs, F.G.S.

"The Telephone and Microphone," by Mr. Charles Todd, C.M.G., F.R.A.S., M.S.T.E.

"The Fossil Corals of Aldinga," by Rev. J. E. Tenison Woods, F.L.S., F.G.S., &c.

"The correlation of the coral-bearing strata of South Australia, with a list of species of tertiary corals," by Professor R. Tate, F.G.S.

"Subterranean water supply in the Interior," by Mr. T. E. Rawlinson, C.E.

In addition to the ordinary meetings of the Society, a very successful Conversazione was held in the Town Hall, Adelaide, during the month of April, which, as your Council believes, excited considerable interest in scientific subjects, not only among the members of this Society, but also among the general public.

The following works have been presented to the Society's library during the year:—

"The Statute Index of Tasmania for 1876."

"The motion of a screw in an infinite mass of water," by Professor Lamb.

"Catalogue of plants in the Botanic Garden, Adelaide," by Dr. Schomburgk, Dr. Ph.

"Annual Report of the Botanic Garden for 1877," by Dr. Schomburgk, Dr. Ph.

"Statistical Register of Victoria, parts of 1876 and 1877."

List of Land Shells collected on Fitzroy Island; by Mr. John Brazier, C.M.Z.S.

During the year the Council carefully considered the Rules of the Society, and came to the conclusion that it was advisable to revise them, and the amended code, adopted by the Society on the 21st May, is now in force. The chief alterations consist in the numerical increase in the Council, the admission as corresponding members of residents in this Province at a distance from Adelaide, and the creation of the new class of Associates.

Several changes in the Council have taken place, due in part to the adoption of these Rules, and in part to the resignation of the Honorary Secretary, Mr. W. C. M. Finniss. On the 18th June Mr. Walter Rutt, C.E., was elected Honorary Secretary; Mr. T. D. Smeaton, whose office as Past Vice-President was abolished, was elected Vice-President; and Mr. D. B. Adamson a Member of Council.

It is with deep regret that the Council record the death of Mr. John Howard Clark, one of the founders of the Society, and for many years one of its most active members. Mr. Clark filled successively for a considerable time the offices of Secretary and Treasurer; and although of late ill-health prevented him from taking any active part in the proceedings of the Society, his interest in all matters connected with science and literature remained to the last unabated.

The number of members of all classes on the Society's roll at the commencement of the past session was 103, and the present number is 101, as shown in the annexed table. The large number of apparent resignations is due to the fact that the names of several gentlemen, who have for some years discontinued their subscriptions without formally sending in their resignations, are now omitted:—

| | On Roll Oct. 1, 1877. | During Current Year. | | | On Roll Sep. 30, 1878. |
|---|---|---|---|---|---|
| | | Elected. | Died. | Resigned. | |
| Ordinary Members ..... | 88 | 9 | 1 | 12 | 84 |
| Honorary Members ..... | 15 | — | 2 | — | 13 |
| Corresponding Members | — | 3 | — | — | 3 |
| Associates ..... | — | 1 | — | — | 1 |
| Total ..... | 103 | 13 | 3 | 12 | 101 |

It is now some years since the proceedings of this Society have been printed. The Council have, after due consideration, decided to recommence their publication in a form which will be more handy, and more in accordance with that adopted by most of the scientific societies of the world, than that in which they were formerly issued; and they hope that the state of funds will enable the Society to continue the publication from year to year.

Arrangements have been made with the Governors of the South Australian Institute for the exhibition at the Society's monthly meetings of any interesting specimens of Natural History which may have been presented to the Museum of the Institute during the previous month. This will not only impart an additional interest to the meetings, but will be a means of making known the contributions which are continually being made to the Museum, and which cannot at present through want of space be utilized for public exhibition.

In conclusion, the retiring Council would express a hope that their successors will be supported in their efforts to develop the objects of the Society by the united assistance of its members. They desire to impress upon all the desirability of placing upon record in its transactions the accumulated results of the observation and research of the scattered population of this province, which will otherwise be lost to science. They would also draw attention to the opportunity which is afforded by the new class of Associates to ladies and young men to take an interest in the diffusion and advancement of the arts and sciences.

WALTER RUTT, Hon. Sec.

## THE TREASURER IN ACCOUNT CURRENT WITH ADELAIDE PHILOSOPHICAL SOCIETY.

| Dr. | | | £ s. d. |
|---|---|---|---|
| October, 1877— | | | |
| To Balance ... ... ... ... | | | 112 16 4 |
| Subscriptions ... | £78 9 6 | | |
| Less commission ... | 5 17 9 | | |
| | | 72 11 9 | |
| | | £185 8 1 | |
| October, 1878— | | | |
| To Balance brought down ... ... | | £124 15 2 | |

| Cr. | | | £ s. d. |
|---|---|---|---|
| By Rent ... ... ... ... | | | 12 0 0 |
| Advertising ... ... ... | | | 10 17 8 |
| Printing ... ... .. ... | | | 11 19 6 |
| Refreshments ... ... ... | | | 8 0 0 |
| Conversazione— | | | |
| Expenses ... | £47 19 0 | | |
| Receipts ... | 31 19 0 | | |
| | | 16 0 0 | |
| Postages and Petties ... ... | | 1 15 9 | |
| | | 60 12 11 | |
| Balance carried down ... ... | | 124 15 2 | |
| | | £185 8 1 | |

Audited and found correct, 8th October, 1878.
E. PARISS NESBIT,
Auditor.

Adelaide, 7 October, 1878.
J. F. LLOYD,
Treasurer Adelaide Phil. Soc.

# ANNIVERSARY ADDRESS

BY

## PROFESSOR RALPH TATE.

—o—

Gentlemen—The duty of closing this session with an address, which I have been requested to undertake, has not devolved upon me through custom, and it may therefore seem to be presumptious on my part to have accepted it; but I have willingly acceded to the request, because I wish to take the opportunity of touching upon some topics which cannot conveniently be communicated in the ordinary way, and to establish a precedent that will be good to follow at each anniversary of this Society.

I have thought that an account of the general progress that has recently been made towards a better knowledge of the Natural History of South Australia, accompanied by a series of remarks upon the best available authorities to be consulted upon such subjects, might supply a want which I know by personal experience is often felt, and at the same time would form a not inappropriate address from the chair which I have now the honour to occupy. The task of compiling such information would not be very difficult to one who had at his command the well-furnished libraries of the Royal, Linnean, Geological, and Zoological Societies of London; but the few weeks which intervened between my acceptation of the Chair of Natural Science in the University of Adelaide, and my departure for the scene of my future labours, did not afford me time to consult any of those rich stores of scientific literature for this purpose. The information which I am able to submit to you has, therefore, been obtained under adverse circumstances—*e.g.*, isolation from many sources of information, and from the assistance of experts—and in some cases from second-hand sources; and it is not to be expected that the lists of works should be exhaustive, but they will give to the student in search of particular information a clue which may be followed up to the desired source. Our public library is ill supplied with works relating to the Natural History of the Province, and those needful works of reference supplementary thereto, though some endeavours are being made to supply the deficiencies. It, moreover, seems to me that the usefulness of the Reference Library is at present practically nullified through the want of accommodation for readers, and by not allowing access to, and freedom of selection from, the shelves. The library of the University is being rapidly enriched with works indispensable to the student in Natural

Science; these are, for the most part, distinct from those in the National Library. In the following pages the sign * prefixed to the title of a work indicates that the work is in the Library of the South Australian Institute, and a † that it is in the University Library. It will be the privilege of the President elect of this Society to enlarge my summary of works and papers bearing upon the Natural History of this country, and to keep the members *en courant* with what has been done during his year of office to increase our knowledge of the natural products of this continent.

In making ourselves acquainted with the actual extent of our knowledge respecting the Geology, Mineralogy, Zoology, and Botany of South Australia, we are brought face to face with the fact that there are many missing pages, and even chapters, in its history, and we shall learn that our knowledge in many departments is mere technical barrenness. It is one of the functions of the Society to make good these desiderata, and to make the knowledge we have and shall acquire real, practical, and interesting. From what follows, you may gather that there is great scope for work in many branches of Natural Science. No member can plead the want of a subject, and each one, by the careful examination of the natural objects around him, may collect facts which may furnish data for others of higher scientific attainments to collate, arrange, and draw conclusions from — all that is demanded is strict accuracy of detail, and allowing the facts to speak for themselves. Identification of species is a portion, though small, of the business of systematic biology, and short synoptical faunas are useful to the general naturalist. When our Zoology shall have been well investigated, popular hand books and elaborate memoirs will doubtlessly follow. In the preparation of synopses of our fauna, localities should be accurately noted, particularly in the case of insects and land shells, which are of all others those whose local stations are most closely dependent on vegetation. Hitherto the work of description has been done at home, with the disadvantage of mistakes of habit and of multiplication of species, which would be obviated if the species were described in their native country. It seems to be a fruitful source of error as to locality, that of giving the place whence the specimens were despatched as that of the habitat. Several glaring mistakes of this kind might be mentioned. One will suffice. *Moloch horridus* is recorded by Gray, "Lizards of Australia," from *Adelaide* and W. Australia. Several species originally described as from New Holland, have not yet been referred to their true

stations ; and the mistake has been made by some authors by confounding South and Southern Australia.

Before entering upon the consideration of the chief subject matter of this address, I must premise that my remarks do not refer to the Northern Territory, unless specially so stated; and that it will be obvious to all that the Natural History of South Australia, thus restricted, cannot be studied without reference to that of neighbouring colonies, which together form one large natural province, capable, however, of being subdivided into regions. These regions are not to be defined by existing governmental boundaries, though the preliminary investigations may not inconveniently be regulated by them. The definition of natural regions must be the result of long and patient study ; and we have not yet the data for formulating them.

## ZOOLOGY.

Class Mammalia.—"That we know more of the fauna of Australia than of other English colonies in different parts of the world is certain, but no thanks are due from us for this knowledge, either to the Imperial or to any of the Colonial Governments. The unassisted enterprise of a private individual has produced the two splendid works upon the Mammals and Birds of Australia, which we all turn to with pleasure whenever reference is required to a member of these two classes of Australian animals. Mr. Gould's 'Mammals of Australia' was completed in 1863. Since that period the little additional information received respecting the terrestrial mammals of Australia has been chiefly furnished by Mr. Krefft, late of the Australian Museum, Sydney, and by his successor, Mr. E. P. Ramsay, in various papers and memoirs. On the marine mammals, however, which were scarcely touched upon by Mr. Gould, we have a treatise by Mr. A. W. Scott, published at Sydney, in 1873, which contains a good deal of useful information concerning the seals and whales of the Southern Hemisphere."—Dr. P. T. Sclater, Opening Address, Biological Section, the British Association, September, 1875.

Mr. F. G. Waterhouse, the curator of the Institute Museum, furnished a classified catalogue of the mammals and birds which are met with in South Australia, to Mr. Harcus's (*†) "South Australia, 1876." The list contains the names of sixty-four terrestrial and three marine mammals, and is unaccompanied by reference to localities. This omission is a great defect, as no judgment can be formed as to their distribution within our province or to their relation to neighbouring ones; and creates doubt

as to the actual occurrence of some species which are usually considered to be restricted within narrow limits in distant parts of the Continent. It is also to be regretted that observations on the habits and distribution of our indigenous mammals are not extant, as year by year they will become more difficult to make, and many of the most rare or local seem to be doomed to extinction through the repellent and exterminating influence of advancing culture of the soil.

Class Aves.—The magnificent series of seven volumes of Mr. Gould's (*) "Birds of Australia" was finished in 1848; and in 1869 a supplementary volume was issued containing similar full-sized illustrations of about 80 species. In 1863 Mr. Gould reprinted in a quarto form, with additions and corrections, the letterpress of his great work, and published it under the title of a "Handbook to the Birds of Australia." This is a convenient work for general reference.

My criticisms on Mr. Waterhouse's List of Mammals will apply with equal force to that of his South Australian Birds. The number of species there quoted for this province is 360; but Mr. E. P. Ramsay, in his "List of Australian Birds, 1877," makes mention of only 343. The discrepancy is more than accounted for by the degradation of so-called species to the rank of varieties, whilst Mr Ramsay's list contains a few species not enumerated by Mr. Waterhouse.

Class Reptilia.—(†) "On the Snakes of Australia" we have an excellent work, published in 1869 by Mr. Gerald Krefft, in which a list of the South Australian species will be found. The late Dr. Gray has written many papers on the Tortoises and Lizards of Australia. Of the latter we have to thank Dr. Gunther for a complete monographic list published in 1875 in one of the newly-issued numbers of the (†) "Voyage of the Erebus and Terror." Most of the plates of this work were also issued in 1867 by Dr. Gray in his (†) "Facsiculus of the Lizards of Australia and New Zealand."

Class Amphibia.—An indispensable work in this department is Dr. Gunther's (*†) "Catalogue of the Batrachia Salentia," published in 1858, which embraces all the Australian species of the class then known; but additions have since been made and referred to by Keferstein, in his new and little-known Batrachians from Australia, (†) "Neue und wenig bekannte Batrachier aus Australien." As localities are given in both works, it will be an easy task to prepare a list of the South Australian species; and doubtless from the small number therein recorded for this province, an increase to it would reward the collector.

CLASS PISCES.—For information on the fishes of Australia reference must be made to the ichthyological portion of the (*) "Zoology of the Erebus and Terror," by Sir John Richardson, and to the same author's papers on Australian fishes in the "Annals and Magazines of Natural History," 1842-1843, and "Transactions and Proceedings of the Zoological Society of London," 1839-1840. Whilst Gunther's Catalogue (*) of the Fishes of the British Museum, complete in eight volumes, is absolutely indispensable to any one engaged in the study of fishes; and no ichthyologist should be without "Cuvier's and Valencienne's Histoire Naturelle des Poissons."

The Count F. de Castlenau has in the last few years published in the "Proceedings of the Zoological and Acclimatization Society of Victoria, 1872," several papers on the fishes of the Melbourne Fishmarket and of other parts of Southern Australia, which include a complete synopsis of the known Australian species.

It may be of interest to know that the fishes of Port Darwin have recently undergone critical examination at the hands of Mr. W. Macleay (Proc. Linnean Soc. N. S. Wales, 1878). One hundred and twelve species are cataloged, 21 of which are described as new. Frequent reference is made to Dr. Bleeker's "Atlas Ichthylogique des Ind. Or. Nederl."

SUB-KINGDOM MOLLUSCA.—In the department of Marine Conchology we have a good foundation to work upon in the "Lists of all the known species of marine mollusca of the province of South Australia," by G. F. Angas, which are contained in the Proc. Zool. Soc., London, for the year, 1865. The number of species therein recorded is:—Cephalopoda, 2; Branchiogastropoda, 229; Conchifera, 96; Brachiopoda, 1. Seventy-eight of the species were unknown to science till described from Mr. Angas's specimens, during the eighteen months preceding the publication of the 'Lists' by Messrs. H. & A. Adams, H. Crosse, and himself.

Such are the results of Mr. Angas's indefatigable exertions during a residence of some years in this province; and because nearly every species mentioned had been collected by him, the catalogue is that of the bona fide molluscan inhabitants of our waters. Though Mr. Angas still pays considerable attention to Australian conchology; yet he has not published anything further in continuation of the above-mentioned papers, excepting that of correcting the nomenclature of a few species in papers on the molluscan fauna of New South Wales, published in Proc. Zool. Soc., ranging from 1867 to 1877, and adding three new forms

in a paper published in this year. These papers are invaluable to the South Australian conchologist, as a fair proportion of shells are common to the two areas. Mr. Angas, in his papers, *op. cit.*, 1865, not only gives lists of names, but adds remarks on the habitats and distribution of each species, and supplies references to works wherein the species are described or figured.

The bibliography is certainly voluminous, but a large number of the descriptions and figures are collected together in a monographic form in Reeve's "Iconica Conchologica." The University Library contains the monographs of the more important Australian genera, and the following works dealing with Australian shells:—Lamarck, 'Animaux sans Vertebres,' 7 vols.; Menke, 'Molluscorum Novæ Hollandiæ; Quoy & Gaimard, 'Voyage de l'Astrolabe; Zoology of the Voyage of H.M.S. Samarang; Journal de Conchyliogie; Cruise of H.M.S. Curaçoa; Gould's 'Otia.

A glance at the numbers of representatives of each class of the mollusca, recorded by Mr. Angas, reveals the paucity of cephalopods and brachiopods, and the absence of pteropods; whilst a reference to the papers discovers the absence of an entire order—that of Nudibranchs or sea slugs. The poverty of the brachiopods is doubtlessly real, though a second species, *Kraussia Lamarckiana*, is known by me to occur; but it is not so with regard to the cephalopoda. Ten species of naked cephalopods I have collected in St. Vincent's Gulf, but so little attention has been paid to animals of the class in Australia that our book knowledge respecting them is very meagre. A careful examination and description of all the existing species would well repay the researches of any one of our naturalists. Quoy and Gaimard describe some Australian cuttlefish, and D'Orbigny's Monograph, and Gray's Catalogue of the classes are indispensable.

The absence of pteropods and nudibranchs from Mr. Angas's lists may be intentional on the author's part, and it is not unreasonable to infer that examples of each class exist on and off our shores, as they are both well represented in the seas of the east coast of the continent. Of Pteropods, 14 species are known in New South Wales. The chief works relating to the class are:—Eydoux and Souleyet, 'Voyage of the Bonite,' (1836-37), and Rang and Souleyet, 'Histoire Nat. des Mollusques Pteropodes,' 5 pl. (1852.) The nudibranchs of New South Wales are 34 in number, most of which are described as new, and beautifully illustrated by M. Crosse, (*) Journal de Conchyl, 1864.

The classes Polyzoa and Tunicata are not noticed by Mr. Angas, the

study of which is not generally pursued by conchologists. I will allude to them separately.

The additions to our lists of species of marine mollusca are recorded in the following works and papers:—A. Adams, in Sowerby's "Thesaurus Conchyliorum," describes three species of *Atys* from Port Lincoln; and Reeve identifies two species of *Cyclostrema* from the same locality with previously known Japanese shells. These and the foregoing species are described and figured in Reeve's "Iconica Conch."

Mr. T. Bednall, in a "List of South Australian Marine Shells," privately printed 1874, inserts thirteen gasteropods and three bivalves not previously known to occur with us.

A census of the marine gasteropods, bivalves, and brachiopods of Tasmania and the adjacent islands (Proc. Roy. Soc. Tasmania, 1877), is the work of the Rev. J. E. Tenison Woods. It bears evidence of considerable labour spent in its preparation, as it contains all the species recorded by previous authors, and all the new species, which are many, described by Mr. Woods in two papers published by the same Society; and the claims of critical and doubtful species are discussed. Those interested in the distribution of the constituents of the marine fauna of Australia will find this production of great service. The horizontal range of some of the species is indicated; but the omissions in this respect are unfortunately many, and the comparative unity of the Tasmanian fauna is rendered more apparent than real. Mr. Woods makes known the occurrence of eleven gasteropods and one bivalve in the south-eastern part of our coastline, which are not mentioned as South Australian by previous observers. He has also corrected the names of some of our species.

The same author, in a paper "On some new Marine Mollusca," Roy. Soc. of Victoria (1877), states on my authority that *Pectunculus laticostatus*, so abundant in a fossilized state in Southern Australia and Tasmania, is living in St. Vincent's Gulf.

Angas, Proc. Zool. Soc., March 1878, adds two species of *Mitra* and one of *Siphonaria* to the local fauna—the three are new to science.

In the pages of this volume will be found a small contribution by myself to South Australian conchology.

Mr. Angas is now publishing in Proc. Zool. Soc. an appendix to his list of 1865. From material received from me he adds fifteen known species of gasteropods and seven of bivalves to our fauna, and describes as new to science seven species of gasteropods and four of bivalves. A

second collection recently forwarded has not been reported on. The total recorded additions are—Gasteropoda 58, Conchifera 16, Brachiopoda 1; but these do not exhaust our knowledge, as I am acquainted with nearly as many more unrecorded species.

Class Polyzoa.—Some evidence of the neglected state of Australian zoophytology up to comparatively recent times may be gathered from the circumstance that out of fifty-four species of twenty-four genera of Polyzoa described by Busk in the Appendix to "Voyage of the Rattlesnake" (1852), forty species are new or undescribed, and four genera are instituted. Forty-two were collected in Bass's and Banks' Straits, one at Port Adelaide, the remainder off other parts of the Australian Continent.

Some of our Australian species are common to the seas of Europe; these are described in (†) Johnston's "British Zoophytes."

In 1860, Macgillivray, in Trans. Phil. Inst., Victoria, vol. iv., pp. 97-98, one plate, and pp. 159-168, two plates (in Library Philosophical Society, Adelaide) wrote upon the Polyzoa of Southern Australia. Four species are credited to South Australia. Professor Hutton's Catalogue of the Marine Mollusca of New Zealand (1873) should be consulted.

In 1875 there appeared (*) Part III of Busk's Catalogue of the Polyzoa 8vo, 34 plates. This contains descriptions of sixteen Australian species of Cyclostomatous Polyzoa, only five of which had been previously recorded—two by Macgillivray and three by Busk, op. cit. (Copies of Parts I. and II. of the Catalogue of Polyzoa are not in the colony, and these portions of the work are out of print.)

Rev. J. E. Tenison Woods, in Trans. Roy. Soc. of New South Wales (1877), describes two new species of South Australian Polyzoa belonging to the genus *Serialaria*.

Hincks, "Notes on the genus Retepora," An. & Mag. Nat. Hist., May, 1878, describes two new species of the genus, and supplies much fuller and more minute diagnoses than we have from the authors who named them—of three others—all of which are stated to have been collected in South Australian waters.

Professor Hutton, in a short paper recently communicated to the Royal Society of Tasmania, describes six new species, and identifies nineteen with known forms. These were collected by myself upon the shores of St. Vincent's Gulf. Some of them are of great interest. *Tubulipora flabellaris* had not been found in the Southern Hemisphere before, and *Vincularia maorica* had previously been known only as a miocene fossil.

The total number of known South Australian polyzoa is thirty-five.

Class Tunicata.—Quoy and Gaimard describe and figure fourteen species of simple and compound ascidians from the south-west and south-east coasts of Australia. Some of these will doubtless be found to form a part of the comparatively rich tunicate-fauna of our shores.

Land and Fresh-Water Mollusca.—A special work on the Land Snails of Australia exists as (†)"A Monograph of Australian Land Shells," by Dr. Cox, published in 1868. The figures of some of the South Australian species are not accurate, and the diagnoses are not always sufficiently full. The number of South Australian Helices published in Dr. Cox's monograph is twenty-two; but since then additions have been made, which make a total of thirty-four. Mr. Angas describes six in Proc. Zool. Soc. for the years 1868, '73, '75, '76, and '77; Mr. Brazier two in the same journal for 1871 and 1872, and a third in Proc. Lin. Soc, N. S.W., vol. 1., 1875; and I have made known three other forms in Proc. Lin. Soc., N.S.W., vol. 2, 1878. No advance has been made in the numbers of species of the other genera constituting our terrestrial molluscan fauna. I think that a revision of our species is needed, but efore considering the claims of several to specific rank it will be desirable to have more information respecting their distribution. Most of our land snails are, according to book knowledge, very restricted, and each is more or less isolated. If this be really so, then we should seek to establish a connection between their isolation and the development of that character proper to each.

No attempt has been made to bring together in a monograph the scattered sources of information concerning the fresh water mollusca of Australia. But the Rev. J. E. Tenison Woods has arranged the fresh water shells of Tasmania, *vide*, "On the Freshwater Shells of Tasmania," (Proc. Roy. Soc. Tasmania), 1876; of which there are 28 univalves and four bivalves, the majority being described as new to science. Woods in 1875 held the opinion that this part of the Tasmanian fauna is perfectly distinct from that of Australia, and that its facies or general character is not Australian; but two years later, when describing some new freshwater shells inhabiting Victoria (Trans. Roy. Soc. Vict, 1878), he takes an opposite view. The freshwater shells of Australia and Tasmania have a common character, and many of them are widely distributed, being common to several hydrographical areas. The identification of the South Australian species will involve considerable labour, as all the Australian freshwater shells and their animals must be re-

viewed before any satisfactory result can be arrived at. We have in the extra-tropical part of this province several species of *Physa*, some *Lymnæa*, an *Ancylus*, *Planorbes*, *Melaniæ*, *Paludinæ*, and several so-called *Bithynias* and *Paludestrinas*, a *Pomatiopsis*, *Unios*, and a *Cyrena*. Some South Australian *Physæ* are described in Reeve's Monograph of the genus. The *Cyrena* of the Lower River Murray is named *C. Angasi* by Prime, Journ. de Conch., vol. xii, 1864; and Mr. Angas in Proc. Zool. Soc., 1877, describes a new *Paludinella* from Lake Eyre.

Class Insecta.—Entomology has long been a favourite pursuit among Englishmen, Frenchmen, and Germans, and with so many workers and with an almost unbounded field of research, it is not surprising to learn that the literature of this class of animals is most voluminous. Of late years specialists have arisen, and the modern bibliography of any order of insects is more compact and accessible. The descriptions of Australian insects are scattered through so many publications that their long array is enough to dishearten the tyro at the very commencement; but there are a few works which deal largely with Australian entomology, these are:—Donovan's "South Sea Insects," 1805; "Boisduval—Entomology of the Voyage of the French Surveying ship the Astrolabe;" Guerin—"Zoology of the Voyage of the Coquille;" and Germar—"Linnean Entomology" (1848); Angas—"South Australia Illustrated," 1847, figures on plate 48, twelve species of orthoptera, neuroptera and hemiptera, on plate 51 thirty-one species of coleoptera, and plate 37 is devoted to lepidoptera.

Moreover Mr. G. Masters has afforded great aid to the student in the orders Lepidoptera and Coleoptera by the publication of catalogues of the names of all the described species known to inhabit Australia, accompanied with a reference to the description of each.

Order Lepidoptera.—His "Catalogue of the Described Diurnal Lepidoptera," 1873, contains the names of 202 butterflies, and of these it would seem that only seven are recorded as inhabiting this province. Mr. G. F. Angas in his "S. Australia Ill.," figures on plates 37 seven species of Diurnal Lepidoptera, two of them are unnamed, one of which has probably been described by Felder, and as three of the species are not recorded for South Australia by Mr. Masters, the total number of butterflies known to occur with us is ten. Mr. Angas has represented on the same plate sixteen species of moths. Mr. Wallace ("Distribution of Animals," vol. 1, p. 404), states that in South Australia there are *less* than thirty-five species; but does not give the names of the species.

ORDER COLEOPTERA.—The "Catalogue of the described Coleoptera of Australia," by Masters (1871-1874), enumerates 5,607 species of beetles of all kinds, which are distributed among 57 families; of these 592 species, belonging to 36 families, occur in South Australia. The largest groups represented by our Coleopterous fauna are—Carabidæ, 103 species, being 11·8 per cent. of the total of Australian species; Buprestidæ, 59, or 17·6 per cent.; Curculionidæ, 122, or 14·0 per cent.; Cerambycidæ, 111, or 27·0 per cent.; Tenebrionidæ, 48, or 11·7 per cent.

Some of the families are very disproportionately represented; thus we have only 1 out of 78 Australian Staphylinidæ, and 11 out of 157 Elateridæ, but 26 out of 60 Anthicidæ. This circumstance is explained partly by the fact that the Australian species of certain families have not been monographed, and partly because collectors have not interested themselves about certain others.

A large number of our South Australian beetles will be found described in—"The Entomologist," by Newman (1842); "Transactions Entomological Soc. of New South Wales," by Macleay, two vols.; "Notes on Australian Coleoptera," by Castelnau, Trans. Roy. Soc. Victoria, vol. 8, pp. 30-38 and 95-225 (1867-68).

"The Journal of the Linnean Society of London" contains the following papers relating to Australian Coleoptera:—"Descriptions of new species of Stigmodera," by E. Saunders, vol. ix., 1867, two plates. This paper contains the characters and figures of fifty undescribed species of the genus *Stigmodera* from Australia; five of the new species occur at Adelaide. "Contributions towards a knowledge of the Curculionidæ," by F. Pascoe, part I., vol. x., 1869, three plates. Seventy-nine Australian species are described, about one-half figured; fifteen of the species are recorded from South Australian localities. Part II., vol. xi., 1871, four plates, contains descriptions of twenty-one new Australian species, four of which are stated to have been collected in this neighbourhood. Part III., vol. ix., 1872, four plates, contains descriptions of thirty-two unrecorded Australian species, three of which are South Australian. In the appendix to (†) "Captain King's Coasts of Australia, 1827," will be found a "Catalogue of Insects," by W. Sharp MacLeay, including descriptions of new species, but unaccompanied with illustrations, and without localities. The Coleoptera number 108, the majority of which are new. (†) "Discoveries in Australia," by Commander Stokes, two vols., 1846. An appendix to vol. I. of this work is devoted to "Descriptions of new or unfigured species of Coleoptera," by A. White. Eightee species are illustrated by two plates, and described.

Additions to the list of South Australian Coleoptera have been made known through the following papers:—Mr. J. S. Baly, (†) "Annals and Magazine of Natural History," November 1877, describes thirteen new species of Phytophagous beetles from Australia—four of which are from Gawler, one being the type of a new genus; and in the number for January, 1878, two species of Chrysomelidæ. The same author has communicated a similar paper to the "Journ. Linnean Society," vol. xiii. (1878), in which seven new species obtained from Gawler and Adelaide are described.

(*) The British Museum Catalogues of the Longicornia, by Mr. F. Smith, 1853, 1855, 10 plates, make mention of 102 species inhabiting Australia. In 1859, Mr. F. P. Pascoe, to whom our knowledge of the Australian longicorn bettles is almost entirely due, published a list of the 259 Australian species of this favourite group in vol. ii. "Journal of Entomology," illustrated by two plates; and seven years after in the (†) Proc. Linnean Soc., vol. ix, 1866, he furnished another list which contains nearly 500 species. He writes:—"If we take into consideration the economy of these insects, their usually short lives in the perfect state, and their attachment to certain trees in which their larvæ have fed, confining their distribution to very narrow limits, we can scarcely avoid drawing the conclusion that we are still very far from having a complete list." Of the new species described in the latter paper fourteen are South Australian, from the neighbourhood of Gawler, collected by Mr. Odewahn. This brings up the total number of recorded South Australian species to 126. In a supplementary paper in the same volume, Mr. Pascoe adds seventeen new species, one of which is South Australia, and in the "Annals and Magazine of Natural History," May, 1867, four new forms are described.

Order Hymenoptera.—Mr. F. Smith in the British Museum "Catalogue of Hymenopterous Insects," 7 vols., 47 plates, 1853-1859, gives a complete list of all the known species of bees, hornets, wasps, ants, and their allies with references to the synonyma, and describes many new species, the majority of which are illustrated by lithographic plates. The number of Australian species recorded is 533, and of these 71 inhabit this colony. For the solitary and social wasps the chief source of information is Saussure's monograph of the family, "Etudes s. la Famille des Vespides," 3 vols., 1852–56, which contains figures of all the Australian species, excepting the six new species described by Smith in the above-named catalogue. The same author, in (†) Brench-

ley's "Cruise of H.M.S. Curaçoa," 1873, describes some new Australian species, and gives diagnoses of some previously known, 18 in all, which are beautifully represented by three coloured plates.

Order Neuroptera.—The number of described species of this order known to occur in South Australia is only ten. The chief work in which species are diagnosed are :—King's "Coasts of Australia ; " Appendix by W. Sharp MacLeay ; (five dragonflies catalogued, three new.) Adam White, in "Eyre's Exped. into C. Australia," describes and figures a neuropter, probably South Australian. (*) "Catalogue of Neuropterous Insects," by F. Walker, 4 parts, 1852-53, contains descriptions of eight South Australian species. (*) "Catalogue of Termitina," by Dr. Hagen, 1858 ; "New Genera and Species of Neuropterous Insects, &c.," by McLachlan, in (†) "Proc. Linnean Soc., vol, ix, 1866 ; and "On a Systematic Classification of the Ascalaphidæ.' by the same author, loc. cit, vol. xi., 1873. In the latter part specific characters are given of four South Australian species, two of which had been previously undescribed.

Order Diptera.—(*)"List of Dipterous Insects"—F. Walker, seven parts, 12 mo., 1848-1855. This work contains the names of 338 Australian species of flies, 184 of which are described as new kinds. South Australia is represented by eight species only, four of which are new ; but Mr. Tepper informs me that he has 80 species of the order in his local collection. Frequent reference is made by Mr. Walker in connection with the Australian forms to Macquart's. Diptera Exotica and Supplement.

Order Orthoptera.—The chief works relating to Australian insects of the family of the cockroaches are :—Saussure, Revue Zoologie, vol. xvi., and Melanges Orthopterologiques (1863-72); Wattemoyle, Noveau Systeme des Blattaires; (*) Walker, Catalogue of Blattariæ, 8-vo., 1868, and Supplement 1869.

The two volumes by Mr. Walker contain all the recorded species up to date, 111 of which are Australian. Diagnoses are given of forty-eight species, five of which are from this province ; the total South Australian forms are eight.

The "Catalogue of Dermaptera Saltatoria," F. Walker, five vols., 8-vo., 1869-1871, deals with the remaining families of the order Orthoptera, and includes the crickets, grasshoppers, locusts, &c. The number of Australian species is 160, of which 124 are fully described in that work ; for the rest reference is given to Serville, Hist. Orth., and Erichson's "Archiv f. Naturgeschicht." The number recorded from South Aus-

tralia is thirteen, making a total of twenty-one orthopterous insects. Mr. Tepper reports that sixty are known to him.

Prof. Wood-Mason, Ann. Mag. Nat. Hist. July 1877, describes and records new orthopterous insects of the families Phasmidæ and Mantidæ from Northern Australia.

Order Homoptera.—165 is the number of Australian Cicads and their allies catalogued by Mr. F. Walker (*), "List of Homopterous Insects," four parts, eight plates, 12 mo., 1850-1858; forty-two of these are referred to by name, whilst 123 are fully described; in the former are two South Australian species, figured in Eyre's expedition; and in the latter are nine, obtained at Adelaide. Though seven species of thrips and scale insects are known to occur in Australia, yet so far as regards published sources of information, no South Australian species has been determined.

Order Hemiptera.—Much of our information respecting the Australian examples of this order is contained in the works of Dallas and Walker, published by the British Museum authorities under the misleading titles of (*) "List of Hemiptera," 12-mo., part I., 11 pl. (1851); and part II., 4 pl., (1852) and (*) "Catalogue of Hemiptera Heteroptera," 8 vols., 8-vo., 1867-1873. The latter work by Walker, is supplementary to and in continuation of the former; taking the two together, there are recorded 298 species belonging to Australia; of these, forty-four are South Australian. In Dallas's List ten South Australian species are described, and in Walker's Catalogue nineteen; for the remaining thirteen we need to consult no less than eight separate publications. These are :—Donovan, Insects of New Holland; H. Schaff, Wanz. Insects; Erichson, Archiv f. Naturg., vol. 8; Guerin, Voy. Coquille; Hope, Catalogue (1837); Serville Hist. Hemiptera; Westwood, Trans. Entomol. Soc.; Stal, Ofv. K. Vet. Ak. Forh, XXIII. Some of the types of the new species from this province form part of the collection in the National Museum at Melbourne.

Class Myriapoda.—The British Museum (*) "Catalogue of the Myriapoda" (1856) gives a complete description of all the genera and species of centipedes, millepedes, and their allies known to exist. Of the 23 Australian species therein recorded, only one is with certainty known to be South Australian.

Class Arachnida.—In Koch's (†) "Arachnides Australiens" we have a masterly monograph of Australian spiders. The work was commenced in 1871, and up to the end of last year 21 fasiculi of 968 pages and 84

plates in quarto have been issued. In addition to Continental examples of the class, there are described spiders from New Caledonia, New Guinea, New Zealand, and some of the Polynesian Isles. The chief materials have, however, been obtained from the north-east and eastern parts of Australia. South Australia has furnished only one species (*Lycosa lacertosa*, p. 952, t. 82, f. 6); it is from Adelaide. That only one species of spider is recorded from this Province will appear most extraordinary; but the knowledge of the existence of many forms and of remarkable variety proves most conclusively that this department of zoology has been lamentably neglected by us. The difficulties attending their preservation can no longer be an excuse for overlooking these creatures; and the study of their habits, which I believe to be in the highest degree interesting, especially the wonderful mimicry of some and the intelligence exhibited by others, has at all times been accessible to us. There cannot be a doubt that the field of observation is an extensive one, and as soon as the student shakes off a natural antipathy to spiders he will find in them much to encourage him to devote a large share of attention to these much maligned animals.

Directions for the preservation of arachnids will be found in Mr. O. P. Cambridge's paper "On some new genera and species of Araneidea" —Annals and Magazine of Natural History, January, 1877—which, moreover, contains the description of another South Australian spider (*Aganippes subtristis*), the type of a new genus, obtained at Adelaide. Five other Australian species are here described. Further, supplementing the great work of Koch, is a paper by H. H. B. Bradley on the araneides of the Chevert Expedition, Proc. Linn. Soc., N.S W., vol 2.

Class Crustacea.—Milne Edward's "Histoire Naturelle des Crustaces," 3 vols., 1834-41, is absolutely indispensable to one occupied in the study of Crustaceans. And though I am not aware of the publication of any work specially devoted to this branch of Australian Zoology, yet several Decapodous Crustaceans which inhabit the shores of this continent are described and figured in the following works :—

Dana, "U. States Exploring Expedition, Crustacea," (1852-53.)

† Miers, "Zoology of the Erebus and Terror, Crustacea," (1874). In this work twenty-three species of crabs, soldier crabs, and shrimps, are described from New Zealand, Australia, and the South Seas; twenty-two of them are figured.

* Miers, "Catalogue of New Zealand Crustacea," (1876), three plates.

† White, in Juke's Voy., H.M.S. Fly (1847), describes a new genus, and five species of Australian crabs; and in Voy. of H.M.S. Rattlesnake (1852) two new species of Decapodous Crustaceans.

† Miers, "Revision of the Plagiusunæ," An. and Mag. Nat. Hist. Feb. 1878, gives, a synonymic list, with brief diagnoses and remarks of the species of this small and well defined group of the Grapsoid Brachyurous Crustaceans; four Australian species are referred to.

Bell, "Catalogue of Crustacea," Part I, Leucosiadæ, Trans. Linn. Soc., vol. xxi., 1855, describes and figures seven Australian species of the family, One species, *Philyra lævis*, inhabits Port Adelaide. The only other references to South Australian Decapods that I know of are made by Gray in Eyre's Exped. Central Australia, in writing upon the species of fresh water crayfish of Australia and Tasmania.

The following may advantageously be consulted :—

White, "List of Crustacea," Brit. Mus. Cat. (1847.) De Haan, "Fauna Japonica" Crustacea (1850.) Heller, "Voy. Novara," Crustacea (1865).

Sub-class Amphipoda.—In the (*) "Catalogue of Amphidous Crustacea,' by Spence Bate, 8 vo., pp. 400, 59 plates, 1862, the author brings together in a systematic arrangement all the Amphipods that were then known to science. Descriptions and figures are given, taken from specimens in the British Museum; but where examples of species have not been procurable, the description by the author of the species has been followed accompanied by copies of figures when illustrated. The number of Australian species is eleven, distributed as follows :—Seven in New South Wales, one common to New South Wales and South Australia, one Tasmanian, one South Australian, and one locality unknown. The two S. Australian species *Allorchestes Gaimardi*, M.Eds., and *Amphithoe Australiensis*, Bate, are marine, whilst a fresh water Amphipod, possibly the *Gammarus Verreauxi*, M.Ed., described from New Holland, and one or two of the aberrant forms of the sub-class, at least, await identification.

Order Isopoda.—Many species of this order inhabit our shores, and a few land forms are not unfamiliar objects. I do not know any special work treating of them; but some information respecting them may be gleaned from the general works given under 'Crustacea.'

Of Phyllopodous Crustaceans, three species have been exhibited before this Society, one *Lepidurus Angasi*, Baird, will be found described and figured in Proc. Zool. Soc., 1866. The others a *Branchipus* and an

*Estheria* have not been identified. A new species of the former from Peak Downs, Queensland, is described in the "Journals des Museums, Godeffroi," No. 12.

The only book information that I am in possession of respecting the Ostracodous Crustaceans of Australia is that comprised in the three following papers by the Rev. R. King in † Proc. Roy. Soc. of Tasmania. "On some species of Daphniadæ found in N. S. Wales," vol. ii., part ii., p. 243. et seq. (1853) five plates. "On some Australian Entomostracans," id. p. 253, three plates, and vol. iii., pt. 1, 1855. In these papers thirty-six species are described all with new specific names, and one new genus is instituted for two of them.

The (†) "Monograph of the Sub-class Cirripedia," by C. Darwin,—published by the Ray Society, represents the present state of our knowledge of these Crustaceans, though twenty-four years have elapsed. In Part I Lepadides, 10 pl., 8 vo., 1851, the Pedunculate Cirripedes are described; eight are recorded from Australia, three of which are peculiar, one *Ibla quadrivalvis*, being confined to St. Vincent's Gulf, Part II., 30 pl. (1854) is devoted to the Balanidæ or acorn shells twenty-two inhabit the Australian shores, eleven of which are peculiar the South Australian species are two of *Acaste*.

Class Annelida.—Baird, W. "New species of Tubicolous Annelides," Proc. Linnean Society, Vol. viii., three plates, 1864. In this paper are described new species of tube-building worms which form part of an extensive collection of annelides in the British Museum. The family Serpulidæ was established by Linnæus, in which he included the Molluscan genus *Vermetus*, the shelly tubes of which bear a close resemblance to those of *Serpula*. Dr. Baird shows that a more detailed knowledge of the animals is necessary to fix them with certainty in their systematic position; thus an examination of the animal inhabiting the tube, named *Vermetus cariniferus*, by Gray, which inhabits our coasts, has resulted in its removal from the molluscan class of Gasteropods to the family Serpulidae of the Class Annelida. The species described include four from New Zealand and three from Australia.

Baird.—"Contributions towards a monograph of the species of Annelides belonging to the Aphroditacea," op. cit., vols. viii-ix. The Aphrodites include the sea mice, many of which are remarkable for their size and from being covered with brilliantly-shining and splendidly irridescent hairs. The only South Australian species of the family recorded is *Aphrodita Australis*, Baird, which was obtained at Port

Lincoln, and is 3½ to 4 inches in length. This paper gives a list of the known species and descriptions of new ones. Thirteen species out of a total of 146 inhabit the seas of Australia and New Zealand. The chief works referred to for Australasian aphroditacea are—Kinberg, "Ofversigt af Kongl. Vetenkaps—Akademiens Forhandlinger" (1855), and "Fregatten Eugenies Resa;" and Schmarda, "Neue Wirbellose Thiere."

Baird.—"Contributions towards a Monograph of the Amphinomacea," op. cit., vol. x., 3 plates, 1868. A list of the known species is given, and eight Australasian species are recorded, four of which are described as new.

Baird, "Remarks on several genera of Annelides belonging to the group *Eunicea*," op. cit., vol. x. (1869). The animals of this group are the marine worms, so remarkable for their great length. Five Australian species are mentioned, three of which are described for the first time.

Baird, op. cit., vol. xi (1873), describes some new species of Annelida and Gephyrea, chiefly from Patagonia and New Zealand.

Quoy and Gaimard make known two species of Turbellarian worms.

Class Entozoa.—Mr. G. Krefft has written an octavo work on "Australian Entozoa," which contains a list of all the intestinal worms observed in Australia, and descriptions of new species, illustrated by three plates.

Class Echinodermata.—Order Echinoidea.—Our knowledge of the sea urchins of Australia is embodied in a paper by the Rev. J. E. Tenison Woods, entitled "The Echini of Australia"—Proc. Lin. Soc. of N.S.W., 1877. The author, at the request of Mr. Macleay, undertook to describe the Echini collected by him in the Chevert Expedition, and took the opportunity of collocating isolated observations on the distribution of this group of marine animals in the Australian seas, except the western portions. His list contains 56 species, three of which are new to science. He divides Australia into three marine provinces, the north-east, the east, and the southern. Respecting the southern, which concerns us most, he writes that it has a peculiar fauna which possesses what are called the truly Australian genera, such as *Amblypneustes, Holopneustes, Microcyphus, and Linthia*; and further remarks—"I cannot find much connection between our tertiary fossil fauna and what we see in the present Australian seas." Three species are common to both, while not only are Australian genera remarkably absent, but even a whole sub-order—the Desmostichia is scarcely represented at all in our fossil formations. In fact, the separation between our tertiary and recent Echini is almost

complete. A very few species and a small number of genera are common to the tertiary and recent periods, but our commonest species are not even generically represented." Thirteen species are stated to inhabit our shores, and in a supplementary paper, op. cit., 1878, another one is added.

The chief works relating to the Australian branch of the subject are :(†) L. Agassiz, "Monographies des Echinodermes," 1838-41; A. Agassiz, "Revision of the Echini," 1873; (*) Gray, "Catalogue of the Recent Echinida Irregularia," 1855.

Other Orders of the Echinodermata.—A general work, combining the results of previous fragmentary knowledge on the Echinoderms is the(†)"Histoire Naturelle des Echinodermes," by Dujardin and Hupe, 1862. A large number of Australian star-fishes was described by Gray in an appendix to Jukes's Voyage of the Fly, the majority of which was later figured by the same author in his † "Synopsis of Species of Starfish," 16 plates, 4 vo., 1866. † Muller and Troschel's "System der Asteriden," 1842, is a monograph of the then known species of starfish and brittle stars (illustrated by 12 plates; some Australian species are mentioned. Quoy & Gaimard, "Voy. Astrolabe," describe three species of Australian holothurians.

Class Actinozoa.—Some South Australian Madreporariæ and Actiniæ are described in the "Voyage de l'Astrolabe", and in (†) Ellis and Solander, "Natural History of Zoophytes" (1786), all of which have been cited by MM. Edwards and Haime (†) "Histoire Naturelle des Corallaires," 3 vols. and atlas (1857-60). The position of the coral fauna in temperate Australia is stated by the Rev. J. E. Tenison-Woods to be as follows—"Up to this time all these discoveries (those made by deep-sea dredgings) have had but little effect on the knowledge of the Australian forms. I may say that the Extratropical Madreporaria of Australia have been literally untouched. Yet a special interest is attached to them on account of what has been made known through geological researches." The above quotation is from a paper "on the Extratropical Corals of Australia," illustrated by three plates, Proc. Linn. Soc. N.S.W., 1877. We have to thank Mr. Woods for throwing light on the subject and science is deeply indebted to him for what he has effected in this and other departments of Australian Natural History. In his paper eleven new species are described, and it has been found necessary to institute two new genera for two of them. From his knowledge of the fossil forms he has been enabled to show that some of our tertiary species still

exist in the Australian seas. Only three species of corals are known to inhabit our shores; one of them is described as new by Mr. Woods.

The Alcyonarian Polypes inhabiting Australian seas are, according to Gray, nineteen in number; most of them are described in two of the British Museum publications:—(*) Catalogue of the Pennatularidæ, and (*) Catalogue of Lithophytes, by J. E. Gray, 8vo., 1870.

Class Hydrozoa.—Busk, in (*) Voyage of the Rattlesnake, records and describes thirty-one species of Sertularian Zoophytes from Australia. Thirteen are from Bass's Straits and north coast of Tasmania, the rest are tropical forms. The following works should also be consulted:—(†) Johnston's "British Zoophytes"; Allman's "Monograph on Gymnoblastic Hydroids"; Hutton, "New Zealand Sertularians", Trans. New Zealand Inst., vol. v., 1872; Coughtrey, "New Zealand Hydroida", id. vols. vii. and viii.

## BOTANY.

Phanerogamic Botany.—Australia had not long been colonized before its flowering plants began to attract scientific attention, and during the first half of this century such eminent botanists as Robert Brown, Solander, Sir Joseph Banks, Cunningham, Labillardiere, Sir Joseph Dalton Hooker, Bidwell, and others, laboured on the spot to elucidate the Botany of Australia. In our day much has been done by other eminent men to further the work of their predecessors. I need only allude to the labours of Baron von Mueller and Bentham as instances; and South Australia has been distinguished by the researches of our Dr. Schomburgk. The sum of all these labours is the (*) "Flora Australiensis" by Dr. Bentham, the seventh and concluding volume of which has just been issued. In the preparation of this work the author has been most ably assisted by Baron von Mueller and others, who, from their knowledge of the living plants, have enabled Dr. Bentham to obviate those disadvantages he necessarily laboured under.

Dr. Schomburgk has given us a Synopsis of the Flora of South Australia, which has been mostly compiled from the abovementioned work, and an able dissertation on the physiognomy of the vegetation of this colony ("Flora of South Australia" in (*) Harcus's "South Australia," 1876.) Though we may safely say that the flora of this province has been well determined, for it must not be forgotten that the early botanical investigations of Baron von Mueller were carried on in our midst, yet, to quote the words of Dr. Schomburgk, "by the constantly-occurring new discoveries, especially in the central parts of South Australia, the

synopsis cannot be considered quite complete." Indeed, a complete revision of the latter part of Dr. Schomburgk's Synopsis is rendered necessary by the publication of Vol. VII. of the Flora Australiensis. A reduction in the number of species is obtained by suppression of names, regarded as synonymic by Bentham, and by expurgation of others not known to be South Australian; whilst on the other hand the list is largely increased by species not previously known to occur within our boundaries. That Dr. Bentham does not, however, fully state the extent of our knowledge is clear when he omits such familiar plants as *Typha angustifolia*, *Lemna trisulca*, and some others, from the South Australian lists. Comparing the two sources of information, I find that the order Liliaceæ is reduced from 25 species to 14, but five others are added; Juncaceæ, from 25 to 14, nine new; Xylideæ, from six to one; Commelynaceæ, Aroideæ, Typhaceæ, Lemnaceæ, and Eriocauleæ, which we thought to contain 15 South Australian species, are, according to Bentham, unrepresented; Alismaceæ is reduced from two to one species, but 11 are added; Restiaceæ, from eleven to four, but six are added; Cyperaceæ, from thirty-three to eighteen, but thirty-four additional species are given, nine belonging to Central Australia; Gramineæ is reduced from eighty-three to thirty-nine, but sixty-five are added, making a total of 104 grasses, thirty-two of which are Central Australian. The lycopods and their allies are only represented by two species, where we were believed to possess eight; the ferns are reduced from thirty-five to sixteen, but *Dicksonia antarctica* is the only addition. Of the 243 species catalogued by Dr. Schomburgk 134 are retained, to which 136 are added, making a total of 270 species of the orders from Liliaceæ to Filices.

Despite the efforts of the many able men that have laboured in this department of Australian biology, I think that the field is not exhausted; and though we cannot expect to be rewarded by our search for undiscovered species, yet the habits of known plants, of which we have a very limited knowledge, afford a very favourable opening for further researches. The modes of fertilization of our native plants, and the mutual dependency of certain plants and animals, are subjects about which very little is known. A reader of Darwin's "Fertilization of Orchids," or Sir John Lubbock's "British Wild Flowers," cannot fail to be incited to a practical examination of the phenomena therein described; and be it known that several of the orders to which especial interest is attached are abundantly represented in this colony. Dr. Bentham, who has investigated the stigmatic

apparatus of *Goodenovieæ*, one of our largest orders, especially commends to the attention of Australian botanists the manner in which impregnation is impeded or facilitated in this group of plants. He writes :—"As far as can be judged from dried specimens, there seems to be considerable diversity in the impediments opposed by the structure of the parts, as well as in the contrivances provided for overcoming these obstacles. The progress of development, however, can only be watched on the living plant; and it is in order to call to the subject the attention of any observers who may be resident in Australia that I lay before the Society the peculiarities which I have observed."—Journal of the Linnean Society Botany, vol. x., p. 204, 1868. The same author makes a similar appeal in his paper "on the Styles of Australian Proteaceæ," l. cit. vol. xiii., p. 58, 1871. As his observations on the peculiar fecundating apparatus of the plants of this order, which includes our common Banksias and Grevillias, were made almost exclusively on dried specimens, "they will require to be supplemented, and probably in several instances corrected by those who can watch the process of ripening and mutual action of the anthers and stigma on the living plants."

The distribution of our native plants, especially in relation to hydrographical and geological conditions, requires working out; and little is known respecting their medicinal uses. Economic botany has, however, received much attention at the hands of Dr. Schomburgk, and the successful efforts made by that gentleman to acclimatise useful and ornamental plants have laid the country under a debt of gratitude to him. The Botanical Garden needs no advocate; and its Director has not been unmindful of the claims of systematic botany to be adequately represented; yet it lacks one important adjunct, namely, a museum of economic botany, devoted to the illustration not only of the raw materials industrially valuable, but also of steps in the processes by which they are rendered available for our use.

Cryptogamic Botany.—The present state of our knowledge of the Orders Filices, Lycopodiaceæ, and their allies will be found in volume VII., "Flora Australiensis." From the circumstance that many of the Australian fungi are either identical with European species or so nearly allied to them, the peculiar Australian forms being few in number, it cannot be hoped that any satisfactory determination of them can be undertaken in this country, though it is no bar to extended observations on the recorded species or to the search for undiscovered ones. The Rev. M. J. Berkeley has given a list of "Australian Fungi, received principally

from Baron F. von Mueller and Dr. R. Schomburgk ;' Journ. Lin. Soc., vol. 13, pp. 155, et seq., 1872. The number catalogued is 235, of which 43 are South Australian.

*Marine Algæ.*—Figures of many Australian seaweeds are given in Harvey's "Nereis Australis," and in Hooker's "Flora of New Zealand' and "Flora of Tasmania ;" but in (†) Harvey's "Phycologia Australica," vols. 5, 8vo, 1858-1863, we have a more comprehensive history of this class of Australian plants. In this work the more characteristic sea-weeds are illustrated by coloured drawings, accompanied when necessary with such magnified dissections as will enable any one possessed of a microscope to refer with certainty the figure to the plant which it represents. The number of plates is limited to 300, but at least one species of every genus is figured. The species which are figured in earlier works are not repeated in the Phycologia Australica, except in the case of types of forms which could not be omitted without injury to the scope of that work. A synopsis of all known Australian algæ is given; and the number of actually known species dispersed along the Australian coasts is 799; of these we appear to have 138 on our shores. The work lacks method in the arrangement of the descriptions, and the omission of a conspectus of the genera is a serious defect.

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## GEOLOGY.

The general geology of South Australia is represented on a (†) "First Sketch of a Geological Map of Australia," by R. Brough Smyth, 1875, which embodies the labours of Selwyn and Woods and the inedited observations of our Survey Department and of some explorers. The country south of Lake Eyre is shown to be occupied by Silurian, Tertiary, and Igneous rocks. Though the broad features seem to be pretty correctly pourtrayed (for as the scale is only 110 miles to an inch no accurate definition can be expected), yet extensive patches of tertiary rocks are known to exist where Silurian is shown, and in the Western District protrusions of the latter are omitted. Moreover, no distinction is drawn between our older and newer tertiaries, which are so widely separated from each other in point of time ; and also the two unconformable sets of the Palæozoic rocks, which were described by Selwyn, are not separately coloured.

The salient points of our geology about which we want to have accurate information are :—The metamorphic or igneous character of the granites; the order of succession of the fundamental rocks ; the age of

the newer palæozoics; the distribution of the upland conglomerates and ferruginous sandstones of the foot hills of the Adelaide Chain, and proofs of their supposed miocene age and fresh-water origin—the same in regard to the "desert sandstones" of the interior; the correlation of the marine older tertiaries of the various disconnected tracts; extended observations on glacial signs, and the probable connection of the newer drift deposits with them; and lastly, accurate measures of recent elevation of the land.

I must not attempt a history of South Australian geology, but will content myself with a list of the works relating to the subject.

1814. Flinders, "Voyage Terra Australis."

1843.* Sturt, "Two Expeditions into South Australia."

1846.† Jukes, "Sketch of the Geol. Structure of Australia," Brit. Ass. Reports, p. 68.

1846. Burr, "Remarks on the Geology and Mineralogy of S. Australia" (Adelaide).

1859. Selwyn, "Geol. Notes of a Journey in S. A." Parl. Report No. 120. Five plates of sections and map.

1860. Burr, "Geol. of a Part of S. Australia." Quart. Journ. Geol. Soc., vol. xvi.

1860. Woods, Geol. of the Southern Part of S. Australia." Quart. Journ. Geol. Soc., vol. xvi.

1862. Woods, "Geological Observations in S. Australia." 8vo, 404 pp. (London).

1866. Woods, "Report on the Geology and Mineralogy of the S. Eastern District." 8vo, 33 pp., map and two plates of sections (Adelaide).

1866. Hanson, "Geology of the South-East and Port Elliot Districts." Phil. Soc. of Adelaide.

1866. Woods, id. in reply to the above.

1872. Ulrich, "Mineral Resources north of Port Augusta." Parl. Rep. No. 65, pp. 23, 9 plates of sections and map.

1875. Higgs, "Remarks on the Mining District of Yorke's Peninsula." Trans. Roy. Geol. Soc. of Cornwall, vol. 9., part 1, pp. 122-131.

1875. Smyth, "First Sketch of a Geological Map of Australia".

1877. Tate, "Strata exposed in the Government Well, Murray Plains." Geological Magazine, Nov., 1877.

1878. Tate, "Note on the Correlation of the Murray Tertiaries" (pub. herewith).

A most valuable addition to the geological literature of Australia is the recently-published "Remarks on the Sedementary Formations of New South Wales," by the Rev. W. B. Clarke, F.R.S. This work is an index to the immense service rendered by that veteran to geology generally, although more particularly confined to the palæozoic rocks of New South Wales, to which he devoted forty years of his life and his remarkable talents.

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## MINERALOGY.

This important branch of South Australian Natural Science will be separately dealt with by Mr. S. Higgs, F.G.S.

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## PALÆONTOLOGY.

The known fossiliferous rocks of South Australia proper belong to the older and newer tertiary period. The fossils of the latter are closely related to the existing fauna, whilst those of the former make part of a large extinct fauna and flora, and which must be studied in relation to those of the equivalent strata in Victoria and Tasmania. Great advances have of late been made towards a better knowledge of the older tertiary fossils of these two colonies, and the chief sources of information are—

McCoy, "Decades of the Prodromus of the Palæontology of Victoria," I-V., 1874-78. The fossils described and illustrated are chiefly tertiary, belonging to various classes of animals.

Mueller, "Observations on New Vegetable Fossils," 1874.

Woods, "On some Tertiary Fossils from Table Cape," 2 pl., Trans Roy. Soc. Tasmania, 1874.

Woods, "Notes on the Tertiary Fossils of Tasmania," loc. cit., 1876.

South Australian Tertiary Fossils have been specially dealt with in the following papers and works :—

The Rev. J. E. Woods described and figured five species of pectens from Mount Gambier, in Trans. Phil. Soc. of Adelaide, 1865. This was followed in the same year by another on the Brachiopoda from the same

locality. Five species are figured and described. Additional species are made known by Etheridge in a paper "On some species of Terebratulina, Waldheimia, and Terebratella from Mount Gambier and the Murray Cliffs. (Annals and Mag. of Nat. Hist., 1876, 2 pl.) This paper gives descriptions of five species of fossil palliobranchs, which are illustrated by well executed drawings contained in two lithographic plates. Two species are decidedly new, *Terebratulina Davidsoni*, and *Waldheimia Taylori*, but a third species described as new under the name of *W. Gambierensis* is identical with *W. grandis*, Woods. The other species illustrated are *W. Garibaldina*, Davidson, and *Terebratella compta*, Sow. The Rev. J. E. Tenison Woods describes and figures some Australian tertiary brachiopods (Trans. Roy. Soc. N. S. Wales, 1877), and notes the occurrence of two of them in the South Australian deposits. In a paper which I have prepared the S. Australian fossil species, twenty-two in number, are treated in a monographic form.

The echinodermal fauna of the Australian tertiary rocks is one of remarkable interest, and has received attention from not a few palæontologists. The Rev. J. E. Tenison Woods figured and described three species of sea urchins from Mount Gambier in the transactions of this Society, published in 1866 ; one of the species had been previously made known. The next contribution to the subject was by Dr. Laube, (†) "Ueber einige fossile Echiniden von den Murray Cliffs in Sud Australien" (Sitz. d. k., Akad. d. Wissench, Wien, 1869), who describes and figures as new eight species, but two of these had been made. known by Mr. Woods. Next R. Etheridge, jun., in Quart. Journ, Geol. Soc., 1875, gives a *resumé* of all that had been published on the S. Australian fossil tertiary echinoderms, but overlooked the important communication thereon made to this Society by Mr. Woods, and by means of drawings illustrates certain detailed characters which were not noted by Laube. Dr. Duncan, in the same Society's journal for 1877 describes eleven new species from the Australian tertiary deposits, and identifies three living species as met with in a fossil state; four species are added to the local list. Collections made by me among our older tertiaries contain most of the species described by Duncan from localities beyond this province.

The last addition is *Salenia Tertiaria*, Tate, described and figured in the Quart. Journ. Geol. Soc., 1877. This beautiful fossil is the subject of some lengthy remarks by Prof. Dr. Duncan in his anniversary address read before the Geological Society of London, February 17, 1878, and in

a series of articles "On the Salenidæ," published in the Ann. and Mag. of Nat. History; in part III., "on a third form of recent Saleniæ, and on the Saleniæ from the tertiary deposits," July, 1878, the learned author writes respecting our species—"It is a fine form of *Salenia*, with all the characters of the cretaceous species, except the distribution of the pores in the ambulacra. In the older *Saleniæ* there is a pair of pores to each ambulacral tubercle, and one intermediate, or in other words, two pairs are in relation to each tubercle. The *Salenia* described by Prof. Tate has but one pair. This is the case with the recent species, so far as is known."

The total number of recorded Echinoderms from our Tertiaries is fifteen, but that is not a moiety of those collected by me from the Murray and Aldinga Cliffs. The chief additional genera are *Pentacrinus*, *Temnechinus*, *Fibularia*, *Laganum*, *Hemiaster*, *Echinobrissus*, *Lintha*, and *Comaster*. The systematic description of the new species is being proceeded with, and I hope soon to have the pleasure of communicating to you a summary of the results arrived at.

The Polyzoa, which constitute so prominent a feature in the Tertiary fauna of South Australia, many of the strata being made up of their *debris*, have been much neglected, and the field is almost untrodden. From their variety of form and the beauty of their ornament they are highly attractive to the microscopist. Professor Busk in 1860 examined a collection from Mount Gambier, forwarded by the Rev. J. E. Tenison Woods, and classified them into forty species of sixteen genera; thirty-six of the former were considered undescribed, and three of the latter being new; but being unaccompanied by descriptions or figures, the list published in the Quart. Journ. Geol. Soc. is of no aid to the student Mr. Woods, in his "Geol. Observ. in S. A.," attached specific names to some polyzoa figured on a lithographic plate in that work; and further added a little to our knowledge in a paper, "Proc. Roy. Soc. of Victoria for 1862." But a more important step was made by him in communicating to the Roy. Soc. of N. S. Wales, 1876, descriptions of "Some Tertiary Polyzoa from Mount Gambier." Thirteen new species are technically described and illustrated by two well-executed lithographic plates; they are *Eschara*, 10 sp., *Pustulipora*, 2 sp., and *Tubilipora*, 1 sp.

The present state of our knowledge of the coral fauna of the Tertiary strata of Australia is given by Mr. Woods in the introduction to his paper published herewith, and that of the S. Australian tertiaries in a supplementary note added by me.

A few gasteropodous shells from the Murray and Aldinga beds are described by me in a paper communicated to this Society.

One other fossil from our rocks has been made known; it is the so-called *Belemnites senescens*, described by myself in the Quart. Journ. Geol. Soc., May, 1877. Its reported occurrence on the Murray is an error, but I have found it at Surveyor's Point, Yorke's Peninsula. Professor McCoy in Decade V. Prod. Pal. of Vict., describes and figures the axis of a zoophyte, under the name of *Graphularia Robinæ*, obtained from the Tertiary strata. He points out its very close resemblance to the guard if a *Belemnite*, and suggests that the so-called discovery of belemnites in the tertiary strata of South Australia is based upon a similar fossil. It is unfortunate for science that Professor McCoy is so oblivious of the labours of others, else he might have taken some pains to clear up the doubt. To me the two fossils are identical, and if the generic name must be changed, then the fossil must, according to the law of priority, be known as *Graphularia senescens*. I have not found a phragmacone, but two specimens exhibit a regularly conical alveolar cavity; and until I can clear away the mysterious nature of this cavity I must hold the question of the systematic position of the fossil as not proven.

A few foraminifera and ostracoda from the Murray and Mount Gambier beds have been determined by Professors Rupert Jones and Brady, the names of which have been published in Quart. Journ. Geol. Soc., 1860, and Geol. Mag., July, 1876.

In conclusion, I may quote the words of my friend, the Rev. J. E. Tenison Woods, who writes, (Pro. Roy. Soc. of Tasmania, 1876):—"It will be seen from this brief sketch that the tertiary formations of Australia have occupied many minds, yet our progress, so far, has been somewhat slow. This is the more remarkable as it has long been believed among scientific men that the development of Australian geology must reveal facts of the utmost importance to science generally." This belief is day by day finding confirmation at my hands; already our Tertiaries are known to contain genera hitherto regarded as of secondary age, and the facts are accumulating which go far to prove that the lower portions of them are older than they have hitherto been regarded, and may indicate a palæontological overlap of tertiary on secondary. So large a number of organic remains have to be arranged, classified, and compared that my labours in this direction are not sufficiently advanced to enable me to submit to you a comprehensive view of the question.

In the department of newer Tertiary Palæontology a very important addition has been made to that fauna which immediately preceded the present one. I allude to the determination made by Professor Owen of the former existence of a large wingless bird on this continent, founded on a tibia obtained in the Mount Gambier District. This bone, he writes, determines beyond question the fact of the former existence in Australia of a wingless or flightless bird of the size of *Dinornis Elephantopus*, but of a genus nearer akin to *Casuarius* and *Dromarius*." It is named *Dromornis Australis*, and indications of its former extensive range in this continent are a femur obtained at Peak Downs, Queensland, in 1869, a pelvis at Goree, near Mudgee, in 1876, and a femur from the Wellington Valley Caves, N. S. Wales. All these bones and the South Australian tibia are considered by Professor Owen to be parts of the same genus if not species. The first to recognise the affinities of this bird was our hon. member, the Rev. J. E. Tenison Woods, and it redounds to his skill as a comparative anatomist that the opinion he expressed has been corroborated by the greatest living anatomist. The original discovery is recorded in his "Report on the Geology and Mineralogy of the South-East, &c.," p. 7, 1866, from which I extract the following :—"In sinking a well on the edge of a swamp fourteen miles N.N.W. of Penola, some bones have been dug up, which were this day (April 25, 1866) recovered by me. They comprise two tibias and two tarso-metatarsal bones, and show them to have belonged to some struthious bird very nearly allied to the emu. . . From the size of the bones it was evidently a larger, heavier, and more clumsy bird. . . . I should propose the provisional name of *Dromarius Australis* for the bird. It is certainly quite extinct, but appears to have been contemporaneous with the natives, for these bones are marked with old scars, one of which must certainly have been inflicted by a sharper instrument than any in the possession of the natives at present; there were, however, fragments of flint buried with the bones, and a native well is distant about fifty yards away."

Professor Owen's "The Fossil Mammals of Australia" will ever remain a classic work, and is the only source of information regarding the extinct kangaroos, wombats, and their allies which are occasionally met with in the superficial deposits and caves of this province, and of other parts of the continent.

## OBJECTS OF THE SOCIETY.

The work of the past year warrants the opinion that the two fundamental objects of this Society have been studiously kept before us Its founders were desirous that it should not only afford an agreeable medium of intercommunication to those whose tastes led them to the pursuit of similar studies; but that it should also present a means of illustrating and recording the many interesting natural phenomena which are altogether peculiar to this country, and which it is to be feared would be otherwise in a few years' time irrevocably lost to the records of science. In respect to the latter and more important object, I affirm that the Society has attained a larger measure of results than at any other period of its existence. We shall have removed for one year at the least the reproach made against us by the President of the Linnæan Society of New South Wales in his anniversary address, that South Australia had not contributed anything to the literature of natural history. This success is in part due to the knowledge of the fact that the Society would make every endeavour to renew the publications of its transactions, and thus by guaranteeing that original observations so laboriously effected should be published in a more tangible and permanent form than hitherto, authors have been induced to make this Society the channel of communication with the scientific world at large. The publication of such papers must always be regarded as a matter of necessity, as by such means are we only enabled to keep up friendly relations with learned bodies elsewhere. Though we have been ambitious to secure only original papers for our evening meetings, and have sought to press capable men into the service of the Society, yet we have not unfrequently been reminded of an insufficiency of supply; but we, nevertheless, believe that as the importance and usefulness of the Society are better known, the difficulty in this respect will become less and less. At any rate, our present success can hardly fail to stimulate those who have aided us to fresh exertion, and to encourage those who have not yet assisted us to enter the vast arena of research. A remark made by Mr. J. S. Lloyd on the public estimation in which the Society is held, in his paper on "The present position of the Society," read July 24, 1866, would seem to apply with equal force now as then, and it may be repeated:—"Of course the amount of good effected by the Society has to be taken in some measure upon trust; but we feel that it is to the advantage of ourselves and the colony that attention should be given to science, literature, and art, and because the positive or practical benefit effected by us may not be exactly arrived at, either by weight or measure, we are not the less certain that

it has an existence. At any rate, it is easy to retort upon cavillers that the results would be more generally satisfactory if the Society received more general support." Our numbers have not correspondingly increased with the increase of population, and it has only been in the last two years that any sensible augmentation has been effected; nevertheless, the eighty members of to-day represent a much smaller percentage of the aristocracy of intellect than the sixty members of ten years ago. Is it apathy or indifference that causes so many to stand aloof, who from their profession or position in society should support us by their influence and subscription? Or have our meetings been of so desultory a character as to be repellent? To them I would appeal for the rectifying of the evils of a one-sided policy, for be it remembered that the improvement of any art or science varies directly with the number of intelligent persons engaged therein.

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Our Relationship to the South Australian Institute is somewhat anomalous. By the Statutes and Regulations of Incorporation we are—

1. Allowed an independent action.
2. Required to contribute a sum towards the working expenses of of the Institute.
3. Entitled to the use of a room, and also to the services of one or more of the officers of the Institute, at such times and in such manner as may be agreed upon with the Board of Governors.
4. And we have virtually resigned all claim to property actually acquired, for it is enacted that the property of the Society preserved in the room of the Institute cannot be permanently removed nor otherwise disposed of without the consent of the Board of Governors.

Thus on the one hand we pay £12 per annum for the use of a room, and resign all rights to the property we have acquired by gift or purchase; whilst on the other, we receive such trivial assistance as the addressing of a few postal cards once a month, and have possibly the power to recovery penalties; and it would seem also that the Board of Governors "have the power out of the funds placed at their disposal to make a grant to any Society so incorporated in aid of the special objects of such Society." By common consent this Society has been excluded from participating in grants to incorporated Societies, but it is not so expressed by the terms of the Act; and the regulation which gives the

Institution a lien on the property of an incorporate Society is not so unreasonable as it appears, if the property has been acquired by aid rendered by the Institute. We are placed at a great disadvantage by the present arrangements, and I would urge upon your Council the desirableness of securing more equitable ones; and I think you will agree with me that £12 per annum is too large a contribution or share of working expenses, and be it observed that the Society of Arts which has the exclusive use of a room contributes only £5 per annum. Moreover, the lien on our property should be removed, and at once in view of its greatly increased value in the form of surplus stock of our own publications, and of exchanges of publications of other Societies.

It may now be asked—What benefits will the Institute derive from us? Most certainly it should not expect pecuniary ones; and I dismiss the question without argument as it is a universally conceded postulate that it is the duty of the State to aid science. If permitted, I believe that this Society would largely benefit the Institute through its Museum. And with this object in view your Council requested your Representative Governor to move the Board of Governors to cause to have exhibited at our monthly meetings all objects presented to or purchased for the Museum during each preceding month. By this means it was thought that our members would be gratified, and that the remarks elicited and explanations offered would give publicity to the donations and thus serve a good purpose. Moreover, by thus affording those likely to be most interested an opportunity of examining the new acquisitions, the Society's records would keep the memory of them alive, though the objects themselves had been consigned to oblivion in boxes and cellars, there to await the advent of an enlightened Government before again seeing the light. Though the Board concurred with the view of your Council, yet no practical effect has up to the present time been given to the resolution: there may be difficulties which we know not of, but if a Committee were empowered to act all obstacles to the attainment of our object might probably be removed.

## OUR PUBLIC MUSEUM.

This reference to the Museum naturally leads me to speak of that public institution. Not only is this Society through its representative at the Board of Governors identified with the Museum, but it has been

instrumental in founding it, for according to Mr. J. S. Lloyd "the formation of a Museum was looked upon as one of the objects of the Society; and no doubt the efforts of the Society in this direction were not altogether without effect, and they have probably borne fruit in the Museum attached to the present Institution." But this Society as the exponent of natural science in this colony may legitimately occupy itself with the question as to whether or not the Museum is fulfilling its proper functions?

A good deal of carping criticism has been indulged in of late in respect to it, but with this I have no sympathy. No man can be found possessing specific knowledge in every department of a general Museum, but I think that if greater facilities were offered to the student in any given branch of our local Natural History, voluntary help of a useful kind would be forthcoming. I propose to examine the question which I have raised from a higher standpoint, and to indicate the chief directions in which reform is needed. By directing your attention to the shortcomings of the existing Museum, I trust that you will use your influence to have them remedied in the Museum of the future. Agitation upon museum reform has been active of late in England, and I have largely availed myself of the opinions of the museum reformers, as I find them to be applicable to our own case; the arrows that I shall shoot are, therefore, not all from my own quiver.

A well-arranged Museum is valuable to the State in various ways. In its highest sense it encourages a love of knowledge for its own sake, apart from any selfish aims; it is a necessary instrument of training in Natural History, and it assists in raising up men possessed of scientific knowledge, to whom appeal may be made for trustworthy information touching the means to be employed for the development of our natural food resources and concerning the character of the natural agents obstructive to that development. A knowledge of the life history of noxious insects enables the entomologist to suggest the right means to keep them in check; and this fact has been fully recognised in the United States, England, France, and Germany. Legislative acts relating to the preservation of birds, fish, oysters, &c., passed by the countries named, have all been dictated by the zoologist. How practically useful and instructive would our Museum be if the rocks, minerals, fossils, and manufactured mineral products of the country were displayed in such a manner as to show in what new directions capital may and may not be invested.

A Museum is, moreover, a means of spreading culture among the intelligent lower classes, and such visitors leave it all the better for having been there, as it is impossible that they should not carry away some sort of idea which otherwise would not have occurred to them. But for the wants of the public a descriptive Guide Book containing elementary inplanations is necessary for the right understanding of the objects exhibited. The effect of museums is to elevate a man's character; and if our Sabbatarian teachers would admit that truth, access to the Museum on Sundays would no longer be denied to those who have no other opportunity in the week, and who do not go to church or chapel. For my part, I am unconvinced by the specious arguments which seek to justify the opening of our Botanic Gardens, and its museum and zoological collection, and the closing of the Zoological Museum on Sunday afternoons.

In our Museum we have not only to consider the wants of the gazing public, but also to provide for the requirements of the special student and to afford materials for the *savant* in promoting original research which functions ought not to be sacrificed for the benefit of mere sightseers. For the former we must have mounted skins of vertebrates showy insects in their perfect stage, prettily-coloured shells, miniature groves of coral, and the like. But Science and Instruction require a great deal more—the animal must be exhibited as far as possible in all its parts, and in all phases of its life; the skin of the kangaroo should be accompanied by its corresponding skeleton; the bird with its nest and eggs; the perfect insect, with its eggs, larva, and pupa; shells, with the animals which produce them, and in every case the station and habit of the animal should be affixed to the specimen.

Collections of typical specimens of this country are absolutely necessary for the advancement of Natural History studies, as the teaching of the elements of the science should be by means of the familiar objects around us. It is a reproach to this State that its Museum so imperfectly —I might say, hardly at all—represents its natural characters; for it happens that the things most characteristic of the country are not thought worth exhibiting; our mineral industries are absolutely unrepresented, if I may except a very few specimens of gold and copper ores. Though I hold that our colonial productions should be most fully represented; yet it is not necessary that all should be exhibited, but nevertheless all should always be open to the inspection of the student.

Our Museum is too small to have any educational value worth naming, and in its present state it teaches too little by attempting too much, and I think it would be far better to exhibit fewer specimens which should fully tell their own tale, than to heap so many together without labels; and because its present resources are so limited, the greatest amount of good will probably be effected by confining attention to the formation of a provincial collection.

The lack of patriotism among those who regulate the affairs of the Museum has been most deplorably shown in some instances that have come to my knowledge—it pains one to recall them. Nevertheless, may I ask why two diamonds, unique as crystals, and which were found within the colony, do not form part of the National Museum collection? Will another, subsequently found and purchased by our Government, find a home with us? Again, why has not that choice collection of our native beetles formed by the late Mr. Odewahn been secured for the country? For, be it known that the Museum does not possess a specimen of the diamond, and that all it has representative of the large coleopterous fauna of South Australia is a small case of dilapidated beetles. If the Museum were the property of this Society, or other body not having adequate means for efficient maintenance, a reasonable answer would be expected not only to such specific questions, but to others that I have already touched upon.

Is the Museum fulfilling its proper functions? I need not press for an answer, as I know that it is the universal opinion that it does not. The chief causes for this may be summarised under the heads of *space, working expenses,* and *management.*

The present Museum accommodation is lamentably deficient, and yet a great mistake is about to be made with that to be contained in the new Institute building, as the space will be only large enough to hold the already exhibited specimens, no provision being made for the display of objects stored away, and of those not already collected. It moreover presents the sad fault of an upper gallery. It would also be well to profit by the example of the United States, who fully recognise the fact that the expense of a grand building starves the museum within.

A well-arranged Museum is of necessity costly; money measures the power of procuring glass-cases and suitable specimens, but as the funds necessary for efficiency should be provided out of the public purse, since it is for the public weal, it is to be hoped that they will be on a scale commensurate with the largeness of the object to be achieved, provided that it is not narrowed down by curtailment of accommodation.

As to management. In the first place, the abnormal connection between the Museum and the Library should be severed, as their interests are somewhat antagonistic. This view is advocated by the press, and in an article in the *Advertiser*, October 23, 1876, it is there urged that "the keeping up of our reading-room in its present state of efficiency, and the formation and development of a free public library, is enough to tax the energies of a single body of men. As for a Museum, we do not think it should be regarded as a part of the Institute at all." It has always seemed to me that it would be an advantage to establish some kind of connection between the Museum and the University—a centre of liberal education where science asserts its proper position—because those who have had most experience in oral teaching will probably be best qualified to assist in its oversight. The principles which are recognised as applicable to education in general apply equally to the arrangement of museums in so far as their educational functions are concerned. The order in which the knowledge of things is best received and retained in the memory is precisely that in which the things themselves were evolved; consequently, the arrangement which in a Museum is best adapted to impart instruction is at the same time that which best records the history of the things exhibited. As the University must have a Museum, and impressed with desirableness of economising space and effort, I suggested to the Council that it should seek to amalgamate the two interests. At a meeting of the Council, held December 15, 1876, two resolutions were unanimously carried, the one affirming the inexpediency of having more than one Museum for the Province, and the other appointing a Committee to confer with the Governors of the Institute about the whole question. The results of that conference have not been publicly made known. But there still remains another course to be followed, by which the evils of having two Museums may be avoided; that is by each one becoming to some extent exhaustive in a special direction.

It may not be too late to direct the attention of the proper authorities to the existing defects, with the view of carrying out the urgently needed reform in connection with the proposed new Museum.

## LOCAL AID TO SCIENCE.

While on the subject of National Aid to Science, I may remind you that your efforts to induce the State to undertake a geological survey of the colony, which at one time seemed likely to be crowned with success have proved futile. The reason assigned for not instituting such a department is that of expense. We, who believe that such an organisation

would be able to render considerable service to the country, must feel regret at this determination of the Government, and regard the decision as an instance of false economy. We hope that a survey is only temporarily deferred, and must note with pleasure that a step in this direction is shortly to be made by the investigation of the Hydro-geological character of certain waterless areas.

South Australia has afforded little aid to the scientific examination of the country and its natural products, but it is to be hoped that as natural science asserts its position its claims on the public purse will be less grudgingly allowed than as hitherto. Much of our knowledge has been gained by private enterprise, but there are many investigations which should be undertaken, and which are far beyond the limited means of the scientific man. Take for instance, the exploration of the deeper parts of the sea off our shores, which might be easily carried on during the periodical trips of the Government steamer, and I believe that voluntary scientific aid is available. Apart from the scientific results likely to be gained by such exploration, much knowledge may be acquired relating to deep-sea fish which might prove industrially valuable.

# ON THE VEGETABLE FRAGMENTS FOUND IN THE TOMBS AND OTHER MONUMENTAL BUILDINGS OF THE ANCIENT EGYPTIANS.

By Richard Schomburgk, Ph.

Director of Botanic Gardens, Adelaide; Knight of the Imperial Order of the Crown; of the Order of Merit of Phillippe the Magnanimous, and the Order of the Crown of Italy; Mem. Imperial Carol. Leopold Acad., &c.

(Read February 5, 1878).

The large collection of plant-remains in the Egyptian Museum, Berlin, obtained from the tombs and other monumental buildings of the Ancient Egyptians has been re-examined by the late Professor Alexander Braun. The notes of this investigation having been found amongst the deceased's papers, Professors Ascherson and Magnus of Berlin thought it was due to the memory of that great botanist to make them public. My friend Prof. Ascherson has kindly favoured me with a copy of these notes, and I consider them so highly interesting that I could not forbear shaping them into a Paper.

The most reliable sources from which we have gained our knowledge of the plants cultivated by the Ancient Egyptians are :—Firstly.—From the plant remains which have been found in their tombs and other monumental buildings, which are now preserved in the museums of Berlin, London, Vienna, Paris, Turin, Leyden, and Florence. Secondly. —The numerous representations of plants on the monumental structures which the Ancient Egyptians used for sacred and profane purposes give us also an idea of the vegetation, although they are inferior to those of animals. Thirdly.—The writers of classical antiquity supply us with a very good description of the Flora of Ancient Egypt.

A very interesting fact has been ascertained by comparing the plant-remains of nearly 5,000 years old with living examples of the same species, that is, that no essential variation between the two is noticeable,

except only in the fruit of the pomegranate, in which a slight deviation is observable. But on comparing the ancient flora of Egypt with the modern one we find that a change regarding the distribution of several plants has taken place. Many plants at present cultivated in Egypt, not a sign of them has been traced in Ancient Egypt; and on the other hand, plants which were plentiful 5,000 years ago have disappeared from the Lower Nile territory. There is no doubt that several plants and fruits entombed found their way by commercial intercourse from other parts of the world.

The fruit trees of modern Egypt are the date, sycamore, nabok (*Zizyphus Spina-Christi*, Willd.), opuntia, orange, citron, apricot, peach, fig, mulberry, apple, pomegranate, banana, pear, plum, and grape; of all these fruits only the date, sycamore, fig, grape, and pomegranate, were known to the Ancient Egyptians. It was the happy thought of Professor Unger to disintegrate and examine the unburnt bricks of which the Pyramids of Dashur Group have been built, with the view to the discovery of the plant materials which had been used in their preparation. The bricks were immersed in hot water, the earthy part crumbled away, leaving the vegetable portion free. Amongst the organic remains detected was *Eragrostis Abyssinica* (Linn.,) or Teft, a graminaceous plant, which is cultivated for its grain up to the present day in Abyssinia. This discovery favours the assumption that *Teft* was cultivated by the Ancient Egyptians. Prof. Unger found also abundance of wheat and barley straw, grains of both the cereals, and a few capsules of the flax-plant.

Of cereals found entombed, the Berlin Museum possesses several kinds of wheat. There is some of *Triticum vulgare*, mixed with which are a few grains of barley; also *Triticum turgidum* (Linn.), the prevailing kind now in cultivation in Egypt, called Egyptian wheat, and two other kinds—*Triticum spelta* (Linn.), and *Triticum monococcum* (Linn.), neither of which is cultivated at the present time. Professor Unger ascertained the fact that from the abundance of the wheat and barley straw in the bricks of the Pyramids of Dashur these cereals must have been extensively cultivated. *Triticum vulgare antiquorum* likewise occurs in the bricks, and, strange to say the same variety was found by Professor Heer in the remains of the Lake-dwellings in Switzerland. The barley has been determined as *Hordeum hexastichon* (Linn.) It is still believed that wheat-grains taken from the Egyptian mummies have germinated; this is as good as proved to be impossible, and is probably

an intentional attempt at deception, for whenever mummy-wheat was supposed to have germinated it was undoubtedly recent grain mixed with it. The true mummy-wheat is dark brown and carbonised.

The cultivation of *flax* must have also been very extensive, and manifold were the uses made of the linen, and principally in the embalming of the dead, and for the garments of the priests, who only were allowed to wear it. In the Berlin Museum are preserved two Ancient Egyptian flax-combs; between the teeth are still some fibres attached, which by microscopical examination prove to be flax. Two kinds of flax have been determined from the entombed seeds, viz.—*Linum humile* (Mill.), and *Linum angustifolium* (Huds.). The latter plant is a perennial, a native of the Mediterranean region, and not cultivated at present. The former is still cultivated in Abyssinia, though not for the sake of its fibre and oil, but for the seed, which is used by the lower classes for food, and is generally eaten during Lent. The seed is roasted and ground, the flour is mixed with water to a paste, to which is added salt and pepper. A very interesting fact is that the seed of *Linum humile* has lately been found in the Pile-dwellings in Switzerland, and it is the opinion that the inhabitants were of African origin.

The sycamore (*Ficus sycomorus*) was one of the most abundant trees of Ancient Egypt, and is still so at this day. Religious worship was paid to this tree by the ancient Egyptians, and it was dedicated to the deities—Isis, and Nutpe. The departed soul received also under the holy sycamore tree the wreath of vindication. A great part of the wooden objects of Egyptian antiquity in the Berlin Museum are prepared from the wood of the sycamore. Its fruits are found often entombed, and are smaller and less flavoured than those of the common fig. One of the relics of the Berlin Museum, found in a tomb, is a cake on a layer of sycamore leaves.

The extensive culture of the *olive* in Ancient Egypt had been spoken of by ancient authors, and Theophrastus mentions the appearance of the olive in the Oasis of the Desert of Libya, where the tree at the present time is growing; but hitherto the fruit has not been found in any of the tombs, the hard stone of which would have preserved well. The Berlin Museum possesses a relic made from olive branches—five small bundles, each containing three small branches, are tied together with strips of palm-leaves. Professor Lepsius, the great authority on Egyptian antiquity, believes this bundle has been used for the same purpose as the rod is used at the present time to chastise children. Many funeral-wreaths pre-

pared from olive-leaves have been found, but these belong to the period of Osarkon, 22nd and 25th dynasties; they were the symbol of vindication of the departed soul before the judgment of Osiris. There are other funeral wreaths in the possession of museums made of the leaves of *Mimusops Kummel*, embellished with flowers of *Acacia Nilotica* (Del.), but they belong to a later epoch, that of the Roman-Greek. The use of the flowers of this common Egyptian tree for wreaths has been mentioned by Theophrastus. *Chrysanthemum coronarium* (Linn.), a native of the Mediterranean, and cultivated at the present time in our gardens, is only found in Egypt growing near Alexandria, and was no doubt cultivated in the flower gardens of the Ancient Egyptians. A *Centaurea*, the species of which could not be determined, occurs. Other wreaths are decorated with the flowers of the blue lotus.

The before-mentioned *Acacia Nilotica* was the only tree of any size in Ancient Egypt producing a durable wood suitable for ship building, but this only in lengths of, at the most, nine to ten feet.

Amongst the entombed fruits are also found juniper berries, probably of *Juniperus excelsa* (Bbrst.), which kind inhabits Asia Minor, the Island Tharos, and Abyssinia; whilst the common juniper, *Juniperus Phœnicia* is a native of the Mediterranean, and does not, as is the case with all the Coniferæ, appear in Modern Egypt; therefore it is doubtful if the tree was wild or was cultivated in Ancient Egypt; and it is more admissible, that the berries of *Juniperus Phœnicia* and also the objects made from coniferous wood found their way from Syria or Asia Minor. No doubt the juniper berries were used for fumigation as at present.

The culture of the date palm in Ancient Egypt was undoubtedly as extensive as at the present time. The tree extends over the whole of North Africa and part of Asia Minor; but its real home is not known. Its fruit is found abundantly in the tombs; so also that of another palm, *Hyphœne Thebaïca* (Mart.). The latter palm, which is frequently mentioned by ancient authors, is distributed over the greatest part of North Africa, and is found in Guinea. A third kind of palm fruit is that of *Hyphœne Argun* (Mart.), which at present grows in the Nubian Desert; the finding of this fruit in the tombs is the more interesting because the tree is not cultivated in Modern Egypt, nor was it, it is believed, in Ancient Egypt.

The pomegranate, *Punica granata* (Linn.), has not only been frequently found entombed, but also represented on monumental structures. The ancient fruits are smaller than the modern ones, and differ from them

in having from four to six cells instead of six to eight. One of the fruits preserved in the Berlin Museum has been bitten into, as the marks of both rows of teeth of a human being are plainly to be seen.

The castor oil tree, *Ricinus communis*, Linn., seems to have been cultivated as extensively in Ancient Egypt as it is at present in Modern Egypt, for the sake of the oil. The seeds of this tree are frequently found entombed, and have preserved a very fresh appearance, and several have been sown, but without results.

The culture of the *vine* in Ancient Egypt must have been also very extensive. On all, even the oldest, monumental structures, the vine is represented, as also branches of the same and the gathering of the grapes. The ancient authors give also an account of its culture and the consumption of the wine, while the results of the latter are represented on monuments. The berries of the vine have been frequently found in the tombs; and the Berlin Museum contains a large series of them. They are as large as fairly-sized raisins, of an oblong shape, and probably of a dark blue colour. Several berries which have been examined contained not one, but three stones. For the purpose of examination they were immersed in water for four days, and afterwards hot water was poured on them, but they did not soften, nor present the fleshy and clammy nature of softened raisins, and on being pressed crumbled like mouldy wood, though the water in which they were soaked acquired a dark chesnut-brown colour. The French chemist, Fontinelle, did not succeed in finding sugar in the berries.

No plant was more venerated than both the renowned species of *lotus* (*Nymphaea lotus*, Linn., and *N. cærulea*, Savig.) These were the favourite flowers of the country. They are represented on almost all monumental structures, and in the hieroglyphs they indicated the upper country, or Southern Egypt. And it is well known what an important part the water-lilies played in the religious ceremonies of the ancient Egyptians. From the earliest time the root and seed served for food to the inhabitants of North Africa, but in Modern Egypt they are not used for this purpose. The ancient Egyptians called the lotus *seschnin*, and with a slight alteration *bischnin* is the Arabic name of the plant. Many fragments of the lotus have been found entombed, and two well-preserved buds are in the British Museum.

Another aquatic plant related to the lotus is *Nelumbium speciosum*, Willd., which must have also been extensively cultivated in Ancient Egypt, as it is mentioned by ancient authors, and is represented on the

earliest monuments; but it has now quite disappeared from the country, and was in all probability originally introduced from Asia, of which it is a native.

One of the most important plants of the Ancient Egyptians was the *papyrus*, which, like the lotus, is seen on the oldest monuments. Fragments of the papyrus are found in nearly all the tombs. It was used for many purposes, both ornamental and useful, but principally for paper, which was of the greatest reputation in antiquity. It is worthy of note that this plant, whose culture was anciently so extensive, has now entirely disappeared from Egypt, while in Sicily and Syria, where the plant has undoubtedly been introduced from Egypt, it is perfectly naturalised. Only on the Blue and White Upper Nile is the papyrus found growing wild.

Amongst the Egyptian plant-relics in the Berlin Museum are the tuberous roots of another *Cyperus*, *C. esculentus*, Linn. This plant is still cultivated in modern Egypt; as its fleshy roots contain oil and sugar, and form a well-tasting dish.

In the Museums of Berlin, Vienna, and Florence are fruits which have been found entombed, and which have been recognised as those of *Cordia Myxa*, Linn. It is a middle-sized tree and is a native of Abyssinia, but is still here and there cultivated in the gardens of Modern Egypt. Also the fruits and leaves of another Abyssinian tree, *Mimusops Kummel*, Hochst., are represented in the Berlin collection. The fruits are of the form and colour of the hips of the dog-rose; they and the leaves have been found in some abundance in tombs. The Ancient Egyptians would seem to have used the leaves for making funeral wreaths, as such a one is in the Museum of Leyden, and the leaves of it are folded and strung on very thin strips of palm leaves. This use of the leaves renders it probable that the tree was cultivated, as it is unlikely that they reached Egypt by commercial intercourse. It is not now found in Egypt, having together with the Papyrus plant and the Nelumbium disappeared in the course of the last centuries, no doubt from the discontinuance of their culture.

Numerous seeds in the possession of the Berlin Museum have been identified as those of a watermelon, *Citrullus vulgaris*, Schrad. This discovery is of the greatest importance, as it is now settled that the watermelon is a native of Africa. Not only on the Upper Nile, but also in other parts of West and South Africa has this species been found growing wild. The fruits are much smaller and less juicy than the

cultivated ones; but it is said that after a short culture the wild ones attain to the same perfection. It is, therefore, no longer doubted that the watermelon was first cultivated in Egypt, and spread from thence to Asia Minor, and later to South Russia and Hungary. The watermelon is mentioned in the complaint of the Children of Israel—"We remember the fish which we did eat in Egypt freely; the cucumbers, and the *melons*, and the leeks, and the onions, and the garlick." (Numbers xi., 5.)

The predilection of the Ancient Egyptians for the onion tribe is not alone established from the above Scripture passage, but also from the numerous representations of it on the ancient monuments. We also learn from Herodotus that the labourers employed building the Pyramid of Cheops ate onions, leeks, and garlick to the value of 1,600 silver talents (about £649,600). The Modern Egyptians follow the example of their ancestors, as onions are extensively cultivated by them, even in the oasis of the Lybian Desert, and garlic not less so in the Valley of the Nile.

There is another fruit found in the tombs, of which the Berlin Museum possesses a number of seeds. It has been determined to be *Balanites Ægyptiaca*, a small tree found in North-tropical Africa, extending from Senegal to Abyssinia. Single specimen trees are found in the gardens of Modern Egypt, but in ancient times it must have been largely cultivated, as the seeds are commonly found entombed.

Other fruits in the Museum of Berlin have been identified as *Sapindus emarginatus*, Vahl. The tree is a native of East India, where its fruits are used as soap, both for cleaning the person and for washing fine linen. In Sanskrit they are called *phenilla*, which means froth. It is not improbable that the Ancient Egyptians, whose commercial intercourse with East India is not doubted, received the fruits from thence just as their descendants do to this day for the same purposes from the East.

The discovery of branches of the poisonous shrub, *Calotropis procera*, R. Br., a native of Persia, is the more interesting as it has been ascertained that the branches still contain the intense bitter natural to the plant, and has proved that the bitter principle in plants is more lasting than that of sugar.

# ON THE DECREASE OF MANY SPECIES OF INSECTS AND INCREASE OF SOME IN SOUTH AUSTRALIA.

By Otto Tepper, Corr. Member.

(Read February 5, 1878.)

Long-continued observations of the life and habits of insects in general have produced the impression on me that, at least in the localities I visited frequently in the course of my rambles, the number and variety of many insect tribes were rapidly decreasing from year to year, while some of them apparently maintained their position, and a few materially increased in number. Many species of Coleoptera, as Longicornia, Buprestidæ, Lytta, &c., some butterflies, &c., have become scarce, while some even seem to have died out altogether in some localities; notably those seem to be first and most frequently affected whose conditions of life depend upon certain assemblages of trees and shrubs. This appears not to be altogether due to the actual want of such trees and shrubs, for I have seen and examined carefully patches of blooming mallee and myrtle, many acres in extent, several times a week for months, but only met with a few of the commonest beetles, flies, or wasps, though at other places not far distant, and almost exactly similar, a great many of the desired Coleoptera, &c., were taken upon these their favourite flowers. Far less direct influences seem to furnish the main cause of this comparative barrenness, the chief of which, I am disposed to consider, is the browsing of cattle, sheep, &c. The woodcutter's axe and the farmer's plough coming next in order. All these change the aspect of nature greatly, and alter very much the relations of vegetable and animal life.

For illustration I will select Monarto on account of various reasons. It is situated about seven miles east of Callington, and was, at the time of my stay, a newly-formed farming settlement on the eastern slope of a

range of hills facing towards the Murray and the Murray scrub. The hills mentioned, formed of metamorphic rocks and granite, were timbered by various species of Eucalypts—whitegum, mallee (*E. dumosa*), peppermint, casuarina, myrtaceæ, and proteaceæ in a number of species, besides other trees and shrubs of minor importance, of which the so-called box-tree and melaleuca were the principal.

Towards the river, and within a mile and a half from my cottage, a black sea of mallee met the view, interspersed with groves of pines (*Frenela*) and patches of porcupine grass ; here and there varied again by hakeas, banksias, &c., in smaller patches. A low granite range divided this region (about 12 or 15 miles from east to west) into two unequal parts, which I frequently scoured in all directions during the most favourable part of the year, viz., from September to April, for the purpose of collecting insects. In a period of some eighteen months, comprising a season and a-half, I obtained between 400 and 500 species of coleoptera, distinct from some 500 species I had previously collected.

Some parts of this locality were densely wooded, some open; large clearings had been made in others for farming and other purposes—hillsides alternating with plains, sand patches with rock; thus presenting a very favourable field for insect development. Yet one could pass for miles through these sceneries and hardly meet any but solitary insects belonging to the commonest species, and examine dozens of mallee, myrtle, or melaleuca bushes, steeped in a cloud of bloom, with the same result. Suddenly, one would come across a patch, limited in extent, teeming with life in great numbers of individuals and species. Yet not one quality could be specified not possessed by others, almost deficient of life, to account for the difference and the predilections of the insects. Another circumstance worthy of remark is this, that these favoured spots are not permanent, but seem to be subject to change in an arbitrary manner, which I often heard mentioned by other collectors.

What is the cause of all this?

My observations, limited as they are, point to this answer, viz., that the desertion of one place and the acceptation of another is mainly due to the disturbances the insects suffer while depositing their ova, amounting often to total prevention. These disturbances are caused by the browsing of cattle and sheep, not to mention, for the present, the radical agencies of axe and plough. Even if the ova be successfully hatched, an invasion of the feeding-ground of the young larvæ by the same intruders prevents many of them from attaining to maturity, either by

being crushed or shaken off the plants, and falling a prey to ants, &c. The consequence is that insect life can only develope freely at such spots which accidentally escape invasion. Another well-known fact greatly assists in localizing species, namely, that most females of many species do not quit their own birthplace voluntarily, for as soon as impregnation has taken place they deposit their ova at the next suitable plant or other place and die. No great wonder, therefore, localities of exuberant insect life should remain isolated. Now, the chances are greatly against the escape of such localities from invasion for any length of time wherever cattle are depastured ; thus, instead of extending, which is a slow process at most times, they gradually contract, and at last become extinct, perhaps in one season, and their inhabitants exterminated.

New centres may be formed, and are, as frequently observed, through individuals, carried accidentally by instinct, gusts of wind, &c., to other favourable spots of bush; but, again, the chances are much against the preservation of the same ratio of species, especially where overstocking is such a prevailing evil as here, and the tendencies in settled districts are always towards extermination.

This result would be rather beneficial to man than otherwise if nature acted discriminatingly, which is not the case, extermination befalling the innocuous and the useful almost always in the first instance, the others apparently receiving an impetus in the opposite direction, completing the work of destruction, initiated by man unwittingly, in an increasing ratio.

Insects, as well as animals, being either herbaceous or predatory, the former draw their sustenance from vegetation direct, while the existence of the latter depends upon the first, limiting their increase within narrow bounds, fluctuating little in a normal state of nature. The great majority of predatory insects (ants, spiders, parasites, and pseudo-parasites excepted) produce a much smaller number of ova than the vegetable feeders, and are therefore more exposed to reduction in number and final extermination by inimical causes than their prey the vegetable feeders. These, in their turn, are, in general, gifted with a prodigious fecundity.

Now, if one or more species of the predatory insects be extinguished, or only greatly reduced in number, the check upon the herbaceous insects, or upon some of them, is removed, and they at once avail themselves of the opportunity, and appear in augmented numbers, sometimes inconceivably large, ending, after total destruction of their food-plant, by

starvation, or through unfavourable physical causes. As examples, I beg leave to mention Locustidæ, the Colorado beetle, some Melolonthidæ (to one species of which is owing the destruction of thousands of Eucalypti in Monarto), several species of moths, &c. The undue increase of their number could, I firmly believe, be proved to be due to the removal of the check upon it, be it in the form of some predaceous beetle, as most likely; of some birds, of climate, or condition of soil. In any of these *man* may, nay, often *is*, the foremost motor.

Insect species in general are best off in localities with alternations of wooded and open tracts; there the soil preserves its humidity for the longest time, because, on the one hand, the water descending as rain is greatly retained, and can percolate freely in the ground at the same time that the decay of dead vegetation is promoted; on the other hand, the ground being shaded remains always tolerably cool, conditions favourable to predatory insects — Carabidæ, &c. The combined effect is to promote from year to year a more luxurious growth of vegetation, well able to withstand the attacks of destructive insects, and sheltering their enemies—predatory insects, birds, &c. In localities where some plant-eating insect increased inordinately, mostly a great deficiency of predatory insects and birds may be noticed. Where there are many woody tracts at small distances surface springs abound, reacting favourably upon the former, thus improving and conserving the favourable aspect of the place.

Now man enters upon the scene.

The arable portions are carefully grubbed, cleared, and ploughed, and on the rest he depastures his cattle and sheep. The summer's heat parches the soil; scores of insects, lizards, birds, &c., perish; those birds feeding upon the former, their eggs or larvæ, which have not been wantonly shot, withdraw themselves to other regions offering more privacy, or die unable to bring up their young to maturity. Useless weeds and destructive insects, gifted with great fecundity and adaptability, augment apace for a while. The winter's rain descends unchecked, and carries the loose unprotected surface-soil annually in millions of tons to the sea. The shrubs and grasses continually browsed off, and unable to seed properly, wither and die. The trees thinned by the wood-cutter, in whose shade formerly scores of humbler or younger members flourished, and in return insuring for their big brother plenty of moisture and coolness, sicken, are attacked defencelessly by some insect, and succumb. Surface springs dry up gradually, elsewhere retentive strata get disturbed, the rain water per-

colates, and is carried far away ere it reappears, leading unthinking people to fancy that grain cultivation will augment the number of springs.

Protection of trees and shrubs and speedy replanting, where extinct, are the only preventative remedies. Every rocky hillock, every sand-patch, every roadside, ought to be studded with groves and avenues of trees and shrubs, and the cattle carefully excluded from them, for the nipping off of the young shoots means dwarfing, sickening, and often death for many of them. When this is brought about, there will again greet our ear the joyous hum of the beetles, the stealthy hush of the lacertilia, and the merry twitter and song of the birds, but in well-balanced number, their mutual checks being carefully supplied by nature. Only in deserts and deserted places locusts hatch in overwhelming numbers, and deserts are places without sufficient vegetation.

The chief beetles which have, according to my observations, shown a decrease in numbers, are the following :—

Most Buprestidæ, especially *Stigmodera*, many *Elaterini*, *Rhynchophora* (weevils), *Cetonia*, *Lamprima*, *Passalidæ*, *Lyttæ*, some species of *Clerus* (*C. notosus*, *trichodes*), *Amarygmus*, *Helops*, and other *Tenebrionidæ ;* and most species of *Carabini*, and *Staphylini*.

As stationary or increasing in individuals I have noted—Among Buprestids a blue and yellow banded *Stigmodera*, resembling *S. Yarellei*, which is very variable in size and colouring; also some of the genus *Cesseis ;* two or three species of *Elater*, many weevils, notably the beautiful diamond weevil; the common black *Cetonia ;* most *Melolonthidæ*, *Rutelidæ*, and almost all the *Copridæ ;* many *Chrysomelidæ* and *Cryptocephalidæ ;* of *Carabini*, *Calosoma*, *Bembidium*, and *Phylophlæus* appear little affected, and the red-headed *Staphilinus* seemingly increases.

# ON THE HABITS AND DESCRIPTION OF A DESTRUCTIVE BEETLE.—(*MELOLONTHA DESTRUCTOR*).

By Otto Tepper, Corr. Member.

(Read June 18, 1878).

Some years ago I resided for about eighteen months in the district of Monarto, about eight miles east of Callington and the River Bremer, arriving there shortly after Christmas, 1871. The peculiar appearance of nearly all the larger Eucalypts struck me at once as something remarkable, not having observed anything like it before. The branches of these Eucalypts—(*E. Viminalis (?)* and *E. Odorata*)—did not carry their leafy crown at the extremity as usual, but axillary, a great number of their twigs having sprouted along three sides of the limbs, exhibited the only green upon the greater number. They presented an appearance as if artificially surrounded with wreaths, when viewed from a distance. A few of the younger and more vigorous individuals still preserved the normal *habitus* entire, while some had a few branches affected as described above.

This state of unhealthiness, for such it was evidently, did not extend to such parts where the undergrowth had been left comparatively undisturbed, but only to the cleared portions and the borders thereof. At that time the farmers had occupied the place for about four years, and everything still looked rather primitive. Making inquiries, I was told that a beetle committed these depredations. This information I regarded rather dubiously for some time, finding so very few live specimens, and still less remains of dead ones. On some previous occasions I had seen Eucalypti stripped of their leaves, but had found the *larvæ* of divers moths and Chrysomelidæ to be the perpetrators. Great as was the damage done by the latter, yet it was in no proportion to what I had now before me. What immense numbers of this beetle must there be at

work to consume such quantities of leaves! What became of them since? Where do they pass their caterpillar existence?

To answer such questions as these I could do nothing at the time but wait for their reappearance.

In the succeeding month of September a few began to show themselves, coming out of the ground after sunset. Some time previously I had noticed in the looser parts of the soil a great number of caterpillars, of the characteristic *Melolontha* habitus, and of all sizes, little distinguished either in form, colour, &c., from others of its genus, their skin being a little tougher in texture, and of a more yellowish colour than that of most others. The size of the full-grown larvæ is about $1\frac{1}{2}$ in. in length and $\frac{1}{4}$ in. in diameter. After several unsuccessful attempts, I found at last some chrysalids in the ground at a depth of from 9 to 12 in., in different stages of development, and also one or two beetles, which had been too weak to pierce the soil, and died after their transformation, thus proving identity.

The chrysalis lies in an oval hollow at the depth mentioned above, the lining of which is formed by the skin of the larva.

In the succeeding months of October and November ample opportunities offered to study the voracious habits of the species, for which I propose the appellation "*Melolontha destructor*."

During the day few could be seen, and none at all active, but soon after sunset countless myriads made their appearance. Like swarms of bees they encircled the treetops in such numbers that the hum of their wings was distinctly audible at a distance of a hundred yards in the calm of an evening, and the working of their mandibles clearly discernible at the base of trees up to 40 feet high, whose leaves they were engaged in stripping off. This will give an idea as to their number.

At about 10 or 11 p.m. the crowds began to diminish, and I cannot remember having noticed them after midnight in cool weather, but during warm and sultry nights a few continued in action till shortly before sunrise. In early dawn, or in the moonlight, the trees attacked by them seemed to be surrounded by a light cloud of vapour like a veil, when seen from a distance, arising from the numerous Melolontha flying around them. The trees were not attacked simultaneously, but in succession; those already sickly from previous attacks, or other causes, obtaining the preference before the more vigorous, the healthiest escaping sometimes altogether, sometimes with only a branch or two stripped bare. A few night's feasting left the victims bare of leaves, and the

ravagers removed to others. Yet (considering the number of coleoptera, an astonishing fact) here and there one or other remained almost intact in the midst of destruction.

In the daytime, the beetles, after dispersing, bury themselves in the loose soil, as deep as its nature will permit, and I often succeeded in exhuming them from depths varying from three to twelve inches, even at a much later part of the season. During rainy weather I have not noticed them at all in action; the moisture probably making their wings unfit for flight. They do not fly very fast; in straight lines or large curves and for considerable distances. Those that fall to the ground in an exhausted state are eagerly attacked and devoured by the ants, those that survive finally die, as far as I could ascertain, in their self-made grave. The females lay their eggs in the soil adjoining the roots of trees and under logs, from whence the larvæ disperse, living on decaying vegetable mould apparently.

How far the ravages of this beetle extended laterally, I was not able to ascertain, but observed them personally over a considerable area, containing many square miles.

The principal causes for their inordinate increase since the settlement was formed appear to be : (1) the loosening of the soil, and (2) the injudicious persecution and destruction of predatory animals.

The former is of great advantage for their preservation, inasmuch as it allows them to bury themselves easier and quicker, thus increasing their immunity from attack by almost any enemy. Before broken up the nature of the soil was not favourable, as, being deficient in lime, it dried hard in summer, presenting great obstacles to the larva as well as the perfect insect, to ensure safety by rapid burrowing.

The destruction of predatory insects (large Carabidæ, etc., strong enough to cope with them successfully) aids their increase, but reptiles and birds, lizards, owls, hawks, etc., may have a still more direct influence by diminishing their enemies. The lizards and hawks are in most parts relentlessly extirpated by the settlers, because the former are universally considered as venomous, and the latter are killed, either for occasionally appropriating a chicken or two; from superstition; or from ignorant love of killing. The small loss in the poultry-yard is instantly observed; but the great benefit rendered by them as destroyers of insect pests is little known and less acknowledged.

In the localities where the destructive Melolontha buzzed about in clouds at night few of the larger predatory beetles existed, and few birds

of prey except in the less disturbed parts of the forest where the latter were more plentiful, and few signs of the former perceptible.

MELOLONTHA DESTRUCTOR (New Species.)—General form and habitus appertaining to genus; female slightly larger than male; length, three-quarters of an inch; diameter, one quarter of an inch; prevailing colour of upper part, bright chestnut brown; head of the female and labrum of male much darker, almost dull black; neutral parts of both sexes a uniform dark brown; eyes small, black; labrum distinct, much developed, edge turned up, well adapted for burrowing; maxillæ slender; mandibles short, strong, toothed; antennæ in both sexes with seven points and three lamellæ, latter narrow, straw colour with female, brown with male; prothorax well arched; flanges toothed and upturned; scutellum medium-sized; elytra translucent, arched, reaching well down the flanks, but leaving the last abdominal segment nearly uncovered (a little shorter with the male), marked by five longitudinal seams, edges strong (inner one black), the whole dotted over with paintlike minute depressions, arranged diagonally; wings large; flight sustained and accompanied by a loud humming noise: first and third pair of legs strong, thorny appendages, well adapted for grasping and burrowing; abdomen large, soft; the third from last segment the largest; last segment small, triangular, under surface of thorax covered with long tawny hairs; shorter ones lining the upper interior edge of prothorax, outer edge of elytra, and first joints of antennæ; feeding from point of leaves towards stalk, moving backwards and eating mostly in regular curves.

# INFANTILE MORTALITY IN SOUTH AUSTRALIA.

By Henry Heylyn Hayter, Cor. Member, F.S.S., &c., &c.,
Government Statist of Victoria.

[Read March 19, 1878.]

As I fear it may be thought presumptuous for one who not only has never resided in South Australia, but has not even set foot within her limits, to address the Adelaide Philosophical Society on a subject affecting the colony, it is not without considerable diffidence that I venture to do so. Considering, however, that my official position affords me peculiar facilities for obtaining information respecting each colony, and for collating and comparing it afterwards, I trust I shall be excused for bringing forward a matter which is undoubtedly one of the most vital importance.

South Australia, although less populous than Victoria, New South Wales, or New Zealand, is in many respects in advance of those colonies or of any other colony of the Australasian group. A greater equality exists between the numbers of males and females; a larger, and, per head, a much larger, extent of land is under cultivation; a larger quantity of wheat is raised; the taxation is lighter*; the exports per head are greater than in any other Australasian colony; and when it is added that whilst the marriage and birth rates in several of the colonies are notably decreasing, those in South Australia have for years past been steadily increasing, and in 1876 were, the former in excess of the rate in any other colony of the group, and the latter in excess of that in any other colony except New Zealand. It will, I believe, be readily admitted that South Australia is in pos-

* This statement is true over a series of years, but in 1876, for the first time, the taxation per head was slightly lower in New South Wales than in South Australia.—Author.

session of certain material advantages the contemplation of which may well afford thankfulness and satisfaction to the minds of her colonists.

But there is one point in respect to which South Australia suffers in comparison with every other Australasian colony. I refer to the excessive mortality of her infants.

This point came prominently under my observation whilst compiling the "Victorian Year-Book, 1876-7." A table showing the infantile mortality of each colony over a series of years, based upon the principle of comparing the deaths of children under one year of age with the births, was given at page 68 of that work. For my present purpose, and in order to make the calculations more readily understood, I have slightly altered this table so as to show the proportion of deaths of infants to every 1,000 births instead of every 100, and thus have been able to obviate the necessity of using decimals.

A reference to the first of the appended tables (A.) will show that during the ten years ended with 1875, 157 children in every 1,000 born South Australia died before completing their first year, whereas the proportion was 126 in Victoria, 125 in Queensland, 104 in New South Wales, 102 in New Zealand, and only 101 in Tasmania. The infantile mortality of South Australia was thus 25 per cent. above that of Victoria, 26 per cent. above that of Queensland, 51 per cent. above that of New South Wales, 54 per cent. above that of New Zealand, and 55 per cent. above that of Tasmania.

Also in each of the respective years of the decenniad it will be noticed that the proportion was always higher in South Australia than in any other colony, and even at periods when circumstances caused the infantile mortality to be exceptionally high in one or more of the other colonies, it so happened that it was always higher in South Australia. Thus in 1866, when infants died in Queensland in the proportion of 167, and in Victoria in that of 153 per 1,000 births, they died in South Australia in the proportion of 174 per 1,000 births. In 1867, when they died in New South Wales in the ratio of 124 per 1,000 births, they died in South Australia in the ratio of 178 per 1,000 births. In 1875, when they died in Tasmania in the ratio of 131, and in New Zealand in that of 126 per 1,000 births, they died in South Australia in the ratio of 181 per 1,000 births.

The average annual infantile death rate of South Australia (157 per 1,000 births) was never reached in any of the other colonies except

Queensland, even during the very worst years of the decenniad, and in Queensland it was only reached in one year, namely, 1866.

The year in which the rate of infantile mortality was lowest in South Australia was 1869, and even in this 131 infants out of every 1,000 born died within the year. This proportion was never approached in New South Wales or New Zealand, even in the very worst years; it was reached only once in Tasmania, twice in Queensland, and three times in Victoria.

In all the years of the decenniad the infantile death rate was higher in South Australia than in New South Wales or New Zealand during their worst years; in nine of the years it was higher than in Tasmania during its worst year, in five of the years it was higher than in Victoria during its worst year, and in four of the years it was higher than in Queensland during its worst year.

Turning to older countries, it will be found that the death rate of infants in England and Wales during ten years was 154 per 1,000 births, which, although higher than that in every other Australasian colony, was 2 per 1,000 below that of South Australia. Also, that in Scotland the mean death rate of infants over a series of years was 126 per 1,000 births, which, being exactly equal to that of Victoria, was very much below that of South Australia; and further, that the mean death rate of infants in London, namely, 161 per 1,000 births, with the exception of once in Queensland, was never approached in any colony of the group except South Australia, in which it was exceeded in four and equalled in one of the years of the decenniad to which the table relates.

The registration of deaths, as it must in all cases precede burial, is probably effected with equal and almost perfect accuracy in all the countries and colonies named, but it is possible that an appearance of excessive infantile mortality might arise from the registration of births being more defective in one country than another. According to the returns there is no reason to suppose this to be the case in South Australia, as the mean birth rate there, based upon the registrations, is found to be higher than that of England, Scotland, Victoria, or Tasmania, to approximate closely to that of New South Wales, and, over a series of years to have been only exceeded to any extent by that of Queensland and New Zealand; whilst during the past year (1876), as has been already stated, the birth rate of South Australia was exceeded by that of the colony of New Zealand only. (See Table B.)

There is thus no ground for believing that the high death rate of

infants shown by the registration returns of South Australia does not really exist or is at all exaggerated. To trace the various agencies by which such a calamitous result is brought about would be to any one a difficult task, and would manifestly be impossible to one unacquainted with, and who has no means of gaining an intimate knowledge of, the ramifications of social life in South Australia.

Whether it be due to defective sanitary arrangements, or to neglect resulting from the debility, indolence, or intemperance of mothers, or from the fact that custom, inclination, or the necessity of their position, causes many of them to engage in some trade or business; or to the ignorance of mothers as to the best mode of rearing children, resulting, perhaps, from early marriages, or to the administration of aperients to new-born infants—butter, sugar, and such other abominations; or to the administration of spirits, cordials, soothing powders, or other narcotic drugs; or to weaning at too early an age; or to administering innutritious food, or food of too substantial a consistency, or too farinaceous a character, either before or after weaning; or to the attendance on the mother of midwives; or to baby farming; or to the poverty of the parents; or whether, on the other hand, it be mainly due to congenital weakness or to the effects of the climate, which, although probably not so hot as that of New South Wales, is hotter than that of Victoria, and, according to the observations of Sir G. S. Kingston, is drier than that of either Victoria or New South Wales, these are matters on which I am unable to pronounce an opinion, but which, I submit, demand the fullest and most careful investigation.

To aid in such an enquiry I have prepared Table C, which shows the causes of death of infants during the three years ended with 1875, arranged in the order of their fatality. I regret that I have been unable to obtain the material for compiling the information over the whole period of ten years to which Table A relates. Although I cannot learn that it has ever been published for the first seven years of the decenniad, it probably exists in the office of the Registrar-General of Births and Deaths in South Australia, and if so, could doubtless be procured without any difficulty.

It is also desirable that the ages at which the infants die should, if possible, be ascertained, so that it might be known in what proportion of instances the death takes place, soon after birth, or after the expiry of one, three, or six months, &c. This information is not now to be found in the published returns.

According to Table C not more than half the deaths are set down to specific diseases, and no less than 1,708 out of 3,641 are returned as having resulted from atrophy, debility, convulsions, premature birth, and teething. These terms are in the highest degree indefinite, being either names of symptoms of diseases, not of diseases themselves, or circumstances entered as supplying convenient expressions for assigning a cause of death when the nature of the actual complaint is not known; 588 more of the deaths are set down to diarrhœa and dysentery, an enormous proportion. Did not a large number of these deaths result from improper food and treatment, and could not many of them have been averted by proper expedients?

The occurrence of whooping-cough, measles, and scarlatina, in epidemic form, will be readily observed by the increased mortality from those complaints respectively in the first, second, and third year referred to in the table. The increased number of deaths from diarrhœa, always found to be concurrent with a measles epidemic, will also be noticed in the middle year.

There is happily no ground for supposing that infanticide exists to any appreciable extent in South Australia, not one of the deaths during the three years under notice having been set down to that cause; 10 deaths were set down to suffocation, most probably by overlying, which is not an excessive proportion, and certainly not large enough to raise a suspicion that the deaths were caused intentionally. Accidents, exclusive of suffocation, resulted in 19 deaths, or about 1 in 192 from all causes; and privation and want of breast milk, in 78 deaths, or 1 in 47; neither of which are high proportions.

My duty is, I believe, accomplished in bringing this matter to the notice of the members of the principal scientific Society in South Australia. It is for them to consider whether any action can be suggested which may result in wiping out altogether, or, at any rate, in reducing to the utmost degree of faintness the one dark shadow which at present partially obscures the brightness which should spread over the whole of the fair surface of their promising and interesting colony.

## TABLE A.—INFANTILE MORTALITY IN AUSTRALASIAN COLONIES.

### (BIRTHS AND DEATHS AT UNDER ONE YEAR OF AGE, WITH PROPORTION OF THE LATTER TO THE FORMER.)

| Year. | Births. | Deaths under 1 Year of Age. | | Births. | Deaths under 1 Year of Age. | | Births. | Deaths under 1 Year of Age. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total Number. | Number to 1000 births | | Total Number. | Number to 1000 births | | Total Number. | Number to 1000 Births |
| | | South Australia. | | | Victoria. | | | New South Wales. | |
| 1866 ... ... | 6,782 | 1,178 | 174 | 25,010 | 3,838 | 153 | 16,950 | 1,939 | 114 |
| 1867 ... ... | 7,041 | 1,254 | 178 | 25,608 | 3,534 | 138 | 18,317 | 2,269 | 124 |
| 1868 ... ... | 7,247 | 1,084 | 150 | 27,243 | 3,054 | 112 | 18,485 | 1,791 | 97 |
| 1869 ... ... | 6,976 | 911 | 131 | 26,040 | 3,284 | 126 | 19,243 | 1,858 | 97 |
| 1870 ... ... | 7,021 | 1,031 | 147 | 27,151 | 3,203 | 118 | 19,648 | 1,867 | 95 |
| 1871 ... ... | 7,082 | 961 | 136 | 27,382 | 3,114 | 114 | 20,143 | 1,812 | 90 |
| 1872 ... ... | 7,105 | 1,145 | 161 | 27,361 | 3,334 | 122 | 20,250 | 2,116 | 105 |
| 1873 ... ... | 7,107 | 990 | 139 | 28,100 | 3,181 | 113 | 21,444 | 1,985 | 93 |
| 1874 ... ... | 7,696 | 1,319 | 171 | 26,800 | 3,341 | 125 | 22,178 | 2,428 | 110 |
| 1875 ... ... | 7,408 | 1,343 | 181 | 26,720 | 3,811 | 143 | 22,528 | 2,695 | 120 |
| Sums and Means | 71,465 | 11,216 | 157 | 267,415 | 33,694 | 126 | 199,186 | 20,760 | 104 |

TABLE A. (CONTINUED.)—INFANTILE MORTALITY IN AUSTRALASIAN COLONIES.

(BIRTHS AND DEATHS AT UNDER ONE YEAR OF AGE, WITH PROPORTION OF THE LATTER TO THE FORMER).

| Year. | Births. | Deaths under 1 Year of Age. | | Births. | Deaths under 1 Year of Age. | | Births. | Deaths under 1 Year of Age. | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total Number. | Number to 1000 Births | | Total Number | Number to 1000 Births | | Total Number. | Number to 1000 Births. |
| | | QUEENSLAND. | | | TASMANIA. | | | NEW ZEALAND. | |
| 1866 ... ... | 4,127 | 690 | 167 | 2,805 | 264 | 94 | 8,466 | 849 | 100 |
| 1867 ... ... | 4,476 | 578 | 129 | 2,971 | 267 | 90 | 8,918 | 873 | 98 |
| 1868 ... ... | 4,460 | 552 | 124 | 2,990 | 351 | 117 | 9,391 | 899 | 96 |
| 1869 ... ... | 4,654 | 528 | 114 | 2,859 | 291 | 102 | 9,718 | 957 | 99 |
| 1870 ... ... | 4,905 | 526 | 107 | 3,054 | 298 | 98 | 10,277 | 956 | 93 |
| 1871 ... ... | 5,205 | 516 | 99 | 3,053 | 260 | 85 | 10,592 | 882 | 83 |
| 1872 ... ... | 5,265 | 578 | 110 | 3,010 | 306 | 102 | 10,795 | 1,074 | 100 |
| 1873 ... ... | 5,720 | 701 | 123 | 3,048 | 266 | 87 | 11,222 | 1,213 | 108 |
| 1874 ... ... | 6,383 | 776 | 122 | 3,097 | 321 | 104 | 12,844 | 1,394 | 109 |
| 1875 ... ... | 6,706 | 1,025 | 153 | 3,105 | 407 | 131 | 14,438 | 1,816 | 126 |
| Sums and Means | 51,901 | 6,470 | 125 | 29,992 | 3,031 | 101 | 106,661 | 10,913 | 102 |

TABLE B.—Mean Birth Rate in Australasian Colonies and Great Britain (Proportion of Births per 10,000 persons living)

| Name of Country. | Number of Births per 10,000 Persons living. | |
|---|---|---|
| | Over a Series of Years. | During 1876. |
| South Australia | 392 | 377·1 |
| Victoria | 373 | 322·3 |
| New South Wales | 397 | 376·9 |
| Queensland | 422 | 374·8 |
| Tasmania | 299 | 301·1 |
| New Zealand | 409 | 417·3 |
| England and Wales | 349 | — |
| Scotland | 346 | — |

TABLE C. — CAUSES OF DEATH OF INFANTS IN SOUTH AUSTRALIA, 1873 to 1875.
(ARRANGED IN ORDER OF FATALITY.)

| Order of Fatality | Causes of Death. | Number of Deaths of Infants Under 1 year of age. | | | |
|---|---|---|---|---|---|
| | | Total in 3 years. | 1873 | 1874 | 1875 |
| 1 | Atrophy and Debility ... | 877 | 256 | 302 | 319 |
| 2 | Convulsions ... | 454 | 125 | 148 | 181 |
| 3 | Diarrhœa ... | 423 | 103 | 165 | 155 |
| 4 | Bronchitis ... | 220 | 64 | 67 | 89 |
| 5 | Premature Birth ... | 190 | 53 | 58 | 79 |
| 6 | Teething ... | 187 | 54 | 61 | 72 |
| 7 | Dysentery ... | 165 | 53 | 60 | 52 |
| 8 | Diseases of Nervous System, exclusive of Convulsions ... | 132 | 23 | 60 | 49 |
| 9 | Measles ... | 128 | 1 | 100 | 27 |
| 10 | Privation, want of Breastmilk | 78 | 17 | 25 | 36 |
| 11 | Gastritis and Enteritis ... | 73 | 20 | 30 | 23 |
| 12 | Diseases of Digestive Organs, exclusive of Gastritis and Enteritis ... | 72 | 21 | 28 | 23 |
| 13 | Tabes Mesenterica ... | 70 | 16 | 33 | 21 |
| 14 | Scarlatina ... | 69 | 2 | 9 | 58 |
| 15 | Pneumonia ... | 60 | 21 | 13 | 26 |
| 16 | Hydrocephalus ... | 53 | 17 | 25 | 11 |
| 17 | Diseases of Respiratory Organs exclusive of Bronchitis and Pneumonia ... | 52 | 22 | 9 | 21 |
| 18 | Thrush ... | 43 | 14 | 16 | 13 |
| 19 | Croup ... | 38 | 10 | 15 | 13 |

TABLE C—(CONTINUED).

| Order of Fatality | Causes of Death. | Number of Deaths of Infants under one year of age. | | | |
|---|---|---|---|---|---|
| | | Total in 3 years. | 1873 | 1874 | 1875 |
| 20 | Whooping Cough ... | 34 | 28 | 5 | 1 |
| 21 | Malformations ... | 32 | 10 | 11 | 11 |
| 22 | Diphtheria ... | 30 | 4 | 16 | 10 |
| 23 | Accidents, Negligence, exclusive of Suffocation ... | 19 | 9 | 7 | 3 |
| | Diathetic Diseases, exclusive of Thrush ... | 19 | 6 | 7 | 6 |
| 24 | Heart Disease ... | 17 | 3 | 6 | 8 |
| 25 | Remittent Fever ... | 14 | 4 | 5 | 5 |
| 26 | Diseases of Integumentary System ... | 13 | 8 | 1 | 4 |
| | Erysipelas ... | 13 | 3 | 4 | 6 |
| 27 | Typhoid Fever ... | 11 | 4 | 4 | 3 |
| 28 | Suffocation ... | 10 | 4 | 4 | 2 |
| 29 | Influenza ... | 9 | 2 | 1 | 6 |
| 30 | Cholera ... | 8 | 1 | 4 | 3 |
| | Phthisis ... | 8 | 3 | 4 | 1 |
| 31 | Scrofula ... | 6 | 2 | 2 | 2 |
| 32 | Venereal Diseases ... | 5 | 3 | 1 | 1 |
| 33 | Diseases of Urinary Organs ... | 3 | 2 | — | 1 |
| | Quinsy ... | 3 | — | 3 | — |
| 34 | Miasmatic Diseases not classed | 2 | 1 | — | 1 |
| 35 | Joint Disease, &c. ... | 1 | — | 1 | — |
| | Deaths from specified causes | 3,641 | 989 | 1,310 | 1,342 |
| | Deaths from unspecified causes | 11 | 1 | 9 | 1 |
| | Deaths from all causes ... | 3,652 | 990 | 1,319 | 1,343 |

ADDENDUM.

Since writing my paper on "Infantile Mortality" the statistics of two later years—namely, 1876 and 1877—have come to hand from the different Australasian colonies, and a table embodying the results is appended hereto.

By comparing the figures in this table with those in Table A it will be observed that the infantile death-rate of South Australia during the two years ended with 1877, although not so low as in some of the years of the previous decenniad—namely, the three years ended with 1871 and the year 1873—was lower than an average extending over the whole decennial period.

It will further be remarked that in 1877, for the first time during the twelve years over which the observations extend, another Australasian colony had a higher infantile death-rate than South Australia. This colony was Queensland, in which, during that year, 148 infants died per 1,000 births as against 140 per 1,000 births in South Australia.

## INFANTILE MORTALITY IN AUSTRALASIAN COLONIES.

(TABLE SUPPLEMENTARY TO TABLE A.)

BIRTHS AND DEATHS AT UNDER 1 YEAR OF AGE, WITH PROPORTION OF THE LATTER TO THE FORMER, 1876 AND 1877.

| Year. | Births. | Deaths at under 1 Year of age. | | Births. | Deaths at under 1 Year of age. | |
|---|---|---|---|---|---|---|
| | | Total Number. | No. to 1000 Births. | | Total Number. | No. to 1000 Births. |
| | South Australia. | | | Victoria. | | |
| 1876 | 8,224 | 1,228 | 149 | 26,769 | 2,980 | 111 |
| 1877 | 8,640 | 1,212 | 140 | 26,010 | 3,299 | 127 |
| Sums and Means | 16,864 | 2,440 | 145 | 52,779 | 6,279 | 119 |
| | New South Wales. | | | Queensland. | | |
| 1876 | 23,298 | 2,629 | 113 | 6,903 | 994 | 144 |
| 1877 | 23,851 | 2,785 | 117 | 7,169 | 1,058 | 148 |
| Sums and Means | 47,149 | 5,414 | 115 | 14,072 | 2,052 | 146 |
| | Tasmania. | | | New Zealand. | | |
| 1876 | 3,149 | 286 | 91 | 16,168 | 1,673 | 103 |
| 1877 | 3,211 | 365 | 114 | 16,856 | 1,527 | 91 |
| Sums and Means | 6,360 | 651 | 102 | 33,024 | 3,200 | 97 |

# ON THE ORIGIN OF MINERAL VEINS, WITH SPECIAL REFERENCE TO THE BAROSSA DISTRICT, SOUTH AUSTRALIA.

By Gavin Scoular, Corresponding Member.

[Read March 19, 1878.]

## ABSTRACT.

The author commenced by enquiring into the primary condition of our planet, citing the opinions of the ancients and Laplace's nebulous theory of the earth's origin. He then sought to prove that the sources of our present accessible metallic deposits have never at any period of the earth's history been deep-seated. Treating of the metalliferous rocks of the Barossa District, he writes—"In the absence of fossil remains or a much stricter investigation of lithological identity than has heretofore been prosecuted, it would be mere waste of words were I to attempt to state unreservedly to what particular formation the rocks constituting the Barossa Range belong. The slender evidence upon which the Rev. J. E. Tenison Woods identifies them with the Silurian is not sufficiently conclusive. And though twelve years have past since the publication of the "Geol. Observ. in S. Australia," the rocks in question are still "unresolved." Mr. Selwyn, in his geological sketch of his tour in South Australia, states that "it is impossible in the absence of fossil remains to determine to what series the rocks belong; they may be of Silurian or Devonian age." Regarding their physical and lithological features the author writes, "They have undergone in many parts a considerable amount of metamorphism, and now repose at high angles of inclination. The rocks for a considerable distance both to the east and west of the junction of Victoria Creek and the South Para River have nearly all an easterly dip ranging from 50° to 60°, and in some

instances to 90°. Accordingly every 30,000 feet of strata in thickness now represents a ground surface of about one statute mile." The author failed to observe any unconformity in the superposition of the strata for a distance of from two to three miles in the channel of the South Para in the locality named, but describes the phenomenon of inversion as exhibited by a band of highly metamorphosed sandstone about one mile to the east from the junction of the Para and the Tenefete Creek. "To the east of the axis of inversion as you ascend the bed of the river, you will pass over bands of comparatively unaltered clay slate, micaceous and gneissic schists, intercalated with quartz reefs and bands of quartzites for several miles in succession, over the existing surface, and still the easterly dip of about 60° and conformity of bedding prevail. The reason for this general precision of easterly dip throughout the western slope of the Barossa Hills is stated to be, because that range is merely the eastern buttress and spring of a once stupendous arch of strata, which in times long since past extended far to the west in a grand anticlinal curve."

The author next discusses the effect of pressure and nuclear heat in the production of fissures; and combats the opinion that they are caused by earthquakes; and proceeds to describe the various methods by which it is conceived that fissures once existing in the rocks, as empty chasms, have been subsequently filled in with quartz and other vein stuffs; and endeavours to show that the vein deposits are due to hydrothermal action. In connection with the latter branch of the subject, he seeks to confirm Mr. Selwyn's opinion that alluvial nuggets of gold were products of comparatively recent infiltrations through the detrital accumulations in which they are found. He writes:—"I have in my possession a nugget taken from the alluvial workings in Hamlin's Gully, Barossa, which shows strong indications of its formation having taken place in the mould from which it was taken. It weight is about 69 grains, it measures about one inch in length, by about five-sixteenths at the broader end, in shape it is not unlike the spearhead of a warrior of the Middle Ages denuded of its point. The thoroughly defined impressions which it retains of the die, and the sharpness of its edges preclude the idea of its having been transported."

# AUSTRALIAN TRIGONIAS AND THEIR DISTRIBUTION.

By W. T. Bednall.—(Communicated by Prof. Tate).

(Read June 18th, 1878).

It has occurred to me that a few remarks introducing to the notice of this Society a form of life peculiar in recent times to the Australian seas might prove interesting, especially as it is connected with a branch of Natural History, which although affording an extensive field for observation and research in this colony, is seldom taken up by members of this body, with perhaps the exception of Professor Tate, namely, Conchology.

I have the more particularly chosen the theme from the fact that it has been my very good fortune to be the first to discover the most western limit, at least so far as at present known, of the genus both on the coast of North Australia and on the southern shores of the continent.

The genus *Trigonia* was founded by Bruguiere, a French naturalist of the last century, to represent a group of bivalve shells of a triangular or three-cornered shape (as the name implies), peculiar to the secondary rocks of Europe, and at that time known only as fossils. They first made their appearance in the Lias, whence they extended through the Lower and Upper Oolite to the Cretaceous series, where they disappeared; the Tertiary formations in no part of the world but this, having produced any individuals whatever. The genus numbers but few living species, but is particularly rich in fossil representatives. Upwards of 100 species were known from the oolitic and cretaceous rocks of Europe, the United States, Chili, the Cape, and Southern India, more than twenty years ago, and now the number must be nearly double that. Australia is, however, the home of these remarkable shells in a living state, and thus adds another instance in which this great southern island-continent is the habitat of forms of life which in other parts of the globe are only found, to use Dr. Mantell's appropriate term, as "Medals of Creation."

## Trigonia—(*Bruguiere*, 1789).

The shell is bivalve, equivalve, inequilateral, and subtrigonal; exteriorly it is strongly ribbed from the apex to the base (I am referring to the recent species only), the furrows being well defined; and interiorly it is lined with nacre or mother-of-pearl of the most beautiful and brilliant hues. But the extraordinarily intricate hinge is perhaps its most noticeable feature. It is composed of two lamelliform teeth in the right valve, which are transversely grooved on both sides, and four in the left valve, grooved on the one side only. These hinge teeth are constructed with such delicate nicety, and they fit together with such wonderful preciseness that when the shell is closed it is difficult to open it without incurring the danger of breaking the parts. The genus was divided by the late Professor Louis Agassiz into eight sections, to the last of which—the Pectinées—all the recent species belong. The first recent specimens introduced to scientific notice were collected by Péron during the expedition sent out by the First Napoleon, in the ships "Geographe" and "Naturaliste," in the year 1800. Lamarck named the new and valuable addition to the already magnificent collection of the Museum Royal, Paris, *T. pectinata*, but for some reason, of which I am unaware, it has since received the synonymous name of *T. Lamarcki* from the late Dr. Gray. Since then other species have been obtained, five being enumerated by the Messrs. Adams in their "Genera of Recent Mollusca." One more has since been added to the list by the discovery in a living state, on the south-eastern coats of Australia (not the province of South Australia), of *T. acuticostata*, originally described by Professor McCoy from fossil examples. I will now proceed to a description of the several species.

### 1.—Trigonia pectinata, Lk.

This very beautiful shell is a native of New South Wales, and is most abundant in Sydney Harbour, where it is by no means difficult to obtain at certain spots with the dredge. The interiors of some specimens are beautifully lined with nacre of a rich silver or golden hue, while others again are, if possible, still more lovely, the tint being of the richest and most delicate pink. The shell receives its specific name from the fact that the numerous longtitudinal ribs with which it is adorned on its external surface are pectinated or combed (say like a cog-wheel). Strong transverse striations traverse the intercostal spaces from the base upwards, gradually becoming fainter as they reach the apex of the shell. I exhibit a very large variety of this species (?) dredged at Cape St. George, a

rocky headland about seventy miles south of Port Jackson, near Jervis Bay.

2.—Trigonia margaritacea, Lk.

This species was in all probability also obtained by Péron during the same voyage, the more so as it, too, has received its specific name from Lamarck. The shell, although at first sight a very similar one to the preceding, when examined carefully has many essential differences. It is a much coarser shell, more decidedly trigonal in shape, the ribs are not nearly so closely set with the comb-like projections, and the spaces between the ribs are more finely but less regularly striated, the striations not apparently extending so high up the face of the shell. The epidermis of *T. margaritacea* is also always of a much darker colour and of a coarser nature than that of *T. pectinata*, while the pearly interior is persistently of a deep purple hue. To this last characteristic it no doubt owes its name. This is one of the species to which I referred as having been found by myself at its known most western limits on the south coast of Australia. Hitherto it had only been taken in Bass's Straits, off the coast of Tasmania. It seems to have been unknown to Mr. G. F. Angas as a South Australian shell when he published his list of South Australian Bivalves in the Proceedings of the Zoological Society of November, 1865, and it must have been about that time when I obtained it on the eastern shores of St. Vincent's Gulf, on the long stretch of sandy beach between Glenelg and the Semaphore. Since then it has been found by other collectors at the same place, and further south at Aldinga, but always in a more or less worn condition. Its particular habitats in our waters have not yet been discovered, no live specimens having yet been dredged. Of the four worn valves shown by me only one is in a sufficiently good state of preservation to exhibit the colour of the nacreous interior, but the general contour of the shell and the bifurcated appearance of the process which partially emarginates the anterior muscular impression in the left valve are distinctive characters enough to show that it is a true *T. margaritacea*, and not a new species. *T. margaritacea* is catalogued by me in my list of South Australian Shells published (for private circulation only) in 1875.

3.—Trigonia nobilis—*A. Adams.*

This species is unknown to me, and I would hazard an opinion, although somewhat presumptuous on my part, that may only be a very fine example of either of the two foregoing species.

4.—Trigonia Strangei—A. Ad.

This species is one of great rarity, and was named by Arthur Adams after Mr. Fred. Strange, an enthusiastic naturalist and collector, who dredged the first specimen in deep water near the entrance to Port Jackson Heads. I have not seen an example, but I gather from Mr. Angas's List of New South Wales shells that it is distinguished from the other species by the ribs being covered with wart-like nodules. In this respect I should think it somewhat resembles *T. uniophora*, only that in that species the tubercles or nodules occur on a portion only, and not on the whole of the ribs. Mr. Angas says that a few odd valves, much worn, have been washed ashore at Long Bay and Wollongong on the coast of New South Wales.

5.—Trigonia uniophora—*Gray*.

The species described by Gray under the above name was obtained at Cape York, the most northern extremity of the Australian continent, by Mr. John Beete Jukes, naturalist of H.M.S. Fly, during the scientific voyage of that vessel between the years 1842 and 1846. It is defined by Dr. Gray as a shell of a reddish-brown colour, with twenty-two or twenty-three high, rather compressed, and somewhat close diverging ribs. The upper part of the central, and the whole of the posterior ribs are covered with close, regular, transverse plates, the lower part of the central ribs with large, rounded, or oblong solid tubercles, and the hinder slope with five or six nodulose ribs. To this species must be referred the specimen found by me at the furthest known limit of *Trigonia* to the westward, on the northern coast of the continent. During a very pleasant excursion from Port Darwin to Bynoe Harbour, Indian Island, and the coral reefs in that locality, I found amongst a lot of rocky debris and broken shells a left valve of the species under remark. It is in a much worn state, but quite good enough for the purposes of identification.

6.—Trigonia acuticostata.—*McCoy*.

Habitat.—South-eastern coast of Australia. I will refer to this species presently.

Up to the present time no representative of the genus has been received from the western, north-western, or south-western shores of Australia, but there can be little doubt that it will be taken eventually when collecting and dredging are more systematically carried on in these

waters. The time, however, may be distant, as the coast is little settled upon, except in the neighbourhood of Swan River. There is the more probability of its being found seeing that the genus is thoroughly Australian as a recent form, and also from the fact that the mollusc itself is migratory in its habits. Like many other bivalve molluscs, *Trigonia* is able to make considerable leaps by means of its powerful wedge-shaped foot; and Woodward in his "Manual" mentions an instance in which a specimen, placed by Mr. Stutchbury on the gunwale of his boat, leaped overboard, clearing a ledge four inches in height. Neither is there any record of the existence of *Trigonia* in the seas of New Zealand; but perchance time may add it to the already extensive fauna of the shores of that country also. The recent *T. pectinata* of the adjacent coast of New South Wales is found as a fossil in the upper miocene rocks of New Zealand.

I will now briefly refer to Trigonia as a fossil in Australia, and for numerous references and notes, and very complete information, mostly obtained by his own personal observation, I am indebted to Professor Tate.

Seven fossil species are known—two from Jurassic, one from cretaceous, and four from tertiary strata. In point of age, the first to be mentioned are the two Jurassic species, as in them we have contemporaneous representatives of the genus *Trigonia* when it first made its appearance in the ever-developing scheme of Creation.

1. T. Mookei, *Lycett.*, Western Australia, allied to *T. costata* of the European Oolite; and
2. T. lineata, *Moore*, Wollumbilla, Queensland. Both these species are described in the Jour. Geol. Soc., Vol. xxvi., 1870.

Next in geological sequence comes the cretaceous form.

3. T. nasuta, *Etheridge*, from Maryborough, Queensland. It is allied to *T. alæformis*, and belongs to a type not known in the Jurassic rocks.

We now come to the Tertiary species, the forms, as a consequence, having the closest affinity to the recent species referred to in the earlier part of the paper.

4. T. semiundulata, *McCoy*. Prodromus of the Palæontology of Victoria Decade, II. t. 19, f. 1—2, pl. 21.

Professor McCoy says this shell is "easily distinguished from any known recent or tertiary species by the rippled appearance produced by the undulated concentric ridging of the anterior two-thirds of the valves.

The transverse edging, though common in the Mesozoic Trigoniæ, is not found in the recent species." The sculpture of this shell leads to the assumption that in it we have a continuation of the style of ornamentation peculiar to forms of the genus belonging to the secondary rocks into the succeeding strata of the Tertiary system. It will be seen, too, that *T. semiundulata* has a wider range geographically than any other, being recorded from South Australia, Victoria, Tasmania, and New Zealand, and also that it has not been found in a later division of the Cainozoic period than the Upper Miocene. It has been found in the

Miocene—Bird Rock Bluff, Victoria (*McCoy*), Muddy Creek, Hamilton, Victoria (*Tate*), Gawler, South Australia (*Tate*), Table Cape, Tasmania (*R. M. Johnston*, Pro. Ryl. Soc., Tas., 1876).

Upper Miocene—Arramoa, New Zealand (*Hutton*, Cat. Ter. Mol., N.Z,, 1873).

5. T. Howitti (*McCoy*), l. cit., Decade III., t. 27, f. 3, pl. 31, 1876.

Loc. Sandy marl, Jemmy's Point, near the entrance to the Gippsland Lakes.

6. T. acuticostata—(*McCoy*)—l. cit. Decade II., t. 19, f. 1-2, pl. 21.

"*T. acuticostata*," remarks the author, "is easily distinguished from the recent species by the remarkable compression of the ribs into acute angular ridges, and from the same cause the spinous tubercles do not form the broad blunt transverse tubercles which they do in the recent species." Since the above remarks were written some years ago, for *T. acuticostata* appears to have been the earliest Tertiary species discovered, it has been found living on the south-eastern coast of Australia. The localities from which it is recorded are :—

Miocene.—Muddy Creek, Hamilton, Victoria (*McCoy*). Cliffs, River Murray, North-West Bend (*Tate*). Casts, probably of *T. acuticostata*, occur in beds of the same age at Tickera, Yorke's Peninsula, and at Aldinga, South Australia (*Tate*).

Pliocene.—Mordialloc, Hobson's Bay, Victoria.

7. T. pectinata, *Lk.*

Upper Miocene.—Hampden, New Zealand (*Hutton*, Cat. Ter. Mol. N.Z., 1873.)

From the above-mentioned observations we obtain the following table of the geographical and geological range of the Trigonia in Australia :—

| | Lias. | Oolite. | Cretaceous. | Tertiary. | Living. |
|---|---|---|---|---|---|
| All other Countries except Australia | Say 200 Sp. | | | — | — |
| Australia | 2 | | 1 | 3 | 6 |
| New Zealand | — | | — | 2 | — |

It will be noted from this table that the genus was excessively rich in representatives from its advent at the beginning to the close of the Secondary Age in Europe, when it died out altogether; whereas in Australia it has survived throughout the whole period of secondary and tertiary periods until the present day, though it must be admitted in a very limited degree in regard to number. I will now add a list of all known Australian Trigonias:—

| | | | |
|---|---|---|---|
| 1. T. Moorei | Mesozoic. | Jurassic | Western Australia. |
| 2. T. lineata | Mesozoic. | Do. | Queensland. |
| 3. T. nasuta | Mesozoic. | Cretaceous | Queensland. |
| 4. T. semiundulata | Cainozoic. | Miocene | Victoria; South Australia; Tasmania. |
| | Cainozoic. | Up. Miocene | New Zealand. |
| 5. T. Howittii | Cainozoic. | —— | Victoria. |
| 6. T. acuticostata | Living and Cainozoic. | Miocene | Victoria; South Australia. |
| | Living and Cainozoic. | Pliocene | Victoria. |
| | Living and Cainozoic. | Living | South-Eastern Australia. |
| 7. T. pectinata | Living and Cainozoic. | Up. Miocene | New Zealand |
| | Living and Cainozoic. | Living | New South Wales. |
| 8. T. margaritacea | Living. | Do. | Tasmania; South Australia. |
| 9. T. nobilis | Living. | —— | —— |
| 10. T. Strangei | Living. | Living | New South Wales. |
| 11. T. uniophora | Living. | Do. | Tropical N. and N.E. Australia. |

In conclusion, I would remark that independently of the scientific interest attaching to the shells I have been speaking of, the casual observer when he sees them must be involuntarily impressed with their beauties and peculiarities. When first discovered at the beginning of the present century in the seas of New Holland they were considered such a rarity by collectors that large prices were given even for old and worn single valves, no better than some of those shown by me. At the present day

the perfect shell is much prized by collectors, and finds a deservedly honourable place in their cabinets. The jewellers, too, have not lost sight of its pearly brilliance, and have successfully turned it to account in the manufacture of elegant trinkets, such as brooches, eardrops, and the like. Whether the attention is most attracted by the brilliant iridescent hues of the nacreous interior, or the wonderful complication of the remarkable hinge with which the valves are closed, the shell of Trigonia must always prove an object of interest to all lovers of the beauties of Nature in her ever-varying never-ending kingdom of wonders.

# THE RECENT MARGINELLIDÆ OF SOUTH AUSTRALIA.

By Prof. R. Tate, Assoc. Lin. Soc.; F.G.S., London, &c.; Cor. Mem. Acad. Sc., Phil.; Roy. Soc., Tasmania, &c.

[Read June 18, 1878.]

The occurrence of the family *Marginellidæ* in the South Australian seas has hitherto been unrecorded.

Species of *Marginella* have been known to inhabit the eastern shores of this continent, whilst the sub-genus *Hyalina* was first recorded in 1871, and *Erato* in 1877, as Australian. Examplar species of each of these have been found by me in our waters. They are eight in number: five of *Marginella*, two of *Hyalina*, and one of *Erato*. Two of the Marginellas are identified with known species, but the others I believe to be undescribed.

## FAM. MARGINELLIDÆ.—GENUS MARGINELLA.

### 1.—Marginella Volutiformis (*Reeve*).

*Conchologica Iconica.* Monograph of Marginella, tab. 24, f. 131, 1865.

An ovate, ivory-white shell, body whorl swollen above, lip varicosely reflected, *columella quadriplicate.* Length, ·3; breadth, ·18 inch.

Washed on shore.—Cape Northumberland (many examples) and Middleton (*Tate*), South-East Coast (*Bednall*, one ex.) It is somewhat common in Tasmania (*Woods*), and I have received specimens from Portland, Victoria.

2.—Marginella turbinata (*Sowerby*).

*Thes. Conch.*, t. 75, f. 70, p. 385; Reeve, loc. cit., t. 22, f. 122.

A solid, whitish, shining shell, with a short spire, and faintly crenulated round the upper part of the whorls. Length, ·45; breath, ·3 inch.

Washed up.—Cape Northumberland (*Tate*), Guichen Bay (*Smeaton*), many examples.

It occurs at Portland, Victoria; is rare in South Tasmania (*Woods*), and has been dredged in Port Jackson (*Angas.*) The South Australian examples are very much larger than those from New South Wales, the dimensions of the latter being, length ·35, and breadth ·2 inch.

3.—Marginella subbulbosa (new species).

Shell shining white, rather solid, having much the shape of *M. turbinata*, but more regularly convex from apex to front; apex obtuse; faintly striated transversely. External lip thickened slightly inflected, minutely denticulated within; columella quadriplicate; plaits equi-distant, the anterior two the larger. Length, ·15; breadth, nearly ·1 inch.

It has some resemblance to *M. Bensoni* (Reeve), which has a triplicate columella; and to *M. bulbosa* (Reeve), agreeing with it in its quadriplicate columella and denticulated lip, but differing in its more prominent spire.

Washed Up. — Wauraltie, west side of Spencer's Gulf, two examples (*Tate*).

4.—Marginella cymbalum (new species).

Shell shining white, rather solid, ovately-globose, spire immersed; columella plicate throughout, plicæ about 12, the anterior six stout, the rest not so conspicuous; outer lip thick and smooth. Length, ·2; breadth, ·14 inch.

This species belong to the Section *Cryptospira*, wherein the last whorl is produced over the spire as in the genus *Ovulum*; its nearest ally is *M. pisum* (Reeve), from which it differs in its a little less globose shape, and in having many plaits on the inner lip, there are only four in that species. *M. pisum* is recorded by Reeve as simply from Australia, but it has recently been catalogued by Mr. Brazier from the north-east coast of the continent. Another Australian *Cryptospira* is *M. ovulum* (Sowerby), but its elongately oval form is a distinguishing character; the Tasmanian species *M. minutissima* (T. Woods), has a triplicate columella.

Washed up.—Aldinga Bay, St. Vincent's Gulf, ten examples (*Tate*).

5.—Marginella denticulata (new species).

Shell shining white, pear-shaped, contracted in front, spire immersed; *columella quadriplicate*, outer lip thickened and minutely denticulated. Length, ·08; breadth, ·06 inch.

Its pyriform shape separates it from *M. pisum* and *M. cymbalum*, but it has more agreement in this particular with the Bornean *M. dens* (Reeve); its denticulated outer lip and strong columella plaits separate it from all.

Washed up. — Wauraltie, west coast of Spencer's Gulf, three examples (*Tate*).

6.—Marginella tridentata (new species).

Shell elongately conical, yellowish white, shining; spire somewhat exserted; last whorl rather swollen round the upper part, attenuated in front; lip broadly thickened, opaque, moderately inflected in the middle region, flexuous, minutely denticulated on the inner edge; columella with three strong plaits. Length ·25, breadth ·15 inch.

Washed up.—Aldinga Bay, St. Vincent's Gulf, one example (*Tate*).

I do not hesitate to found a new species upon the unique specimen before me, because it presents a combination of characters—a triplicate columella, denticulated lip, with a narrow conical shape, not presented by any known form. Its nearest ally is *M. sordida* (Reeve), from which it differs in being proportionately a little broader, and in having a denticulated outer lip. *M. Tasmanica* is the only other Australian species with a triplicate columella, but its shape is widely different from the present species.

7.—Marginella albida (new species).

Shell semi-transparent, whitish, oblong-cylindrical, surface marked with regular striæ of growth; spire very short, apex obtuse; base rounded, slightly attenuated; aperture narrow, widening to the front; columella a little arcuate anteriorly with five plaits, the anterior two of which are thick; outer lip thickened, flatly variced behind, and finely dentate on the inner edge with about twenty teeth. Length 2, breadth ·1 inch.

This species may be characterised as a diminutive, white, *Hyalina pallida*, Linne, with a five-plaited columella. Only two other forms of

the genus are known in the Australian seas—*H. mustellina* (Angas) Proc. Zool. Soc., London, 1871 t.1., f.5., which is banded with grey and brown and has a quadriplicate columella; and H. *fusiformis* (Hinds) with a conical spire and quadriplicate columella.

Among shell sand from the Marino Beach, Holdfast Bay; and Aldinga, St. Vincent's Gulf. (*Tate*); two examples.

## GENUS ERATO.

### 8.—Erato bimaculata (new species).

Shell minute, ovately pyriform, pale primrose-yellow to yellowish white, with rufous-red around the extremity of the anterior canal and on the callous border to the hinder part of the aperture; body whorl swollen, constricted at the base; outer lip stoutly swollen, extending to the apex of the spire, with about twenty-five strong, transverse plicæ; aperture very narrow, curved, emarginate posteriorly; columella with eight crowded transverse plaits. Length ·17, breadth ·12 inch.

*E. bimaculata* closely resembles *E. angulifera* (Reeve) from Borneo, but it has a less angular and inflated body whorl, and the colouration is peculiar. Three other species are known to inhabit the Australian seas, but they have little affinity with our shell.

Washed Up.—St. Vincent's Gulf at Aldinga and Marino, six examples (*Tate*); at the Semaphore, one example (*Bednall*), on the East Coast; and at Surveyor's Point on the West Coast, two exs. (*Tate*). Spencer's Gulf at Wauraltie, one ex. (*Tate*).

Reeve's "Monograph of *Marginella*" was concluded in January, 1865; it includes descriptions and figures of 15 species, which were then or are now known to be Australian, in a little more than a decade the number has been doubled. At the present time 185 species at the least are living chiefly in tropical seas, but extending into warm temperate regions in the Mediterranean, California, S. Africa, and Australasia. Of the 32 species recorded for Australia five only belong to the tropical part, and the large number of 27 extra-tropical forms makes this area the chief centre of habitation of the genus in so far as regards the temperate portions of the ocean; and in tertiary times it would appear to have been the focus of distribution of the genus.

The geographical distribution of the Australian species of the family Marginellidæ is shown by the accompanying table; from which we learn

that a majority of the species is confined to the south-east of Australia, and that two only are at all somewhat widely distributed.

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TABLE SHOWING THE DISTRIBUTION OF THE AUSTRALIAN MARGINELLIDÆ.

| NAMES OF SPECIES. | AUTHORS. | N&NE AUST. | WEST AUST. | STH. AUST. | VIC-TORIA | TAS-MANIA. | N. S. WLS. |
|---|---|---|---|---|---|---|---|
| Marginella australis ... | Hinds | * | | | | | |
| (H) fusiformis ... ... | Hinds | * | | | | | |
| guttula ... ... | Reeve | * | | | | | |
| lævigata ... ... | Brazier | * | | | | | |
| (C) pisum ... ... | Reeve | * | | | | | |
| liturata ... ... | Menke | | * | | | | |
| De Burghiæ ... | Reeve | | * | | | | |
| (H) albida ... ... | Tate | | | * | | | |
| (C) cymbalum ... ... | Tate | | | * | | | |
| (C) denticulata ... ... | Tate | | | * | | | |
| subbulbosa... ... | Tate | | | * | | | |
| (H) tridentata ... ... | Tate | | | * | | | |
| turbinata ... ... | Sowerby | | | * | * | * | * |
| Volutiformis ... | Reeve | | | * | * | * | |
| Allporti ... ... | Woods | | | | | * | |
| formicula ... ... | Lamarck | | | | * | * | |
| muscaria ... ... | Lamarck | | | | | * | * |
| Stanislas ... ... | Woods | | | | | * | |
| Tasmanica ... ... | Woods | | | | | * | |
| (C) minutissima ... | Woods | | | | | * | |
| Angasi ... ... | Crosse | | | | | | * |
| attenuata ... ... | Reeve | | | | | | * |
| Metcalfi ... ... | Angas | | | | | | * |
| (H) mustellina ... ... | Angas | | | | | | * |
| ochracea ... ... | Angas | | | | | | * |
| olivella ... ... | Reeve | | | | | | * |
| (C) ovulum ... ... | Sowerby | | | | | | * |
| (C) pulchella ... ... | Kiener | | | | | | * |
| rufula ... ... | Reeve | | | | | | * |
| simplex ... ... | Reeve | | | | | | * |
| Strangei ... ... | Angas | | | | | | * |
| translucida... ... | Sowerby | | | | | | * |
| Erato angyostoma ... | Sowerby | * | | | | | * |
| gallinacea ... ... | Hinds | * | | | | | |
| bimaculata ... | Tate | | | * | | | |
| corrugata ... ... | Hinds | | | | | | * |
| Total ... ... | 36 | 7 | 2 | 8 | 3 | 8 | 16 |

# THE FOSSIL MARGINELLIDÆ OF AUSTRALASIA.

By Prof. R. Tate, Assoc. Lin. Soc.; F.G.S., London, &c.; Cor. Mem. Acad. Sc., Phil.; Roy. Soc., Tasmania, &c.

[Read June 14, 1878.]

The family is not known in rocks of older date than the Eocene. The number of fossil species given for each genus in Woodward's Mollusca, 1866, is: Marginella and Hyalina, 30; Volvaria, 5; Erato, 2. Doubtlessly some additions have been made since that date, and the list is now increased by the 18 species from the Australasian Tertiaries which are enumerated in this paper. The large proportion that these bear to the known fossil forms justifies the assertion made in the last paper that the Australian area was the chief centre of habitation of the family in the Tertiary period.

## DESCRIPTION OF SPECIES—GENUS MARGINELLA.

### I. Outer lip smooth.

#### (1) Columella quadriplicate.

#### 1.—Marginella Aldingæ (new species).

Shell very small, somewhat fusiformly ovate, shining; spire, short, obtuse; whorls $4\frac{1}{2}$, nuclear whorls rounded smooth, the anterior two angulated, ornamented with nodulose plications at the angle and strong striæ; there are about twelve plications on the last whorl, which are evanescent towards the front and the suture; aperture narrow, sigmoid; outer lip much thickened and reflected, and deeply channelled above, without denticulations; columella quadriplicate. Dimensions—Length, 0·125; breadth, 0·1.

Very different from any living form, but recalls the West African harpæform Marginellæ, all of which are more fusiformly ovate.

Locality and Horizon.—Eocene marls, Blanche Point, Aldinga, South Australia, (*Tate*) many examples.

2.—Marginella Cassidiformis (new species).

Shell small, rather solid, cream-coloured, shining; ventricose-shaped like a typical *Cassis*, ornamented with plications on the shoulder of the whorl, fourteen on the last whorl. Aperture narrow oblong; outer lip straight, thick, and channelled above; columella quadriplicate, the anterior two oblique, the other two transverse. Dimensions: —Length, ·18; breadth, ·14.

Differs markedly from *M. Aldingæ* in shape and form of aperture, &c.

Locality and Horizon.—Miocene, Muddy Creek, near Hamilton, Victoria (*Tate*, 4 exs).

3.—Marginella muscarioides (new species).

Shell small, volutiform, shining cream-coloured, and obscurely marked with several narrow longtitudinal bands of dark colour. Spire conspicuously exserted; whorls regularly convex, last whorl gibbous slightly angled over the suture, transversely striated, and in some examples obscurely plicated at the angle. Aperture wide, curved posteriorly, and dilated anteriorly; outer lip moderately thickened, ivory white, smooth, and strongly channelled above, not extending on to the penultimate whorl. Columella with four strong plaits. Dimensions: —Length 0·275, breadth 0·15

This species is a diminutive *M. muscaria*, Lamk., from which it differs in certain minute but constant details.

In *M. muscaria* the callous lip is proportionately thicker, and ill-defined above, but a more particular difference is its extension on to the penultimate whorl, thence spreading over the base of the shell and giving rise to a flattened appearance varicosely margined on the left side. The under side of *M. muscarioides* is regularly convex, and the posterior angle of the aperture is squarish.

Locality and Horizon.—Miocene, Muddy Creek, Victoria, (*Tate*) many examples.

4.—Marginella hordeacea (new species).

Shell small, broadly ovate; spire short obtuse; last whorl regularly convex above, slightly depressed on the under side. Outer lip very thick and strongly channelled above, inner edge smooth; columella

with four strong distant plaits. Dimensions.—Length 0.225, breadth 0.175 inch.

*M. infans* (Reeve) makes some approach to *M. hordeacea*, but there is no recent species so broadly ovate as it. The flatted underside and the thick lip give it a striking character.

Locality and Horizon.—Miocene limestones, upper part of Blanche Point Cliff, Aldinga, South Australia. Very abundant (*Tate*).

5.—Marginella dubia (*Hutton*),
Cat. Tertiary Moll. of New Zealand, 1873, No. 52, p. 8.

"Ovato-cylindrical, spire short, smooth; outer lip slightly thickened; axis, ·6; breadth, ·3.

"Upper Eocene.—Broken River, Chatham Islands, N.Z." (*Hutton*)

6.—Marginella albescens (*Hutton*),
Cat. Marine Moll. of N.Z., 1873, p. 19, No. 65.

"Shell small, oval, translucent; spire short; aperture narrow; columella with four plaits, white. Length, ·2; breadth, ·1.

"Upper Miocene. — Awamoa; and Recent, New Zealand" (*Hutton*).

II. Outer lip dentate.

(1) Columella quadriplicate.

7.—Marginella Wentworthi (*Tenison Woods*),
Proc. Roy. Soc., Tasmania, p. 109, 1877.

"Shell small, ovately oblong, tumid, smooth, shining; spire exsert obtuse; whorls five, roundly angulate; aperture narrow, oblong; outer lip much thickened, deeply channelled above, enamelled on the edges, with numerous small tubercular teeth within the margin; columella with four plaits; anterior aperture widely channelled."

Locality and Horizon. — Miocene, Table Cape, Tasmania.—(*Johnston*).

Miocene.—Muddy Creek, Victoria (*Tate*), and R. Murray Cliffs (*Tate*).

Eocene Marls.—Blanche Point, Aldinga, South Australia (*Tate.*) Common in all localities.

*M. Wentworthi* has some resemblance to *M. muscaria*, differing from it not only as *M. muscarioides* does, but in its denticulate lip and more lanceolate form. But for its shorter spire it might be mistaken for

*M. eburnea* of the Paris basin, which has however a smooth lip. The shell varies much in its size; the dimensions of extreme forms from Muddy Creek are

| | | | | |
|---|---|---|---|---|
| | Length | 0·34 | Breadth | 0.16 inch |
| | " | 0·19 | " | 0·12 The Aldinga specimens |
| are stouter | " | 0·29 | " | 0·18 |

8.—Marginella Strombiformis (*T. Woods*), loc. cit., p. 109.

"Shell small, solid, smooth, shining, ovate, narrowed anteriorly, spire short obtuse, whorls four, rounded; body whorl obscurely longitudinally plicate below the suture; columella anteriorly obliquely somewhat coarsely quadriplicate; aperture narrow, curved, posteriorly emarginate, outer lip conspicuously thickened and produced posteriorly, finely tuberculately dentate within. Length, ·275; breadth, ·12 inch.

Not unlike a minute Strombus viewed from above owing to the produced lip; it is nearest in form to the W. Indian *M. marguerita*, Kiener, but that is a somewhat larger and more angular shell."—(*Tenison Woods*).

Locality and Horizon.—Miocene, Table Cape (*Johnston.*)

9.—Marginella micula (new species).

Shell minute, milk-white smooth, shining, conically ovate; spire very small obtuse; body whorl gibbous over the suture and constrictedly attenuated anteriorly; outer lip produced posteriorly slightly thickene; and minutely denticulated; aperture wide, curved, posteriorly emarginated columella four-plaited, plaits distant. Length ·11, breadth ·085 inch.

Locality and Horizon.—Miocene—Muddy Creek, Victoria. (*Tate*); many examples.

*M. micula* is near in form to the W. African *M. vitrea* (Hinds) but has a smaller spire and is more attenuated; it, moreover, belongs to a different section of the genus. So much as *M. vitrea* differs in form from *M. marguerita*, so does *M. micula* differ from *M. strombiformis.*

10.—Marginella inermis (new species).

Shell ovate to somewhat pear-shaped, attenuated anteriorly, smooth and shining, spire very short; aperture oblong, strongly arched posteriorly; outer lip slightly variced, edge thin and inconspicuously denticulated; columella quadriplicate. Length, ½; breadth, ¼-inch.

Locality and Horizon.—Miocene—Muddy Creek, Victoria. (*Tate*) seven examples.

11.—Marginella ventricosa (*Hutton*).

Cat. Tertiary Moll., No. 53, p. 8.

Ovato-ventricose: spire very short, smooth, outer lip thickened, strongly dentate; columella plaited. Axis, ·65; breadth, ·5.

Eocene—Broken River (*Hutton*).

(II.) Outer lip dentate.

2 Columella quinqueplicate.

12.—Marginella Winteri (new species).

Shell narrowly oblong, smooth and shining; spire exserted subacute, aperture triangular, moderately wide in front; outer lip white, rather flexuous, thinly but broadly thickened and somewhat inflected, with about 30 small obtuse denticles. Columella 5-plaited; the posterior one is small and absent in young shells. Length, $\frac{1}{2}$; breadth, ·35 inch.

The shape is much that of *M. bibalteata* (Rv.), and is narrower and more acute than *M. serrata* (Reeve), both of which have quadriplicated columellas.

Locality and Horizon.—Miocene—Muddy Creek, Victoria (*Tate*) many examples.)

I associate with this species the name of S. P. Winter, Esq., of Murndal, on the Wannon, as a slight recognition of the aid he has rendered to myself and other investigators of the palæontology of the Muddy Creek beds.

13.—Marginella propinqua (new species).

Shell oblong-cylindrical, solid, light horn coloured, transversely streaked with white, enamelled; aperture triangular, with a broad milk-white varix strongly denticulated on the bevelled edge; columella five-plicate. Length, ·45; breadth, ·22 inch.

It differs from the foregoing in its short spire and more tumid body whorl. In form it agrees with *M. Philippinarum* (Redfield), which is quadriplicate.

Locality and Horizon.—Miocene—Muddy Creek, Victoria, many examples; upper beds of the River Murray Cliffs (*Tate*).

14.—Marginella Woodsi (new species).

Shell solid, enamelled, cream-coloured, ovately oblong; spire short, obtuse; whorls rotundly angulate; aperture narrowly oblong,

rounded posteriorly; outer lip white, broadly thickened, channelled above, subsigmoid and denticulated within; columella with five plaits, the posterior one small. Length, ·3; breadth, ·175 to ·2 inch.

Has affinity with *M. Wentworthi* and *M. muscarioides*, being somewhat intermediate in form, but larger than both, and is distinguished by its short spire, and 5-plicate columella; it is more oblong than *M. Wentworthi*, and more attenuated anteriorly than *M. muscarioides*, and is moreover dentate.

Locality and Horizon.—Miocene—Muddy Creek, Victoria. (*Tate*) many examples.

This species is dedicated to the Rev. J. E. Tenison Woods, F.G.S., whose name is most intimately associated with the coral fauna of the Muddy Creek beds.

II. Outer lip dentate.

3. Columella septemplicate.

15.—Marginella septemplicata (new species.).

Shell stoutly ovate, gibbosely convex, light horn colour, shining; spire immersed, outer lip broadly but thinly callous, the callosity extending all round the aperture, denticulated within; columella with seven broad plaits. Length, ·375; breadth, ·23 inch.

Locality and Horizon.—Miocene—Muddy Creek, Victoria. (*Tate*) 4 exs.

No living species has the form, size, and columella plications of *M. septemplicata*; it belongs to the section *Persicula* of Schumacher.

GENUS VOLVARIA.

15.—Volvaria ficoides (*Hutton*).

Cat. Foss. Moll. of New Zealand, p. 8.

Ovato-pyriform; smooth; whorls four; spire not exserted, aperture narrow, outer lip inflected; columella quadriplicate. Axis, 1·1; breadth, ·85.

Upper Eocene.—Oamaru, New Zealand (*Hutton.*)

GENUS ERATO.

16. Erato? octoplicata (*Woods*).

Ref. *Marginella octoplicata*, Proc. Roy. Soc., Tasmania, 1877, p. 109.

"Shell solid, smooth, shining, pyriform; spire scarcely visible,

of three very small depressed whorls; body whorl distinctly striated with lines of growth; mouth narrow, subsigmoid; columella with eight plaits, the anterior valid scarcely oblique, the posterior four faintly traceable, outer lip much thickened, and very regularly dentate with 12 raised linear teeth; at the base of the columella there is a distinct varix, which proceeding round the posterior end of the shell unites with the reflected lip, making that broadly marginal. It bridges over the gap between *Marginella* and *Erato* and *Cypraea*. *Marginella 5-plicata*, Lam., *M. elegans* (Gmel.) and *M. turbinata* (Sow.) show an approach to this form, but they are larger shells."

Unacquainted with the species I cannot pronounce upon its generic affinities, but from its diagnosis it would appear to be rather an *Erato* than a *Marginella*.

Horizon and Locality.—Miocene; Table Cape, Tasmania (*Johnston.*)

17.—Erato Australis (new species).

Shell minute, shining, horn-colour; tringularly pear-shaped; spire rather exserted somewhat acutely conical; whorl 4½, body whorl marked with lines of growth, rotundately angled over the suture, and constrictedly attenuated in front; outer lip moderately thickened and inflected, inner margin denticulated; aperture moderately wide, enlarged behind and narrowing to the front; columella with four slender oblique plaits succeeded by denticles. Length, 0.23; breadth. 0.15 inch.

*E. Australis* is seemingly related to the above, but separable by its exserted spire, in which character it agrees with *E. gallinacea*, Rv. from the Philippines, and *E. callosa*, (Adams and Rv.) from the Chinese Seas, differing from them in its narrower shape, and less inflated body whorl.

Locality and Horizon.—Eocene marls at Blanche Point, Aldinga South Australia (*Tate*), fifteen examples.

18.—Erato minor (new species).

Shell minute, somewhat elongately pyriform, orange yellow, spire short obtuse; outer lip shining white, with a broad callous expansion posteriorly, extending over the penultimate whorl and enveloping the base of the shell; columella with five conspicuous plaits and denticles. Resembles the living *E. Sandwicensis*, (Pease,) but the aperture is not so prolonged posteriorly, and the spire is much shorter Dimensions.—Length 0·15, breadth 0.1 inch.

Locality and Horizon.—Miocene, Muddy Creek, near Hamilton, Victoria (*Tate*), 4 exs.

Divisions of the genus *Marginella* have been proposed by several conchologists; these are founded chiefly upon the character presented by the spire, whether elevated or hidden, whilst the outline of the shell has served for further subdivision Were I to adopt the divisions proposed by the MM. Adams, I should be necessitated to suggest others for the reception of certain of the fossil forms; not deeming this desirable, I select more stable characters those of the plication of the columella, and the absence or presence of denticles on the lip, as bases for the arrangement of the species into artificial groups to facilitate reference, such as is set forth in the following conspectus.

## CONSPECTUS OF THE SPECIES OF FOSSIL MARGINELLÆ.

I. Outer lip smooth; columella quadriplicate.

1. Fusiformly ovate, *M. Aldingæ*, Tate.
2. Ovate ventricose, *M. Cassidiformis*, Tate.
3. Volutiform, *M. muscarioides*, Tate.
4. Broadly ovate, *M. hordeacea*, Tate.
5. Ovato-cylindrical, *M. dubia*, Hutton.
6. Oval, *M. albescens*, Hutton.

II. Outer lip dentate.

A.—Columella quadriplicate.

7. Ovate-oblong, *M. Wentworthi*, T. Woods.
8. Ovate, *M. strombiformis*, T. Woods.
9. Conically-ovate, *M. micula*, Tate.
10. Pyriform, *M. inermis*, Tate.
11. Ovate-ventricose, *M. ventricosa*, Hutton.

B.—Columella quinque-plicate.

12. Fusiformly oblong, *M. Winteri*, Tate.
13. Oblong-cylindrical, *M. propinqua*, Tate.
14. Ovate-oblong, *M. Woodsi*, Tate.

C.—Columella multiplicate (*Section Persicula.*)

15. Columella 7-plicate, *M. septemplicata*, Tate.

Remarks on the Affinities of the Species.—Of the fifteen species enumerated in the foregoing table, only one is known as a living shell, it is *M. albescens*, which inhabited the same region in Miocene times as it does now. Three have allied species among recent forms :—

*M. hordeacea* resembles *M. infans*, of Singapore.
*M. muscarioides* „ *M. muscaria*, of S. E. Australia.
*M. strombiformis* „ *M. marguerita*, of the West Indies.

Then there are five species which are only distantly allied to, though resembling certain living forms, because their essential points of difference are less trivial than variation of shape; these and their living analogues are as follows :—

| Fossil Species. | Recent Species. |
|---|---|
| *Outer lip of shell dentate.* | *Outer lip smooth.* |
| M. Wentworthi is the analogue to | M. muscaria, S.E. Australia. |
| M. micula „ „ | M. vitrea, W. Indies. |
| Columella 5-plicate. | Columella 4-plicate. |
| M. Winteri is the analogue to | M. bibalteata, W. Indies. |
| M. propinqua „ „ | M. Philippinarum, E. Indies. |
| M. Woodsi „ „ | M. volutiformis, S.E. Australia. |

Analogous forms to certain other of our Tertiary fossils have been indicated by McCoy and Duncan in the genera *Voluta* and *Cyprœa*, and among some of the corals and echinoderms.

Our tertiary fauna, so far as it has been critically studied, shows an affinity rather with the recent fauna of the East Indian and Chinese Seas than with that of temperate Australia. However, this phenomenon is not exhibited by the Marginellidæ, at least only in a very slight degree, and their alliance is as strong with the West Indian and Australian faunæ. In respect to the West Indian fauna, it may be stated that it possesses many points of affinity with that of the Miocene of Europe.

# WHIRLWINDS.

By Otto Tepper, Corresponding Member.

[Read July 16, 1878.]

By whirlwinds are understood local disturbances in the atmosphere, of limited diameter, and moving in a spirally-ascending direction, at the same time shifting laterally.

They are during the summer months of such frequent occurrence in Australia and elsewhere that many people do not deign to take much notice of them unless their attention is enforced by some specially destructive whirlwind. Yet the *causes* of these phenomena appear so much enveloped in mystery that the careful observation and study of them may well repay for the pains taken, as perhaps through these phenomena the origin of the far grander waterspout and cyclone may be elucidated.

A. v. Humboldt considers them as effects of opposing currents; but how currents moving in *straight* lines with moderate velocity can produce spiral ones endowed with great swiftness it is hard to comprehend, even leaving out of question the fact that whirlwinds only take place during almost absolute calms.—(Belt, "the Naturalist in Nicaragua.")

Maury, again, ascribing them also to the meeting of currents, invokes the aid of electricity, citing an experiment with a metallic ball, by means of which, when highly charged with electricity, a small waterspout was raised ("Geogr. of the Sea"). The objection to lateral currents being the cause having been stated, electricity as such is equally doubtful, it being hardly conceivable, in the absence of such powerful concentrating agent as a *metallic* ball how thousands of tons of water could be raised for hundreds of feet by any *known* natural agent. Besides this, it seems that whirlwinds occur as frequently as not in nearly dry atmosphere, with little indication of electric tension and *before* any thunder-

clouds form. They appear rather to act as producers of the concentration of electricity in the clouds than otherwise, but when taking place under an overcharged cloud no doubt act as channels of exchange and discharge, and in this way—two forces acting conjointly—their effectiveness would be increased immensely.

To get a fair understanding of the phenomena, the following points must be considered, viz.:—

1. The time of day they take place.
2. The accompanying circumstances.
3. The actual facts observable—*a*, at the start; *b*, during progress; *c*, at the end.
4. The *mechanical* agencies, by means of which the observed facts can be explained.

In no instance can I remember ever to have witnessed a real whirlwind either much before 10 a.m. or after 4 p.m.; the period of maximum frequency being between noon and 3 p.m., thus limiting their occurrence to the hours of maximum daily temperature. By this observation it is not implied that they *cannot* occur at some other time (for I have noticed often small momentary whirling gusts at other times, when obstructions of peculiar form offered themselves to the winds), but that their normal occurrence falls within the periods named.

The *weather* at the time is distinguished by calm, intercepted by short, fitful blasts of wind from every point of the compass irregularly, and considerable warmth. If a *hot wind* is prevalent at the time, whirlwinds invariably occur in a temporary lull. In respect of size they range from a few inches in height and diameter, over an ash-heap or in large fireplaces, to lateral dimensions of several hundreds of feet, and vertically to several thousands of feet in elevation.

The producing causes may be found in the sudden temporary escape of overheated air, when in unstable equilibrium, through a resisting medium, viz., a stratum of denser, colder, rapidly-moving current above. By this escape a partial vacuum being formed, the gravitation of the surrounding still air will assist in forcing the lower strata directly under the vent, powerfully up and towards the same, by which means the increased force of the whirling current can be easily accounted for.

The effect of the upper polar current upon the ascending heated air particles is very great, because there is a mechanical law, according to which a fluid or gas in rapid motion acts to some extent like a solid in pre-

venting other fluids at rest or only moving slowly from entering or mixing with each other. As far as fluids are concerned this is illustrated in a grand scale by the oceanic currents, and by the ease a sharp stream of gas or vapour can be ejected to some distance through some other without mixing. Claiming the same property for the upper aerial currents (which must acquire a considerable momentum, being entirely unimpeded in their course, and therefore offer a great resistance by their inertia to any intrusion), they will act as a barrier to the ascending particles of heated air, infringing upon the swift cool current at right angles or nearly so, and thus are arrested in their course and detained, as illustrated in Plate 3, fig. 1. Air being a bad conductor of heat the warm particles will be very slow in parting with it, especially to others in rapid motion, and therefore long retain their buoyancy. A certain tension, a pressure exerted by them upon the barriers would therefore result and increase continually, though in a slow ratio Gradually the atmosphere would grow hotter, the upward pressure stronger, the area of the calm extended, and the upper current forced upward in the places of maximum pressure, as shown in fig. 2, plate 3.

In the meantime the air becomes more and more oppressive, and to some extent charged with moisture. The heat becomes *visible*, the whole lower strata of the atmosphere seem quivering, undulating, strangely distorting distant objects. The combat of the forces is approaching its climax; but pressure being very unequal over any extent of area on account of the difference of the heat-radiating capacities of the soil, at the points of maximum pressure a small volume of hot air forces itself into the swift current, and instantly is swept along. This event is noted—above, probably by the formation of a thin streamer of cloud by the condensation of aqueous vapour; below, by a slight puff of wind in the direction of the seat of the momentary disturbance, and therefore in different directions at different localities.

When the sun has reached an altitude of 45°—50° the time has arrived for decisive measures—the rupture and overpowering of the upper current and the escape of the imprisoned air. The equilibrium is at last attained; the overheated air suddenly forces its way at some point through the rapid upper current by means of a sufficiently large vent, but keeps its exit open for a short time only; then it is closed again by the onward pressure. From all sides the confined air streams up into the gap or towards it, but being formed in a moving medium, it is carried along with it bodily, according to the same law that prevented its entrance, viz., its viscosity when in motion. (See fig. 3).

By this forward motion the direction of the air particles, at first perpendicularly upwards towards the point of rupture, attains obliquity before gaining entrance *de facto*, while those that started at the rear become still more slanting in their course, having to hurry forward at an increased rate, but impinging upon those coming from the sides and the opposite direction, are forced out of it, their motion thus becoming sideways, forward, and upward—*i.e.*, spiral. These in front are forced aside by their adhesion and the forward pressure of the up-rushing current, and the inertia of the comparatively unaffected volume of the adjacent air. In this manner the spiral mo ion is obtained.

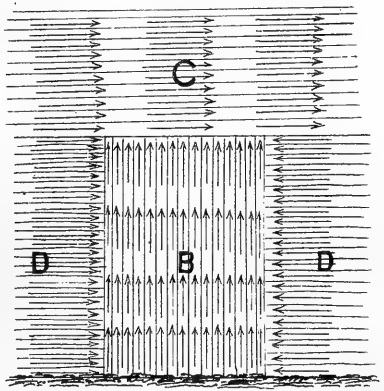
The *upward* force of the ascending current is further augmented (and, derivatively, the lateral motion) by the downward pressure of the superincumbent strata of the air, by forcing the lower into the (funnel-like) vortex, which latter assumes the functions of a partial vacuum. The commotion produced in the vortex gradually affecting the adjacent mass of air, the spirally-ascending current assumes naturally in progression the form of a *descending* inverted cone—observed at times in the case of waterspouts, etc.—which finally reaches the surface of the earth, there exerting the *maximum* of force because here the *weight* (gravitation) of the atmosphere, etc., is greatest, and reaches the earth at *a point* from which the action rapidly extends on all sides. The spiral motion is strongest *near* the circumference, while at the centre of the current—the whirlwind—it is directly upwards, but in a more or less oblique direction, on account of the forward motion of the whole and the friction with the surrounding air.

Generally the gyrations of the whirlwind cease as suddenly as they begin—first in the centre, then at the circumference. A dust column, seen at a distance, appears invariably to break off at some distance above the ground, the objects comprising the lower part rapidly descending, while those in the upper portion seem slowly to float upwards, conspicuous articles of small weight being often carried to considerable distances ; the light dust preserves its columnar form sometimes for a quarter of an hour or more without apparently changing its place.

In conclusion, the following is a short *resume* of what is intended to be shown in the foregoing, viz :—

1. Whirlwinds are upward currents of heated air, endowed with a spiral motion at the circumference, progressive motion and small diameter in proportion to their height.

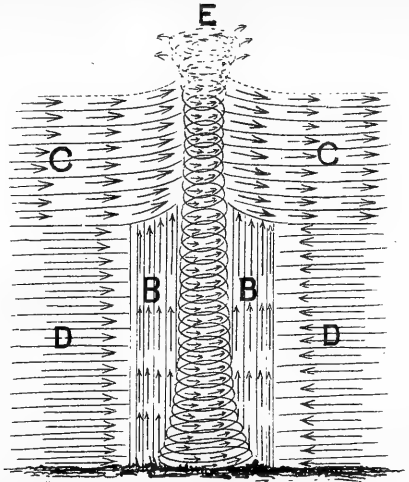
Fig I.




A *Surface of land.*

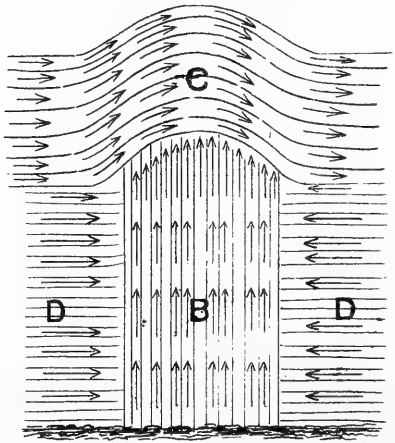
B. *Ascending hot air.*

Fig. III.




E. *Rupture of the upper current, and air ascending in Spiral motion.*

Fig. II.




C *Upper current.*

D *Surface winds.*

2. They only occur during the warmest part of the year and day, and in calm weather.

3. They are due to the unstable equilibrium of the air, the hot lower portion acquiring a high state of tension by being unable to rise according to the laws of heat, being prevented by some rapidly moving current of cold air.

4. They are produced by the hot air obtaining exit through a narrow vent forced through the upper current.

5. Their locomotion is produced by the vent and its cross air current being carried along with the cold current.

6. Their spiral motion is produced by the shifting of the centre of attraction (the vortex) of the hot air particles and their infringement upon each other, and the unaffected volume of the adjacent air, assisted by friction. In fact they are produced by the same causes, only inversely, as the rotating motions of fluids escaping through a narrow vent below them.

7. They are terminated by the closing of the vent by the onward pressure of the cold current.

8. The retention of light articles in the upper regions (even, perhaps, their ascension) may be greatly facilitated by electricity.

9. Stable equilibrium is produced by the escape of the over-heated air, and its replacement by cold air derived from the upper current or the S.W. surface wind.

# ON SOME FOSSIL CORALS FROM ALDINGA.

By the Rev. J. E. Tenison-Woods, F.L.S., F.G.S., &c., Hon. Memb. Adelaide Phil. Society.

[Read September 17, 1878,]

Some corals collected by Professor Tate have been sent to me for examination, and though labouring under considerable disadvantages for the task of their description I have accepted it with much pleasure; not only because these organisms possess more than an ordinary interest for me, but also because they form very good tests, perhaps better than any others of the age and relations of the beds. From the beginning, the corals of our Australian Tertiary formations have received more attention than any other fossils from the same beds. There are few indeed from Victoria or Tasmania that have not been described. There is, therefore, a well-established ground to go upon. I have also recently published in the Proceedings of the Linnean Society of New South Wales for 1877 (vol. 2, p. 292) a list of the extra-tropical corals of Australia. This enables us to compare any new tertiary corals, or the corals of any new beds with the known fauna, so as at once to make very reliable deductions; and thus the relations are, in a manner, of either fossils or formations immediately made known to us. The corals from the Aldinga beds possess a more than usual importance. Very little has been made known of the fossils, and that little excites our interest in a high degree. Professor Tate has made known the existence in its strata of fossil *Belemnites* and *Salenia* and the other organisms are sufficiently different from those of such well-known formations as Mount Gambier, the Murray, and the Muddy Creek to make us wish for more information. The examination of the corals now to be described has not disappointed my anticipations. The forms are for the most part new, and also for the most part so connected with what

has been been already described, that they are seen to belong to one great group. I shall reserve for the end of the paper such remarks on the species as may throw light upon their affinities. I will merely observe now that the most of the specimens were either broken or in such a hard matrix that a full and satisfactory examination is what I could not obtain in every case. The matrix and the preservation shows a remarkable difference from the corals of the various strata of Victoria or Tasmania. There the corals were well preserved, but in a very brittle and soft matrix, so that unless they were very carefully handled they were irrevocably destroyed. A peculiar glazed appearance, which is very common in the fossils of Victoria and Tasmania, is not seen in these; nor do they seem to be stained with ferruginous oxides to the same extent. I mention this because in Victoria and Tasmania the peculiar characters referred to seem to be due in part to the intercalation of volcanic rocks with the formation. It would be worth while to enquire whether such influences had begun when these, perhaps the oldest members of the series, were deposited.

Before I begin the description of the species it may be as well to take a glance at what has been hitherto done in our Tertiary fossil corals, so that the references may help those who wish to follow up the subject.

In 1864 Professor Duncan described some fossil corals sent by me to him. The descriptions and figures appeared in the Annals of Natural History for September of the same year.

In 1865, the same experienced author described in the Annals for September, p. 182, some other corals.

In 1870, he also described in the Journal of the Geological Society, p. 285, a number of new species sent home from the Victorian Geological Survey, and at the same time gave a complete review of all our tertiary species, stating their relations and the evidence they afforded of our climate.

In 1875, he further described in the same Journal, vol. 31, p. 673, some Tasmanian fossil corals, and again in 1876 other species from the same tertiary beds in vol. 32, p. 341.

In 1876 I described two species of fossil corals from Table Cape, Tasmania, in the Proceedings of the Royal Society, Tasmania, p. 115.

In 1877, in the Proceedings of the Royal Society of N. S. Wales, p. 183, I figured and described some new species of corals, and also extended the observations of Prof. Duncan on his and my *Caryophyllia viola*

and *Sphenotrochus excisus*, which I removed into the genus *Deltocyathus*. In this paper I also gave a list of all the Australian Tertiary species, but from which list was inadvertently omitted *Sphenotrochus emarciatus*, *Antillia lens*, Duncan, and *Placotrochus elegans*, nobis.

MADEPORARIA APOROSA.

FAMILY TURBINOLIDÆ.—GROUP TROCHOCYATHACEÆ.

GENUS DELTOCYATHUS, *M. Edw. and Haime* (1848).

*Deltocyathus*, M. Edw. and Haime, 1848. *Corallum* simple conical free, no trace of adherence; *calice* nearly circular and shallow; *columella*, ending in a rounded multipartite surface; *septa* straight, large exsert and granular, and the higher orders generally well developed; *pali*, highly developed, unequal, penultimate largest and turned towards antepenultimate so as to form chevrons or deltas; *costae*, highly developed distinct to the base, with many granulations.

*Deltocyathus italicus* (*Edw. & Haime*), was formerly the only species of this coral known. Messrs. Edw. and H. separated it from *Stephanophyllia* in which genus it had been placed by Michelin (*Iconographie zoophytologique*, Decrip. of polyp. fossil of France, &c., 1841-1847, p. 32, pl. 8, fig. 3, a young specimen). But *Stephanophyllia* has porous walls, and therefore is very far removed from the family in which the species has to be included. It must, however, be remarked that there are certain pits in the intercostal spaces, which look very much like pores. M. Edwards and Haime describe it thus :— Corallum, a short cone; costæ unequal, formed of a series of very regular globules; columella composed of three bundles of stems disposed in series; four complete cycles; septa very little exsert, thick on the outside; pali very unequal, thick. Professor Duncan is of opinion that the specimens found by Mr. de Pourtales in the Caribbean Sea did not differ much from the Miocene fossils of Europe, or these again from those found at Cape Otway. At least he says that the differences are not greater than are to be found between external divergencies in the fossil forms. The specimens from Aldinga differ very much, first of all in the size. They are longer than any of the dimensions given. They differ again in the shape. Some are perfectly hemispherical, some are truncated cones, and some bell-shaped. But I cannot doubt that I am dealing with a very closely allied species. In one important point it seems to me to differ, and that is that there is no columella. The septa all unite in the centre by numerous processes,

and what seem to be lobes of the columella are in reality the pali of the primaries, which meet in the centre. The same thing occurs in what I call *Deltocyathus viola*, and I must reserve my remarks on the subject for another occasion. I shall therefore name the species and describe it as follows :—

DELTOCYATHUS ALDINGENSIS, n. sp., pl. 1, fig. 1.

*Corallum*, hemispherical, or in the form of a truncated cone, or bell-shaped, that is to say, hemispherical, with a very thick cylindrical base like a pedicel, no trace of attachment. *Costae* very distinct and prominent, with numerous small rounded granules, in four cycles corresponding to the septa and continuous with them; primaries and secondaries equal and distinct to the base, where they suddenly thicken; tertiaries thinning out towards the base, and joining the third and fourth orders at about three-fourths from margin, and then making one continuous rib; all very closely covered with numerous small rounded granules. Intercostal spaces about equal in width to costæ and having numerous rounded pits or pores in equi-distant series. *Calice*, circular, either flat or a little convex, from a cauliflower-like mass in the centre arising from the pali. *Septa* in six systems of four cycles, which are not exsert, of equal thickness, very granular, with finely zigzag margins, and continuous with the costae ; primaries straight, free to the centre, where they join rounded cauliflower-like pali; secondaries also straight and free until about two-thirds from the centre, where they are joined by the tertiaries and become much thicker, and here a kind of paliform excrescence projects. The higher orders unite with the tertiaries about a third from the margin. Dimensions—Alt. of the largest specimens 7, diam. 8½ millimetres.

The sides of the septa in a section are seen to be very regularly, closely, and prominently granular. A section at the centre shows that all the septa are united by small processes. When the calicular surface is ground flat, the primaries and secondaries are seen to unite in the centre, and the pali (?) are then seen to be represented by a very slight thickening, nothing in proportion to the foliated appearance of the surface. The junction is not apparent on the natural surface, but the tertiaries seem to send out a transverse thickened process to meet the fourth and fifth orders on each side. It is by a process of this kind that all the septa are joined for they do not in reality curve towards each other.

DELTOCYATHUS TATEANUS, n. sp., pl. 2, fig. 5.

*Corallum*, very small discoid, flat, thick in proportion to diameter,

base concave, and very slightly smaller than calice. *Costae*, very prominent, continuous with septa, not quite so wide as intercostal spaces, smooth, acute, persistent to the centre of base. *Epitheca*, none. *Calice*, circular. *Fossa*, very shallow, scarcely depressed in the centre. *Systems*, six. *Cycles*, four. *Septa*, not exsert, or only slightly. *Pali*, apparently before secondaries, a chevron-like mass with the ends directed towards tertiary septa. In the specimens the surface is worn, and the pali are indistinguishable from the septa, and it thus appears as if the tertiaries united with the secondaries about a third from centre. There are also tubercles in the centre which seem like pali of primaries. *Wall*, thin, bending outwards to meet costa. Dimensions—Alt., $1\frac{1}{2}$; diam. 3 millim.

Only two specimens, both worn, and one a little broken; the latter the only one in which the pali could be fairly made out. Better specimens may however show that some of my conclusions are subject to modification. It is closely allied to the living *D. rotaeformis*, nobis, but in that species the costae do not correspond with the septa. I have great pleasure in dedicating this species to my friend Prof. Tate, whose zeal and industry in the cause of geology need no encomium from me. It should be noted that the concavity of the base is not seen except in the longer specimen, the other being convex. In the young stages of *Deltocyathus italicus* the base is often rounded, and in form like *Trochocyathus meridionalis*, Duncan; but in all other respects the species seem to be different.

DELTOCYATHUS ALATUS, n. sp., pl. 2, fig. 4.

I am doubtful whether to regard this fossil as only a variety of *D. excisus*, Duncan. It comes from the Murray cliffs where the latter is not found. Its peculiarities are as follows. The septa are much more spinous in their granules, and they are not so exsert but often deeply lobed. That is to say the kind of lobate teeth and crest at the edge of the primaries and secondaries are distinctly divided and stand out separately. The pali are very solid and distinct. There is no columella, but the septa and pali unite in the centre. The two prolongations of costae at each side of the coral in *D. incisus* become flattened and spread out into aliform appendages in this coral. Not, however, in all cases. There are specimens which approximate closely to *D. incisus*, and there are others where they are much more prominent, and more spread out on the side of the corallum than in the figure given. The granules on the

costae are finer, more numerous, and closer than can be easily expressed on a small sized drawing. On the whole I should not be disposed to regard the species as distinct; but the variation is very important, varying in amount in different specimens. It will be seen that aliform appendages are therefore not of such specific importance as they have been thought to be.

With regard to the genus, I must observe that I do not think the mere deltiform pali a sufficient generic distinction from *Trochocyathus*. But all those species which I have classified as *Deltocyathus* have really no columella. The pali are united to the septa and meet in the middle giving rise to a rather compact tissue in which the component septa are generally distinguishable in this species, but not in *D. viola*. Most of the species may be said to represent *Trochocyathus* in Australia. I think if it be added to *Deltocyathus* that there is no columella, there will be no necessity for creating a new genus. It must be acknowledged that the divisions as they at present stand are not satisfactory. If it were clearly stated that there is no columella because the visceral cavity is empty as in *Desmophyllum*, or that the septa and pali meet in the centre, as in *Conocyathus*, there would be no ambiguity. At present both are described as having no columella.

The fossil at present referred to is common in the Murray River cliffs, four miles south of Morgan. Dimensions, about the same as *D. excisus*.

It is remarkable that though *D. excisus* is very common at Muddy Creek, I have never seen a specimen with any form of base except two small basal prolongations, though this form is the exception at the Murray beds. The deeply lobed septa are rarely seen in the Muddy Creek specimens.

The next species is a *Trochocyathus*, of which we have already two fossils described and two doubtfully from New Zealand. In this genus the fossils extend from the present day to the Lias.

TROCHOCYATHUS HETEROCOSTATUS, n. sp., pl. 2, fig. 1.

*Corallum* short, broadly wedge-shaped, with a very conspicuous oval, slightly convex, radiately ribbed, basilar scar, which has a neat, somewhat prominent, clearly defined margin; base proportioned to calice as five to eight. *Calice*, elliptical, shallow ends of major axis slightly lower than those minor. *Costae*, distinct, granular, with fine granules, and disposed in four cycles, but in a very singular and exceptional manner.

Those corresponding to the fourth and fifth orders of equal width, and continuous from margin to base. First, second, and third orders broader and more exsert at the summit, but thinning out rapidly to a fine point, and terminating at about a fourth from the base, except the primaries at the ends of the major axis which are continuous to the base. *Septa*, exsert proportionately to the orders in six systems of four cycles. Primaries somewhat high, rounded, narrow, or not projecting much into the fossa. Secondaries apparently only half their height, but all are broken in the only specimen I have seen. Third order a little thinner, but apparently as high. Fourth and fifth orders nearly as thick at the margin, but only very slightly projecting into the fossa as a thin edge; all highly granular and continuous with the costae. Granules disposed in ridges at the edge of the primaries. Pali small, styliform processes before all the cycles except the last. Columella uncertain, as it was partly covered with hard matrix, which could not be removed without destroying the septa. Dimensions—Alt. 4, major axis $4\frac{1}{2}$, $3\frac{1}{2}$.

### Family Oculinidæ.

In the third principal group of the *Madreporaria aporosa* we have the family of the *Oculinidæ*, that is to say, branched corals with lateral buds with a great deal of very compact ivory like tissue. We have two species of this family in the collection—one with alternate calices and a peculiar structure which affords evidence of importance, as I shall notice presently. It belongs to the genus

### Amphihelia—(*Edwards and Haime*).

which is erected for dendroid corals with alternate buds. The cœnenchyma is highly developed, especially at the base. The costae are only faintly marked. The columella is rudimentary, or absent, and there are no pali. The septa are few, entire, and not exsert. There are two species living—one in Australia and the other in the Mediterranean. One has been found fossil in our tertiary rocks. This is A. *incrustans* (Duncan), a very abnormal form.

### Amphihelia striata, n. sp., pl. 1, fig. 4.

*Corallum* of irregular, short, cylindrical branches; calices circular, scattered, the lower ones sunken, the terminal ones very much exsert, all alternate, very deep and narrowing towards the base. No columella, but filling up from below in an open kind of spongy tissue arising from the coalescence of the septa. In the terminal calices the septa are exsert and salient, in the lower ones they are quite inconspicuous, in six

systems of three cycles, which are unequal according to the orders, a little thick but conspicuously swollen and rounded at the extra-mural part. The costae are conspicuous on the edge of the young calices, but the whole corallum is covered with a thick compact outer layer or sheathing tissue, which is covered with fine anastomosing grooves. On one branch these grooves form circles like tattooing; underneath this the costae seem to be very continuous, and each is covered with a linear series of small granules. In most of the broken fragments the outer sheath can be seen plainly.

This species comes very near *A. venusta*, E. and H., but the peculiar striations on the outer sheath, and the costae distinguishes it sufficiently. Some of the calices fill up from below by a kind of spongy tissue which results apparently from a union of the septa; others are quite empty to the base to which the calice narrows in a curved line, the point being only separated by a very thin wall from the curved upper portion of the alternate calice below. This is a variation in the structure which affects Prof. Duncan's reasons for transferring *Amphihelia* to the Turbinolidæ. It is not confined to the young branches, but is seen in the oldest portions of the corallum and in calices adjoining one another.

AMPHIHELIA ZICZAC, n.sp., pl. 2, fig. 2.

In the species which I am about to describe there are peculiarities which I think should place it almost in a genus apart. There is an axis into which the calices are sunk, and then outside this, but separated by hollow spaces, there is an outer sheath of some thickness. These hollow spaces seem to have no communication with the visceral cavities. It seems like an outer covering of dermic tissue, which was secreted over the basal structure while the lower cells were alive, leaving large apertures for them. As far as can be seen also, the septa are represented only by merely raised rounded lines on the upper part of the calice, and though they are never conspicuous in the genus, yet here they can scarcely be seen except at the bottom of the visceral chamber where they are confluent. The following is the diagnosis:—

*Corallum* in zigzac branches of various thickness, the longer or probably basilar ones having an outer sheath with interstices, which do not communicate with the visceral cavities. *Calices* at every angle, projecting, alternate, numerous, and at equal short distances. *Septa* only salient at the bottom of the calices, and represented by rounded lines at the upper part, and not visible at all at the margin, in three cycles; the two first equal, and confluent at the base, but no calice was preserved

entire, and it could not be said whether the third order was present in all the systems or not. *Costae*, none visible; but the surface is covered with fine grooves which divide it into small polygonal spaces on which there are faint granulations, but the whole structure is so much worn that this appearance is exceedingly difficult to make out. Dimensions:— Length of the branches from ·25 to ·37; diameter, from ·3½ to ·7; distance between the calices on the same side 8 millimeters.

### Family Astræidæ—Group Trochosmiliaceæ.

### Genus Conosmilia (*Duncan*), 1865.

In the descriptions of new corals from Australia, published by Prof. Duncan in the "Annals of Natural History for 1865," (p. 182), a new genus was erected for simple pedicellate corals with a twisted laminated columella and scanty endotheca. This was *Conosmilia*. I have given a synopsis of the genus in the "Proceedings of the Royal Society of N. S. Wales" for last year. I think the general character of these fossils may become the type of a family, as there are other anomalous genera to be noticed presently. In the collection there is one species of what I believe to be this genus; but it is a deformed specimen, and therefore any attempt to determine the details would be hazardous. I shall merely give it a name and some of its leading features, and leave the rest until better specimens are found.

### Conosmilia contorta, n. sp., pl. 1, fig. 3.

*Corallum*, very much twisted and distorted, but normally a very elongated one, cylindrical or slightly elliptical. *Costae*, broad, flat, or in places acute, smooth or indistinctly vermiculate, corresponding with septa. *Epitheca*, thin, smooth, somewhat shining, in concentric folds occasionally. *Septa*, not granular, not exsert, but projecting in rounded edges more or less according to the orders. Systems, six. *Cycles*, four. *Fossa*, rather deep. *Columella*? *Endotheca*, scanty. Long. 20 lat. of calice, 8. One specimen with doubtful fragments of two others.

In the new species I am about to describe we have *Conosmilia* without a columella, but with pali. In every other respect it resembles the above-named genus of fossils, which Professor Duncan was the first to describe. The absence of a columella or the presence of pali has always been regarded as of generic importance in the present classification. I therefore propose a new genus for these corals, which I shall name *Cyathosmilia*. There is considerable analogy between this genus and *Cono-*

*cyathus* of the Trochosmiliaceæ. They may be regarded as Conosmilæ with pali and without a columella, or Conocyatheæ with endotheca and without the peculiar cyclocostal arrangement which is so thoroughly *Turbinolian* in its character.

CYATHOSMILIA (new genus).

Simple pedicellate corals with endotheca and pali. No columella.

CYATHOSMILIA LATICOSTATA n. sp., pl. 1, fig. 2.

*Corallum* small, curved, slightly compressed in the direction of the curve, tapering towards the pedicel, which is very small and concave, bearing a crest at the outer edge of the curve, which is composed of irregular projections. *Costæ*, simple, broad, raised, rounded, separated by very narrow grooves (which correspond with the tertiary septa, while the costæ correspond with the primaries and secondaries), terminating in regular angular points at the edge of the calice, giving it a coronate appearance. *Epitheca*, conspicuous in concentric folds of irregular width, and undulating over the costa. *Calice*, broadly elliptical. *Fossa*, shallow, in fact only the slightest depression is perceptible. *Systems:* six, with three cycles. *Septa*, not exsert, granular, primaries and secondaries equal, thick, wedge-shaped; tertiaries thin, small, inconspicuous. *Pali*, before primaries and secondaries only, thinner than septa, slightly exsert, primaries only half the size of secondaries. *Endotheca* filling up space between pali, septa, and fossa, and rather numerous; stages very rare between septa, except at the base. *Wall*, thin, dotted with deep pits, or pairs of pores, on opposite sides of the septa. These are not visible except in worn specimens where the epitheca is absent; otherwise it covers them. *Dimensions*—Alt. 6 to 11, major axis $2\frac{1}{2}$ to 5, minor 2 to 4.

Aldinga, about a dozen specimens, but very few complete. In all the larger ones the broken ends of the septa are very distinctly seen to be composed of two thick laminæ pressed together. In these specimens also the intercostal space is flat, wide, and shallow. The centre corresponds to the tertiary septa, and has pores on each side which are distinct, regular, and apparently deep. There were fragments of corals collected which, if perfect, would have been twice the dimensions given.

CYATHOSMILIA ? TENUICOSTATA n. sp., pl. 2., fig. 3.

I give this name to a single specimen of a conical corallum with a rather broad, blunt, cylindrical pedicel, which is granular, and does not seem to have been adherent. *Costæ* corresponding with septa, granular

above, vermiculate below, equal in size and separated by rather broad, flat intercostal spaces. *Epitheca* pellicular, smooth, shining. *Septa* very much thickened at calicular margin exsert, closely and thickly granular. Systems six, cycles four, the fourth rudimentary, though its corresponding septa do not differ from the others. Primaries very thick; secondaries smaller; tertiaries rather thick, but not reaching more than half way to the centre. *Pali* high, broad, and granular; probably before all except the last; yet this is uncertain, as the coral is broken. *Columella? Calice* broadly elliptical, not deep. Dimensions—alt. 5, maj. diam. 6, min. $4\frac{1}{2}$. One broken specimen, in which the endotheca could not be well made out; but its general habit and appearance induces me to refer it to the *Astreidæ* rather than *Trochocyathus*, to which genus it would belong if there were no transverse interseptal dissepiments.

The next fossil in the collection has remarkable affinities and relations. It is a *Conosmilia* without an epitheca and simple granular costæ, but with a very remarkable columella, which terminates in two conspicuous round tubercles. This distinction is of generic value, and I propose a new genus for its reception. In reference to the peculiar columella, I shall designate it by the name of *Bistylia*.

BISTYLIA (new genus).

Simple corals, without epitheca, and a bistyliform columella.

There are two divisions in the Trochosmiliaceæ—(1) without any epitheca; (2) with epitheca. This genus belongs to the first, and is associated with *Lophosmilia*, *Parasmilia*, *Cœlosmilia*, having, like all these, scanty endotheca. The first-named, however, has a lamellar columella, the second a spongy one, and the third none. All three are upper mesozoic fossils, with one living *Cœlosmilia*. *Axosmilia* is one of the Trochosmiliaceæ, with a styliform columella, but it has a distinct epitheca.

BISTYLIA ADHERENS, n. sp., pl. 1, fig. 5.

*Corallum* small, more or less contorted, nearly always adhering by a large portion of its side, cylindrical, suddenly contracting to a point. *Costæ* small, rounded, granular, continuous, corresponding with septa, and alternating in size with them, broader than intercostal spaces, which have numerous concentric folds, probably the former margins of the corallum. *Calice* circular, generally a little contracted or bending in. *Systems*, six. *Cycles*, three. *Septa* slightly exsert; rather thick, granular, primaries largest, secondaries a trifle smaller, tertiaries half the size,

edges rounded or rendered sinuous by the granules. *Fossa*, moderately deep. *Columella*, two small rounded tubercles. Dimensions—Alt. from 4 to 8; diam., ·2½ to 3 millim. Six specimens, the most of which had on one side a calcareous cast of the shell to which they adhered, which was a small bivalve apparently.

Family Astræidæ.—Group Cladocoraceæ.

This division is distinguished by the budding which is lateral, and which remains always with its individuals more or less free forming tufts, but never giving rise to a massive corallum. The first genus is *Cladocora*, containing slenderly branching ramose corals, and which according to Professor Verrill is closely related in its polyps to the *Astrangiaceæ*. The corallites in this genus are cylindrical, very long, erect, and free laterally. They have an incomplete *epitheca*, which often unites one individual to another. The calices are circular and shallow. *Columella* papillary. There are six unequal systems all exsert, rounded, and finely toothed at their edges. *Pali* before all the *septa* except the last. *Wall* compact, moderately thick, and furnished with simple costa, which are granular, hispid, and straight.

The fossil figured is an interesting specimen of the genus, one not far removed from the well-known *Cladocora cespitosa* (Gualtieri), which is common in the Mediterranean Sea. Unfortunately the specimen is worn and broken so that the details cannot be made out satisfactorily. There are no perfect calices, and the branches are a good deal waterworn. I have very little doubt, however, that the species is new. It is thus described :—

Cladocora contortilis, n. sp., pl. 1, fig. 6.

*Corallum*, a very compact tuft of corallites of different dimensions turning around one another. *Branches* irregular, cylindrical, conical, or of equal thickness throughout, occurring at short distances and twisting round to coalesce with others and form a thick, matted, stony mass. *Epitheca* not visible. *Costæ* numerous, narrow, angular at the edges, granular and straight. *Septa* not easily made out, but apparently three thin cycles, some uniting or bending towards the others, and all apparently meeting the pali in the centre. *Wall* rather thick. *Endotheca* somewhat abundant, and, as well as I can judge, rather more abundant than is usual in the genus. *Dimensions*—Alt. 35, diam. of largest branches, 5; of the smaller ones, from 2, 2½ and 3 mil. The fossil appears to me to be very distinct from all existing or fossil species. In the bent and twisted form of the branches it may come nearest to *C. stellaria* (Edw. & H).

FAMILY ASTRÆIDÆ—GROUP ASTRÆACEÆ.

A very interesting, but very imperfect fossil form of *Plesiastræa*, is amongst the collection. The genus belongs to the *Astræaceæ* or corals which have a massive structure, the individuals being intimately united, but multiplying by budding. The main distinguishing feature of *Plesiastræa* is the possession of conspicuous pali, which, indeed, separates the genus clearly from every other species in the group. There are at most only eight species known, two of which are Australian, and one fossil. Three belong to the Pacific. In the species under consideration I am unable to speak very positively as to its character as the fragment is small and very much worn, in fact there is not a single perfect calice in the specimen. It has a very strong resemblance to *Plesiastræa Urvillei* in this that the calices are of equal size, and often oblong, in which respects it differs from *P. Peronii*, the form common on our coasts. Owing to the very complete details given by Messrs. Edwards and Haime in their diagnosis of the internal structure of *P. Urvillei*, which is living at King George's Sound, I am able to say that the fossil is new.

PLESIASTRÆA ST. VINCENTI, n. sp.

*Corallum* flat. *Calices* very slightly salient, very close, but with distinct borders, circular or compressed. *Costæ*, continuous with the septa, and projecting so as to unite at times with the contiguous ones of the next calice, prominent above the margin. *Systems*, six; *Cycles*, four; but the forth absent from some systems; primaries, secondaries, and tertiaries nearly equal, and extending to the pali, which are so worn that it would be hazardous to attempt details, except that they seem large. The edges of the septa seem to be dentate, much in the way that is figured in the "Annals des Sciences Nat.," (vol. x., plate 9, fig 2a), and the columella appears to be a few papillæ. In a vertical section the exothecal traverses are seen to be abundant, horizontal, and at irregular distances, but there are about 20 in 10 millimetres. The endothecal traverses are extremely irregular, thinner, sloping upwards at every angle, and giving rise to a cellular tissue. In both these particulars it differs remarkably from *P. Urvillei*. Diameter of calices, 3 rarely 4 millim.

Note.—This coral which was first brought to my notice by my pupil, Mr. Stirling Smeaton, occurs in large hemispherical, or flattish rounded masses; an imperfect lump measures seven inches in diameter, and from two to three inches in thickness. Locality—Hallett's Cove, St. Vincent's Gulf *(R. Tate)*.

Summary.—The general facies of these interesting corals is that of the Australian tertiary beds, as far as we are acquainted with them. None of the species are however known. Some of the genera have been found in other beds. These are—*Deltocyathus*, *Trochocyathus*, *Amphihelia*, and, doubtfully, *Conosmilia*. Our *Deltocyathus*, as already observed, is closely allied to, if not identical with, *D. italicus*. That species is common in the Cape Otway beds in Victoria, and is living in the West Indian Seas. It will require a careful comparison to determine if our fossil is the same. It is very abundant apparently at Aldinga. We have two species of *Trochocyathus* already described. Both are very distinct from the Aldinga species, which is much smaller, and has a well-marked basilar scar. We have one of the species living in the Port Jackson. Professor Duncan thinks that the genus can hardly be separated from *Deltocyathus*; but if my remarks on the absence of a true columella are found to hold good for all the species, the distinction is a justifiable one. *D. Tateanus* comes near to an existing form. The flattened character may, however, vary, as we see that in the case of *D. Aldingensis* these are features which vary much at different ages and for different individuals. In *Amphihelia striata* and *A. ziczac* we have two forms of *Oculinidæ*, which are of great interest. They are both closely related to our existing Australian *A. venusta*, but are very different from our tertiary fossil form, *A. incrustans*, which I venture to suggest would perhaps have been better placed in a genus by itself. Both the Aldinga fossils in their structure throw a remarkable light upon the mode of growth of these corals. We see not only that the calices fill up from below in some instances, but not at all in others, a circumstance clearly dependent upon the exigencies of the animal, or perhaps upon its size. This gives us a glimpse of the very artificial manner in which our great divisions of the *Madreporaria* are classified, and makes us fear that as the habits and economy of the animals and their stony dwellings are studied the whole arrangement will have to be remodelled. *Amphihelia* did not, as far as we know, make its appearance until the tertiary period. The *Oculinidæ* generally are entirely a recent family, extending to the Mesozoic rocks, but only four genera are found in them, and only two below the chalk. The only fossil species of *Amphihelia* known are those from Australia.

I have already observed the position that the new genera of *Trochosmiliaceæ* take in the classification. They are a series of simple corals with scanty endotheca, in which respect they are related to Upper Meso-

zoic forms rather than to any other. But our Australian corals are a group in themselves, with really no very strong affinities with any hitherto described. None of those have pali; some have an epitheca, and others are destitute of it, but the fossils amongst our Australian group which have any of these features are sure to differ in every other respect in a remarkable degree from them. It is, as I have already remarked, this natural extension that we might expect to which our systems of classification will have to submit, as our knowledge of the variation of the plan of nature becomes wider. It is on this account that we cannot form any conclusions, or at least any safe conclusions, as to the age of our beds from paleontological considerations alone. The resemblances to the fossils of tertiary ages in the northern hemisphere are few and of a trifling kind, while the differences are very numerous and wide. We are baffled by the difficulty of comparing things which have little or nothing in common. But while this is true, we may institute comparisons upon paleontological grounds alone between our various Australian deposits. Thus, this group of *Trochosmiliaceæ* shows us that the Aldinga formation has fossils which intimately connect it with the Australian group of tertiary rocks. No species can be identified with those already described, though one, *Conosmilia contorta*, may be only a variety. *Cyathosmilia* is a kindred genus with pali. *Bistylia* is a little more divergent, for it has distinct costa like *Parasmilia*, but with a bistyliform columella.

*Plesiastræa* is entirely a recent form, and we may say Australian as well, for the species described which are not Australian are either from the Pacific or Indian ocean. There is one fossil species known in the Belgian miocene. The fossil species here described is very close to our living form, now common on the same parts of the coast.

Though no existing species has been yet found, and though the genera even are, as far as we know, for the most part extinct, yet I think we are justified in calling the coral fauna an Australian Tertiary one — the forms of life approximate to a Mesozoic character, in my opinion, though I form it upon slight grounds, and I should say that we have one of our oldest tertiary fauna represented. The corals are partially such as would grow in a deep sea at the present time, but *Cladocora Plesiastræa* are merely litoral species, and probably also *Amphihelia*. There are no reef-building forms amongst them, for though the three last named are branched corals, yet they never grow to any size beyond insignificant tufts. They do not evidence a climate different from the present climate of South Australia, that is if the animals were subject

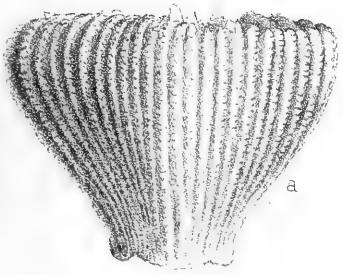
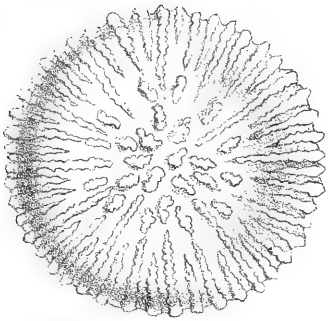



Fig. 1.



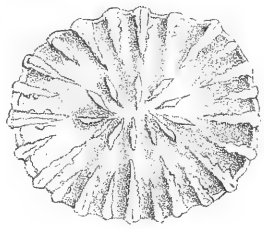




Fig. 2.

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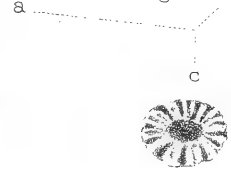


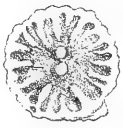
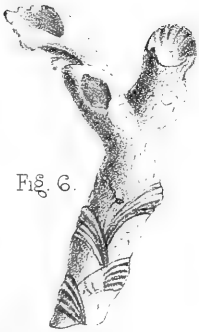



Fig 5b



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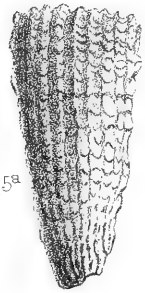

Fig 5a

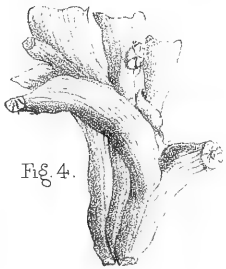

Fig. 4.

Wilson Woods, Delt

S.T. Leigh & Co Lith. Pitt St. Sydney.

Fig. 1. Deltocyathus aldingensis
" a. Coral. b. Calice.
Fig. 2. Cyathosmilia laticostata
" a. Coral. b. Calice c. Section
Fig 3. Conosmilia contorta.

Fig. 4. Amphihelia striata
Fig. 5. Bistylia adherens.
" a. Coral b. Calice.
Fig. 6. Cladocora contortilis.

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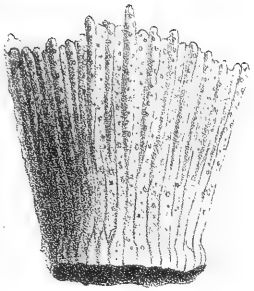
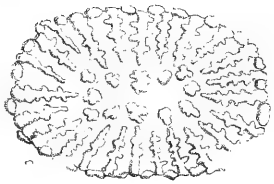


Fig. 1a

Fig. 1b

Fig. 3.



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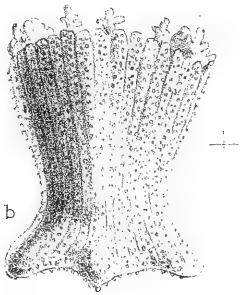

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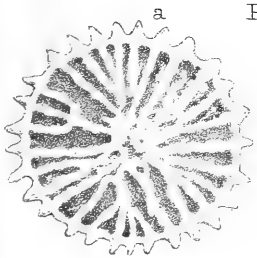

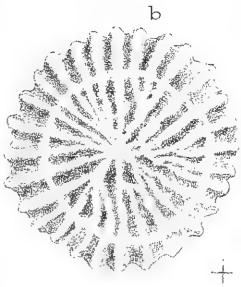

Fig 4.c

*ison Woods Delt*

*S. T. Leigh & Co Lith. Pitt St Sydney*

Fig. 1. Trochocyathus heterocostatus
" b. end View.
Fig 2 Amphihelia zigzac branch & Section
Fig 3 Cyathosmilia tenuicostata
a. Coral. b. Section

Fig. 4. Deltocyathus alatus.
" a. Calice. b. Coral.
Fig 4.c Deltocyathus alatus, (end View).
Fig. 5. Deltocyathus tateana.
" a Calice. b base

to such conditions of life as kindred animals would be now; but I think we should be cautious in forming any positive conclusions on this subject, as the most of the animals are so different from any we know. Besides, each species is subject to its own condition of life. Thus, I have found lately that a Millepora coral exists extensively on the extreme South of New Zealand. This is the only species known to me outside the tropics. If the species were found fossil, we should certainly say that it gave evidence in favour of a warm climate. Cumulative evidence from the whole forms of life are the only safe grounds on which climatical conclusions can be formed.

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## EXPLANATION OF PLATES.

### Plate I.

Fig. 1. *Deltocyathus Aldingensis*, a. coral, b. calice, both much enlarged.

Fig. 2. *Cyathosmilia laticostata*, a. coral, b. calice, much enlarged, c. section slightly enlarged to show the double septa.

Fig. 3. *Conosmilia contorta*, nat. size.

Fig. 4. *Amphihelia striata*, nat. size.

Fig. 5. *Bistylia adherens*, a. coral, b. calice, both enlarged.

Fig. 6. *Cladocora contortilis*, nat. size.

### Plate II.

Fig. 1. *Trochocyathus heterocostatus*, a. coral, b., end view of calice showing primary costæ; both much enlarged.

Fig. 2. *Amphihelia ziczac*, a. branch, b., another partly ground down to show secondary layer of dermic tissue.

Fig. 3. *Cyathosmilia tenuicostata*, a. coral, b. section.

Fig. 4. *Deltocyathus alatus*, a. calice, b. coral.

Fig. 5. *Deltocyathus Tateanus*, a. calice, b. base, both much enlarged.

# NOTES ON THE CORRELATION OF THE CORAL-BEARING STRATA OF SOUTH AUSTRALIA, WITH A LIST OF FOSSIL CORALS OCCURRING IN THE COLONY.

By Prof. Ralph Tate, Assoc. Linn. Soc., F.G.S., &c.

[Read September 17, 1878.]

The Tertiary Corals of Australia have been perseveringly and critically studied by Dr. Duncan and the Rev. J. E. Tenison Woods, and to them alone are we indebted for our knowledge of the no less than 42 species which are recorded by the latter author ("On Some Australian Tertiary Corals;" Trans. Royal Society of New South Wales, 1878) as constituting the coral fauna of Australian Tertiary times.

All the species hitherto known are derived from the Miocene (or Eocene) rocks of Western and Southern Victoria and Tasmania; not one being known from the equivalent strata in South Australia. In Dr. Duncan's paper some species are stated to have come from Mount Gambier; but Mr. Woods, who collected and forwarded the specimens, states that this was not the case, but that they were from the Tertiary beds of Muddy Creek, in Western Victoria. Dr. Duncan regards, moreover, South Australia as comprising the whole of that geographical division of the Continent of which Victoria forms a part; and consequently many of the Victorian corals have had incorrectly given to them a South Australian habitat.

In the foregoing paper twelve species new to science are established, all of which are from this province. These additions to the Tertiary coral fauna of Australia bring up the total to fifty-four. As other species occur with us, I thought this an opportune occasion to lay before you the results of my determinations in the form of a catalogue, and also to submit a summary of my observations on the geological strata from which the corals have been obtained.

Our tertiary strata, though very fossilferous are not generally in that state conducive to the preservation of their organic contents. Casts

of corals are not rare in the limestones and calciferous sandstones of the River Murray cliffs, at Mount Gambier, at Adelaide, and elsewhere. But certain beds forming part of the sea cliffs of Aldinga Bay, St. Vincent's Gulf, and at a few very circumscribed spots on the River Murray, contain corals as well as other forms of life in a good state of preservation. From these I have gathered 21 species, 7 from the Murray cliffs and 14 from the Aldinga series of beds.

The palælontological differences between the highly fossilferous portion of the Murray beds and that of the Aldinga rocks, so strongly marked in the case of the corals, has for some time past been regarded by me as indicative of a difference of age, the older series being the latter; and not due to difference of habitat. I do not intend on this occasion to substantiate this statement, but will content myself by pointing out the relative positions of our coral bearing strata.

A generalized section of the strata of the River Murray cliffs is as follows :—

1.—Lacustrine (?) sand and marls. No fossils, exceeding 60 feet in thickness.

2. Upper Marine Series ; shelly limestones (false bedded) and oyster beds, with occasional argillaceous and sandy bands. Rich in gasteropods and corals. About 50 feet thick.

3. Middle Marine Series ; usually a yellow calciferous sandstone ; 40-45 feet thick. Rich in echinoderms, brachiopods, pectens, and polyzoa.

4. Lower Marine Series.—Ferruginous sandstones and polyzoan limestones. Rich in echinoderms and brachiopods, but for the most part of different species to those in the upper beds.

The Upper Marine Series is the direct equivalent to the Muddy Creek beds, which are variously referred by the Victorian geologists to the Upper Eocene, Oligocene, and Lower Miocene, and which Mr. Selwyn (Quart. Journ. Geol. Soc, vol. xvi., p. 147, 1859) considers to be the oldest tertiary deposits in Victoria.

The Aldinga section admits of division into—

1. Lacustrine (?) clays. No fossils ; 48 feet.

2. Upper Series.—Calciferous sandstones and impure limestones, with oyster banks ; 22 feet.

3. Lower Series, consisting of beds of a most diversified character—clays, limestones, and sands rapidly replacing one another in horizontal and vertical extension ; not less than 80 feet. Corals occur in the clays and limestones.

Sections after this character appear in a length of coast-line of about 20 miles, extending from Hallett's Cove on the north to the south side of Aldinga Bay. The upper Aldinga series I place on the same horizon as the upper series of the Murray cliffs; and the lower Aldinga beds I regard as equivalent in part to the middle and lower Murray series, but on the whole inferior to them. The coral bed at Hallett's Cove is probably coterminous with the upper series of the Aldinga section.

The following list includes all known South Australian corals, corrected in accordance with the Rev. J. E. Tenison Woods's Paper "On Some Australian Tertiary Corals" (Trans. Roy. Soc., N.S.W., 1878):—

Lower Aldinga Series.

1. Trochocyathus heterocostatus (*T. Woods*). Clays at Blanche Point.
2. Deltocyathus Tateanus (*T. Woods*) " " "
3. " Aldingensis (*T. Woods*) " " "
4. Cyathosmilia latitcostata (*T. Woods*) " " "
5. " tenuicostata (*T. Woods*) " " "
6. Bistylia adherens (*T. Woods*) " " "
7. Conosmilia contorta (*T. Woods*) " " "
8. Flabellum distinctum (*Ed. and Haime*) " " "
   also in limestone at Port Vincent, Yorke's Peninsula. It is fossil at Cape Otway, Victoria, and is living in the Red and and Japan Seas, and off the north-east coast of Australia.
9. Amphihelia striata (*T. Woods*). Limestone bands in clays at Blanche Point, Aldinga Bay.
10. " zic-zac (*T. Woods*). Glauconitic limestones, north of Blanche Point.
11. Cladocora contortilis (*T. Woods*). Calciferous sandstones, in which the fossils are silicified, south side of the mouth of the River Onkaparinga.

Upper Aldinga Series.

12. Plesiastræa St. Vincenti (*T. Woods*). In a conglomerate bed, Hallett's Cove, St. Vincent's Gulf, 12 miles south from Adelaide.
13. Plesiastræa sp., Hallett's Cove.
14. Conotrochus typus (*Sequenza ?*), Hallett's Cove.

Upper Murravian Series.

15. Sphenotrochus Australis (*Duncan*). River Murray Cliffs; and Muddy Creek.
16. Flabellum Victoriæ (*Duncan*). River Murray Cliffs, and well-sinking, 21 mile camp north from North-West Bend; also, at Muddy Creek.
17. Placotrochus deltoideus (*Duncan*). Very common. River Murray cliffs, and '21 mile camp.' Occurs at Muddy Creek, Hamilton, Victoria, and Table Cape, Tasmania.
18. Antillia lens (*Duncan*). River Murray Cliffs, and Muddy Creek.
19. Balanophyllia Australiensis (*Duncan*), River Murray Cliffs, and '21 mile camp;' also Muddy Creek.
20. Deltocyathus viola (*Duncan*). River Murray Cliffs, five miles south from Nor'-West Bend; also Muddy Creek.
21. " alatus (*T. Woods*). R Murray Cliffs.

# SUBTERRANEAN DRAINAGE IN THE INTERIOR.

By T. E. Rawlinson, C.E.

Communicated by C. Todd, C.M.G. [Read September 17, 1878.]

[Abridged.]

The author states the object of his Paper to be to enquire into the cause of the disappearance of the vast bodies of river water which collect on the inner watershed of the bordering coast ranges of Australia, and considers this can only be accounted for by their absorption into porous beds of sand, gravel, &c., under the tertiaries occupying the interior basin of the Continent.

To facilitate such enquiry, the author suggests that the Philosophical Society should collect geological data supplied by the sinking of wells and dams in various parts of the country. He then notes the following facts :—

The Murray River, before receiving the Ovens, flows with a volume of 2,660¾ cubic feet per minute. The Ovens River contributes 596½ cubic feet per minute, but with this addition the volume of the water of the River Murray, below the junction with the Ovens, is only 2,975 cubic feet, instead of 3,260¼ cubic feet, which is the amount of the Murray with the volume of the Ovens River added, but, further down the River Murray is diminished to 2,411 cubic feet, just before it receives the River Goulburn. Now here is a distinct loss of 850 cubic feet of water per minute in a course of a few miles.

The rivers of the north watershed of Victoria, such as the Loddon, Campaspe, Avon, Avoca, Richardson, and Wimmera, which yield vast quantities of water in the wet season, and near their sources are perennial streams, fail to have a volume at all in the lower part of their course as they approach their outlet in the River Murray during the summer season.

The northern watershed of Victoria, during the year, from only a portion of its area (about two-thirds), yields between two to two and a half millions of cubic yards of water, of which one million is available for conservation and use if suitable works are undertaken for that purpose ; but at present the large proportion of these waters are wasted in flooding adjacent lands in temporary floodings of the River Murray, and a large proportion is unaccounted for.

In addition to the watershed of Victoria above referred to, we have the vast area of New South Wales, Queensland, and South Australia, from or into which flow the Murrumbidgee, the Lachlan, and the Darling as feeders of the River Murray ; the Barcoo, Cooper's Creek, and other large streams which empty themselves at nowhere in particular in the interior, and yet in some seasons convey vast volumes of water down their channels.

It has been hitherto a most convenient explanation of the phenomenon of the disappearance of these large volumes of water that they are evaporated, and in the case of the River Murray and its tributaries that they pass away to the sea ; but neither of these causes is sufficient to produce the results alleged. It is true that on the level plains of the interior evaporation may be a very large element of dissipation of the rainfall ; but it does not apply in the same manner to the mountain ranges, where the great bulk of the water falls, and even on the plains evaporation can only take place when there is moisture to be acted upon, consequently during long droughts radiation of heat from the ground may be excessive ; but it abstracts no moisture from that which has already been dessicated, and when heavy rains do fall the ground is rapidly cooled, radiation and its consequent influence in evaporation is checked, and much of the water passes into the ground or away to the natural drainage channels, and on the ceasing of the rain and the return of clear cloudless sky, there is a reduced area over which evaporation can take place. I have more particulary noted these matters owing to the persistence with which the disappearance of our interior river waters have been attributed to evaporation. This last is a large and important item for consideration in all questions of Hydrography in Australia ; but it is only one, and does not account fully for all the observed phenomena.

The example I have given of the River Murray is a good illustration of the position which I have assumed, namely, that evaporation and sea outlets are but element, but do not embrace the whole. Here we have a

river having a volume of 2,663¾ cub. ft. receiving another river having a volume of 596½ cub. ft., and yet about 50 miles lower down in its course its volume is only 2,411 cub. ft., being 850 cubic feet less than it was above. It needs no very profound reasoning to arrive at the conclusion that such a sensible loss (rather more than one-fourth of the gross volume) cannot be accounted for by the ordinary process of soakage or evaporation; and the inference to be drawn is exceedingly strong that there exists natural features, which favour the theory that the waters seek an underground absorbent or outlet for the missing volume. It is no strange thing in Australia that in certain places, where beds of limestone exist, there are caverns and subterraneous watercourses, but, singular as these appear, and real in fact, they do not satisfy the question of what becomes of the rain which annually falls on the inland slopes of this Continent, the large portion of which does not reach the ocean by ordinary river channels.

The knowledge that so large a part of the interior of Australia is tertiary, resting at its edges on older strata, except in one instance where it touches the Southern Ocean, gives some clue to the formation of a theory which may account for the disappearance of the waters, and, I believe, will ultimately be proved to be the storage reservoir where is conserved the rain and river waters which other theories fail to account for. There is one thing certain, which, if it be granted, that vast volumes of water disappear from our river systems they cannot pass to the sea by way of Victoria, New South Wales, Queensland, the Northern Territory. or Western Australia, owing to the land being edged round with primative impervious rocks, and the possibility of escape at the only visible outlet—namely, the south-east part of South Australia is very improbable owing to the want of all evidence of such outflow in the Southern Ocean, which skirts our shores.

Consequent on the deductions made from the above line of reasoning and known facts, I feel confident that in and below our central tertiaries there exists abundant supplies of water if sought for with a reasonable degree of care and skill.

It is quite possible that there may be one or two mistakes or failures at the outset, but that should not deter us from following up the question to a successful issue. And once establish the existence of these water supplies in unlimited quantities at reasonable cost the future of this country is assured as one that must take the lead in wealth and prosperity, and possibly the central state of a federated Australia.

## LIST OF MEMBERS, SEPTEMBER 30TH, 1878.

Those marked (F) were present at the first meeting when the Society was founded. Those marked (L) are Life Members. Those marked with an asterisk have contributed papers.

### HONORARY MEMBERS.

| | | Date of Election. |
|---|---|---|
| Barkely, Sir Henry G.C.M.G., K.C.B. | .. | 1857 |
| Ellery, R. L. J., F.R.S. | .. Observatory, Melbourne | 1876 |
| *(F) Feignagle, C. G. | .. Melbourne | 1853 |
| *Garran, A. LL.D. | .. Sydney | 1853 |
| *Hull, H. M. | .. Hobart Town | 1855 |
| Jervois, H. E. Sir W. F. D., G.C.M.G., C.B. | ... Government House | 1878 |
| Little, E. | .. | 1855 |
| Macleay, W., F.L.S. | .. Sydney | 1878 |
| Russell, H. C., B.A., F.R.A.S. | Observatory, Sydney | 1876 |
| Warburton, Col. P. Egerton | .. Beaumont | 1858 |
| *Wilson, C. A. | ... Supreme Court | 1853 |
| *Woods, Rev. J. E. T., F.L.S., F.G.S., &c. | .. Sydney | 1877 |
| (F) Young, J. L. | ... Parkside | 1853 |

### CORRESPONDING MEMBERS.

| | | |
|---|---|---|
| *Hayter, H. H., F.S.S. | ... Government Statist, Melbourne | 1878 |
| *Scoular, Gavin | .. Blair, Smithfield | 1878 |
| *Tepper, Otto | .. Ardrossan, Yorke's Peninsula | 1878 |

### ORDINARY MEMBERS.

| | | |
|---|---|---|
| Adamson, Adam, jun. | ... Angas-street | 1878 |
| *Adamson, D. B. | ... Angas-street | 1867 |
| Angas, J. H. | ... Collingrove, Angaston | 1874 |
| Baker, Richmond | ... Page-street, off Gouger-street | 1868 |
| Bagot, U. N. | ... Melbourne-street, N. Adelaide | 1877 |
| Biggs, Col. | ... Victoria-square | 1878 |
| *Bonney, Chas., S.M. | ... Glenelg | 1855 |
| Brookes, Joseph | ... Absent from Colony | 1877 |
| Brunskill, George | ... Messrs. Stilling & Co., Grenfell-street | 1878 |
| Bundey, W. H. | ... Pirie-street | 1876 |

| | | |
|---|---|---|
| Burgan, T. .. | Gilles-street | 1858 |
| *Campbell, Hon. Allan, M.D. M.L.C. | North-terrace | 1867 |
| *Chalwin, Thos. ... | St. John-street, South-terrace | 1877 |
| Chapple, F., B.A., B. Sc. ... | Prince Alfred College | 1876 |
| *Clark, A. S. | Grenfell-street | 1853 |
| (L) Cooke, E., M.P. ... | South-terrace | 1876 |
| Crawford, F.S. ... | Surveyor-General's Office | 1865 |
| *Davenport, S. ... | Beaumont | 1856 |
| Davidson, Rev. Professor, University of Adelaide ... | Jeffcott-street, N. Adelaide | 1876 |
| Dobbie, A. W. ... | Gawler-place | 1876 |
| Duffield, W. ... | Gawler | 1859 |
| Dumas, V. E. R. ... | King William-street | 1877 |
| Elder, Sir Thomas ... | Grenfell-street | 1871 |
| Farr, Rev. G. H., M. A. ... | St. Peter's College | 1876 |
| *Finniss, Hon. B. T. ... | Stanley-street, N. Adelaide | 1873 |
| *Fletcher, Rev. W. R., M.A.... | North-terrace, Kent Town | 1876 |
| Gall, D. ... | Tynte-street, N. Adelaide | 1865 |
| *(F) Gosse, William, M.D. F.R.C.S. ... | North-terrace | 1853 |
| Gosse, Chas., M.D. ... | North-terrace | 1877 |
| Goyder, G. W., Surveyor-General ... | Government Offices | 1862 |
| *Gunson, J. M., M.D. ... | Kent-terrace, Norwood | 1877 |
| *Hamilton, George, Commissioner of Police .. | Adelaide Club | 1868 |
| Harrold, Arthur .. | Hindley-street | 1876 |
| Harry, Thos. .. | Penn Chambers | 1878 |
| Hay, Hon. Alexander, M.LC. | Beaumont | 1861 |
| Hickson, R., M.I.C.E., Engineer of Harbours and Jetties .. | Unley | 1876 |
| *Hill, W. .. | Kensington-road | 1874 |
| *Hosking, J. .. | Brown-street | 1855 |
| Hull, W. B., C.E., Assistant Hydraulic Engineer .. | Hydraulic Engineer's Office | 1874 |
| *Ingleby, R., Q.C. .. | Carrington-street | 1861 |
| Johnson, J. A. .. | Alfred Chambers, Currie-street | 1875 |
| *(F) Kay, R., Secretary South Australian Institute .. | College Town | 1853 |
| Knevett, S. .. | Carrington-street | 1878 |
| *Lamb, Prof. Horace, M.A. University of Adelaide .. | Medindie | 1876 |
| *Laughton, E. .. | 59, King William-street | 1874 |
| Lee, S. E. H., Government Surveyor .. | Survey Office, Adelaide | |
| Light, G. T., Government Architect .. | Government Architect's Office | 1873 |
| *Lloyd, J. S. .. | Lefevre-terrace, N. Adelaide | 1856 |
| *Macgeorge, Jas. .. | Green's Exchange | 1855 |
| Magarey, T. .. | Enfield | 1861 |
| Magarey, A. T. .. | Barton-terrace, N. Adelaide | 1873 |

| | | | |
|---|---|---|---|
| *Magarey, S. J., M.B. | .. | North-terrace | 1874 |
| Mayo, G., M.D. | .. | Morphett-street | 1853 |
| Mayo, G. G., C.E. | .. | West-terrace | 1874 |
| *Murray, A. | .. | Coromandel Valley | 1858 |
| (L) Murray, David | .. | Hutt-street | 1859 |
| Nesbit, E. P., jun. | .. | Gilles-street | 1875 |
| *Ponton, T. G., F.Z.S. | .. | Belgrave-Terrace, Victoria-square | 1877 |
| Rees, Rowland, C.E. | .. | Waymouth-street | 1874 |
| Riddoch, J. | .. | Yallum Park, Penola | 1866 |
| Ringwood, A., Assistant Observer | .. | Adelaide Observatory | 1878 |
| *Rutt, Walter, C.E. | | Engineer-in-Chief's Office | 1869 |
| Salom, M. | .. | Lefevre-terrace, N. Adelaide | 1866 |
| Sawtell, Dr. T. H. | .. | North Adelaide | 1878 |
| *Schomburgk, R., Dr.Ph., &c., Director | ... | Botanic Gardens | 1865 |
| *Smeaton, T. D. | ... | Bank of South Australia | 1857 |
| Smith, R. Barr | ... | Torrens Park, Mitcham | 1871 |
| Sparks, Hy. | ... | Glenelg | 1878 |
| Stuckey, J. J., M.A. | ... | Victoria Chambers, King William-street | 1878 |
| *Tate, Prof. Ralph, F.G.S. (University of Adelaide) | ... | Buxton-street, N. Adelaide | 1876 |
| Thomas, J. Davies, M.D. | ... | North-terrace, Glenelg | 1877 |
| Thomas, R. G., Sec. Board of Health | ... | Unley | 1877 |
| Thow, W. | ... | Locomotive Department, S. A. Railways | 1878 |
| *Todd, Chas., C.M.G., F.R.A.S., M. S. T. E., Postmaster-General, Observer, and Superintendent of Telegraphs | ... | Observatory | 1856 |
| Tomkinson, S. | ... | Bank of Australasia | 1876 |
| Townsend, W., M.P. | ... | King William-street | 1878 |
| Verco, Joseph C., M.D. | ... | Wellington-square, N. Adelaide | 1878 |
| Vickery, G. | ... | Meadows | 1868 |
| Ware, W. L. | ... | Victoria Chambers, King William-street | 1878 |
| *Waterhouse, F. G., C.M.Z.S., &c., Curator of Museum | ... | S. A. Institute | 1859 |
| Way, His Honor S. J., C.J. | | North Adelaide | 1859 |
| Way, Dr. E. | ... | North-terrace | 1878 |
| Wragge, —, F.R.G.S. | ... | Care of R. Ingleby, King William-street | 1877 |
| Wyatt, Wm., M.D. | ... | Burnside | 1859 |

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ASSOCIATE.

| | | | |
|---|---|---|---|
| Smeaton, Stirling | ... | Medindie | 1878 |

# RULES.

## ADOPTED MAY 21, 1878.

WHEREAS "The Adelaide Philosophical Society" is incorporated with the South Australian Institution, under the provisions of the South Australian Institute Act, 1863, and it is desirable to consolidate and alter the Rules and Regulations at present existing, it is therefore agreed that the Society shall be governed by the following Rules and Regulations, to the exclusion of all previous rules and regulations:—

1. The title of the Society is "THE ADELAIDE PHILOSOPHICAL SOCIETY."

2. The objects of the Society are the diffusion and advancement of the arts and sciences by the meeting together of the members for the reading and discussion of papers connected with the above subjects, and by other approved means.

3. The Society shall consist of the present members, and of such persons as shall be hereafter elected members.

4. The members shall be classed as follows:—Ordinary Members, Corresponding Members, Honorary Members, and Associates, all of whom shall be elected by ballot.

5. His Excellency the Governor of South Australia for the time being shall be requested to be the Patron of the Society.

### FEES.

6. Ordinary members shall subscribe £1 1s. per annum, payable in advance on the 1st day of November to the Honorary Secretary.

7. A member may at any time compound for future annual contributions, that of the current year exclusive, by the payment of the sum of £10 10s.

8. Ordinary members elected during the first half of the financial year shall, within one month after election, pay the full annual subscription of one guinea; but if elected during the second half of the year, they shall pay the sum of half a guinea only as subscription for the remainder of the financial year.

9. Any person who has not paid the year's contribution on or before the 1st day of January shall cease *ipse facto* to be a member of the Society; provided always, that written application for the same shall first have been made by or on behalf of the Treasurer; and provided also, that the Council shall have power to restore the defaulter's name at his request, and after payment of arrears.

### ELECTION OF ORDINARY MEMBERS.

10. Every election of a member into the Society shall take place at an Ordinary Meeting only.

11. Every candidate for admission into the Society must be recommended by two members. The certificate setting forth the names, address, and occupation of the candidate, with the names of his proposer and seconder, shall be sent to the Secretary, and shall be read at a Meeting of Council, and also at the following meeting of the Society, and the ballot shall take place at the next following Ordinary Meeting of the Society.

12. The election of members shall be by ballot, one negative in six excluding; and no candidate having been excluded shall be again proposed for admission during the current year.

13. Persons elected shall have immediate notice thereof transmitted to them by the Secretary, accompanied with a copy of the Rules.

14. Members have a right to vote at all meetings to propose candidates for admission into the Society and into the Council of the Society, subject to the Rules touching the election and constitution of the Society. They are eligible to be members of the Council, and shall have access to the library, and shall be furnished with a copy of any transactions, proceedings, or journal which may be published by the Society.

### Honorary and Corresponding Members.

15. The Honorary Members shall be persons distinguished for their attainments in science, literature, or art.

16. The Corresponding Members shall be persons residing beyond ten miles from Adelaide, who, by furnishing papers or otherwise, may have promoted the objects of the Society.

17. Every person proposed as an Honorary or Corresponding Member shall be recommended by the Council, and be balloted for as in the case of ordinary members.

18. Honorary or Corresponding Members shall be exempted from payment of fees; they may exercise the privileges or perform the duties of an Ordinary Member, except that they shall not vote or otherwise interfere in the business of the Society, or hold office or seat on the Council.

### Associates.

19. Associates shall consist of young men of not more than 21 years of age, and of ladies.

20. Associates shall subscribe 5s. per annum, payable in advance on the 1st day of November, to the Honorary Secretary.

21. The election of Associates shall be after the same manner as in the case of ordinary members.

22. Any Associate failing to pay his or her subscriptions within one month of notice of election, or who shall be three months in arrear with his or her subscription, shall cease to be an associate.

23. Associates shall enjoy all the privileges of members excepting those of taking part in the management of the affairs of the Society, of voting, and of introducing visitors.

24. Any Associate shall be entitled to become an ordinary member of the Society at the first ordinary meeting following the receipt of his application for membership.

## Meetings.

25. Meetings of the Society shall be convened by circular to the members resident in the colony. The circular shall state the subjects to be brought before the meeting, the names of the candidates for membership, and any notice of motion.

26. Meetings of the Society shall be held on days to be fixed by the Council; and as far as practicable one meeting shall be held in each month. Each meeting to commence at half-past 7 o'clock p.m.

27. The President, or in his absence one of the Vice-Presidents, shall take the chair; and in the event of the absence of all the above, the members present shall elect a Chairman.

28. The business at the Society's meetings shall be transacted in the following order, unless it be specially decided otherwise :—

I. The reading and confirming the minutes of the last meeting.
II. The nomination of candidates for membership and associateship ; and the election of members and associates.
III. Vacancies among officers, if any, to be filled up.
IV. The transaction of the ordinary business.
V. Motions to be considered, and notices of motion for next meeting to be read.
VI. The consideration of any special matters which members may desire to bring forward subject to the approval of the Chairman obtained before the commencement of the meeting.
VII. At 8 o'clock the paper or subject notified in the circular shall be read.

29. Any member shall be allowed to introduce two visitors upon entering their names in the Visitors' Book. But no visitor shall speak at a meeting of the Society unless specially invited to do so by the Chairman.

30. No paper shall be read at any meeting which has not been previously notified to the Council.

31. Every paper read before the Society shall be the property thereof, and immediately after it has been read shall be delivered to the Secretary and shall remain in his custody.

32. An annual general meeting of members duly convened by circular shall be held in the month of October at half-past 7 o'clock in the evening, on such day as the Council may appoint. In the event of less than ten members being present, it shall not be lawful for the meeting to proceed to business except for the purpose of adjournment, and the meeting shall stand adjourned to a day and time then resolved upon.

33. At the adjourned meeting the members then present may proceed to business although ten members may not be present.

34. The Council shall call a special meeting of the Society, on receiving a requisition in writing, signed by ten members of the Society, specifying the purpose for which the meeting is required, or upon a resolution of its own. No other business shall be entertained at such meeting. Notice of such meeting, and the purpose for which it is summoned, shall be sent to every member, at least seven days before the meeting. Ten members to form a quorum.

35. One member of the Society, not being a member of the Council, shall be chosen at the meeting of the Society next before the month of October in each year as auditor of accounts and balance-sheet of the

Society, and shall examine and certify the same prior to the meeting in October.

THE COUNCIL.

36. The officers of the Society shall be a President, two Vice-Presidents, a Treasurer, and a Secretary, who, with four other members, shall constitute the Council.

37. The Council, on its first meeting, shall appoint one of its members to represent the Society at the Board of Governors of the South Australian Institute.

38. The Council shall have the management of the affairs of the Society.

39. The Council shall meet once in every month for the transaction of business at such time and place as may be appointed. Special meetings of the Council may be convened at any other time on the authority of the President, or of three members of the Council. Due notice of all Council meetings to be sent to each member.

40. No business shall be transacted at any meeting of the Council unless at least four members of the Council are present; in case of equality of votes the Chairman shall have an additional or casting vote.

41. It shall be the duty of the Council to decide on the papers to be read at the monthly meetings, whether by members or non-members; to determine as to the publication, in whole or in part of any paper so read; to prepare a report of the proceedings of the Society for the preceding year, and a balance-sheet of the Society's funds, for presentation at the meeting of the Society held in the month of October; and generally to transact the ordinary affairs of the Society.

42. Any member of Council personally interested in a question before the Council, shall withdraw during its consideration.

43. Every vacancy in the Council shall be immediately filled up at the next meeting of the Society, and by election by ballot. The member, so elected, shall occupy the place of the retiring member.

44. Any member of Council absenting himself from three consecutive ordinary meetings of Council, without satisfactory explanation, shall be considered to have vacated office, and the election of a member, to fill his place, shall be proceeded with in accordance with Rule 43.

ELECTION OF OFFICERS AND MEMBERS OF COUNCIL.

45. All Office-bearers and Members of Council shall retire from office annually at the general meeting in October.

46. The officers and members of Council, so retiring, shall be eligible for the same or any other office.

47. The President, the two Vice-Presidents, Treasurer, and Secretary shall be separately elected by ballot (should such be demanded) in the above-named order, and the four vacancies in the Council shall be filled up together by ballot at the general meeting in October.

SECRETARY.

48. It shall be the duty of the Honorary Secretary to attend and take minutes of the proceedings of the Society and Council respectively, to make the necessary arrangements for meetings, to issue the required notices, to collect the annual subscriptions and to pay them to

the Treasurer, to take charge of all the property under the control of the Society; and generally to transact the ordinary routine business of the Society.

TREASURER.

49. It shall be the duty of the Treasurer to receive all funds belonging to the Society, to pay all accounts approved by the Council, and to render annually an account of all moneys received and expended during his year of office.

ALTERATION OF RULES.

50. The Rules and Regulations of the Society shall not be altered unless a written notice of motion, signed by not less than five members, be given at a meeting of the Society; and thereupon such motion may be brought forward at the next meeting.

51. Any resolution passed as above altering or repealing the Rules and Regulations of the Society shall be in force until the meeting held in the month of October following; and, if not then confirmed, shall thereafter be held void and of no effect.

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## BYE-LAWS RELATING TO COMMUNICATIONS TO THE SOCIETY.

1. Every paper which it is proposed to communicate to the Society shall be forwarded to the Hon. Secretary for the approval of the Council at least fourteen days before the date of the meeting at which it is desired to be read.

2. The Council may permit a paper written by a non-member to be read if communicated through a member.

3. In the absence of the authors papers shall be read by the Hon. Secretary.

4. No paper or other communication read before the Society shall be published without the consent of the Council.

5. The Council shall decide, not later than at its meeting next following the reading of a paper, whether it shall be printed in the transactions, and if not, such paper shall be returned, if desired, to the author.

6. All communications intended for publication by the Society shall be clearly and legibly written on one side of the paper only, with proper references, and in all respects in fit condition for being at once placed in the printer's hands.

7. In order to ensure a correct report the Council request that the paper shall be accompanied by a short abstract for newspaper publication.

8. The author of any paper which the Council has decided to publish will be presented with twenty copies, and he shall be permitted to have not more than one hundred copies printed on making application, as per annexed form, to the Hon. Secretary, and on paying the cost of such extra copies.

9. A proof corrected by the MS. shall be submitted to the author, who shall be allowed to make any reasonable amendments therein upon paying the cost of the alterations.

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Printed at the "Advertiser" General Printing Office, Adelaide.