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1889.

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Royal Society of Victoria.

ANNUAL MEETING,

THURSDAY, MARCH 14, 1890.

SHORT ADDRESS ON THE PROGRESS IN ASTRONOMY DURING 1888–1889.

By R. L. J. ELLERY, F.R.S., F.R.A.S.

In pursuance of an arrangement made by your Council, that at our annual meeting an endeavour should be made to lay before the members a popular and brief outline of the progress in various branches of science during the past year, I have undertaken to give a short account of the principal items in the year's advance in astronomical knowledge. Although there is nothing very thrilling or remarkable to record, there are many points of considerable importance and interest, some of which we recognise as steps towards a better knowledge of the constitution of the universe and of individual parts of the solar system, as well as of the tenants of space in regions beyond.

The large number of comets that come under our observation every year now, as compared with former years, must not be regarded as evidence of the existence of a greater number than formerly, but of the fact that the heavens are now so closely scrutinised, that but few which come to perihelion, escape detection. During the year 1888, no less than six were discovered, viz. :—

(*a*)	Sawerthal's Comet,	discovered at Cape,	February 18.
(*b*)	Eucke's ,,	re-discovered,	August 3.
(*c*)	Brooks' ,,	,,	August 7.
(*d*)	Fayes' ,,	,,	August 9.
(*e*)	Barnard's ,,	Lick Observatory,	September 3.
(*f*)	Barnard's ,,	re-discovered	October 31.

The relation of comets to meteor streams is now pretty firmly established, but exactly what that relation is, still remains to be determined. Meteor streams in distant parts of their orbits have been seen as comets, but whether all comets themselves are an aggregation of meteors, or meteor streams disintegrated comets, is yet a matter for speculation. Mr. Lockyer has lately propounded a new hypothesis of the heavenly bodies, which may probably lead to new directions of enquiry, and further knowledge in this respect. His idea is that space is a plenum of meteoric particles, mostly moving in groups or swarms in regular orbits. These orbits sometimes intersect, giving rise to collision of particles, and to the formation of new and lesser orbits, and so forming a rotating agglomeration of meteoric matter, with evolution of heat and light, becoming visible as a nebula or nebulous star, and perhaps eventually as a concrete star itself. Nebulæ, comets, and nebulous stars are considered all of the same kind of matter under different conditions of motion of constituent particles, and consequently under different temperatures, as shown by spectroscopic characteristics. If Mr. Lockyer's great hypothesis be correct, we must conclude that all the heavenly bodies are made of the same stuff, under different conditions of sparseness of distribution, motion of constituent particles, and temperature. A comet, a nebula, or the planet Saturn for instance, would be of similar matter under differing conditions.

There has been a good deal written about the discovery of strange appearances in Mars, and we have read sensational articles of canals, martial inundations, &c., with all the flights of imagination of clever newspaper writers, who dress up the bare cold facts of the astronomer in a tempting garb for the popular reader. The facts are briefly as follows:— Several veteran observers with large telescopes, have recently spent much time in a continuous scrutiny of the planet Mars, during the periods of his nearest approach to the earth, and more especially at the approach in the early months of 1888. The appearances of a network of dark

lines and of changes in these lines have presented the most interesting features to the observers. These lines or "*canals*" as they are called, appear to overspread the brighter parts or continents of the planets. The markings are stated to have been seen to change under observation, the so-called canals to "germinate" or split off, leading some to the suggestion that they are actually artificial works in progress! Enormous inundations of portions of the planet's surface are also stated to have been seen. The great Lick telescope was devoted to observations of these appearances in July and August, and photos of rough drawings are on the table. There can be no doubt about the appearances, but there is about the interpretation of them. Astronomers generally, I think, are "waiting" for further developments, for there are insuperable difficulties in accepting the explanations already ventured upon. It is more than probable that all these appearances will eventually be attributed to diffraction or optical effects from conformation of vaporous surroundings of the planet, rather than of any objective change in its surface.

The great Lick telescope, the largest refracting telescope yet constructed, with an aperture of thirty-six inches, and a focal length of fifty-six feet, was first pointed to the heavens on January 3, 1888, but could not be really used till July 16th following, owing to the freezing of the hydraulic gearing. So far, I think it has proved itself, not only the biggest, but the best telescope in the world, if one can judge of its work that has been put before us, especially the drawings of some of the planets. This giant refractor, it appears, is not long to enjoy the reputation of being the largest refractor in the world, for it is now proposed to build an observatory at Los Angelos in Southern California, on Wilson's peak, 6000 feet high, which is to have a telescope of forty-two inches aperture. If this comes to pass, California will be able to boast of having the two largest refracting telescopes in the world. Speaking of telescopes, I may inform our members that the Melbourne Reflector is

still under repair, the work of repolishing the mirrors, after twenty years' work, was commenced in May last, but the preparations and practice landed us in the hot summer weather before the operation was completed, and the work had to be deferred till cooler weather prevailed, for polishing cannot be attempted so long as we are subject to temperatures of 80 to 90 and over. The work will be recommenced in about a week, and if all goes well, I hope to have the telescope at work again by May.

Preparations have been pushed on for commencing the international work of obtaining photographic charts of the heavens, if possible, during the current year, but I fear that the most than can be accomplished under the most favourable circumstances, will be "to get ready" to commence early in 1890. The photographic telescope for Melbourne is well advanced, and the building for its reception will be erected shortly. In the meantime, many improvements are being made in the methods to be adopted, and beautiful photographs have been got of faint nebulæ and other objects which have hitherto been considered "out of range" of the sensitive film.

The lunar tables hitherto used have been found insufficient, and the most recent ones, viz., those of "Hansen's," after a long period, it is found the tabular and observed places of the moon differ very considerably, showing that some disturbing causes have not been sufficiently allowed for in their construction. Some years ago, Sir George Airy (late Astronomer Royal), then over 70 years of age, undertook the development of a new lunar theory, a work of great magnitude and mathematical intricacy. In November last, he communicated to the Royal Astronomical Society, the fact that he had discovered an error which had crept into the earlier part of his work, that would necessitate attacking it from the beginning, but that with advancing years (now 88) and failing strength, he could scarcely hope to bring it to a satisfactory conclusion. It is to be hoped, however, that some others will take up this important work, so

intrepidly begun by our old Astronomer Royal in the evening of his life.

During the year, two men who had made their mark in the astronomical arena, have passed away, Richard A. Proctor, the well-known author of many astronomical works (though not a practical astronomer), and Editor of the periodical *Knowledge*, died of yellow fever in New York, on 12th September. J. C. Houzean, Honorary Director of the Royal Observatory, Brussels, author of *Uranometric Generale Vade Mecum de l'Astronomie and Bibliographic Generale de l'Astronomie*, died July 12, 1888, at the age of 68.

SHORT ADDRESS ON THE CHEMISTRY OF TO-DAY.

By Professor Orme Masson.

I fancy it will be best not to attempt to do what is impossible—to give you an account, in the ten minutes at my disposal, of the results of the chemical researches of the past year. I shall rather try to indicate some of the great problems in the science which still await solution, but towards the solution of which something has been contributed by recent important investigations.

The phrase "modern chemistry" has been used in many senses. It carries us back to 1661, or thereabouts, when we hear Boyle described as the "Father of Modern Chemistry;" to the end of last century, when Lavoisier is credited with having founded modern chemistry by his enunciation of the correct theory of combustion; and there are not wanting chemists who would make the science much younger by

dating its birth from the publication of their own text-books. From my present point of view, I would ask you to go back to the year 1863 as the date of the beginning of new things—to the year when Newlands first gave us the true principle for the classification of the elements—a principle afterwards extended by Lothar Meyer, Mendeleieff, and others, and now so well known as the Periodic Law. This is by far the grandest and most fruitful and far-reaching generalization of the past quarter century. It underlies much of the most important work of the present and of the future.

If the known elements be arranged in the order of their atomic weights, from hydrogen (1) to uranium (239), along a horizontal line, that line may be cut up into sections and these sections may be placed each below the last, in such manner that the elements which naturally resemble one another—which form a natural group—always fall in the same vertical line. To put it in another way—and a better way—we can construct a curve of which the magnitudes of the atomic weights are the abscissæ and those of any property capable of exact measurement are the ordinates; and we find that the curve, representing variation in the intensity of the property, is of a periodic character, and that similar elements occupy similar positions in the different periods.

The properties of the elements (including the properties of their compounds) are therefore functions of the atomic weights. It follows from this, that it is highly desirable that our knowledge of the atomic weights of all known elements should be as exact as possible.

The unit generally adopted as the standard for atomic weights is H = 1. But almost all actual determinations of atomic weights of other elements involve the previous knowledge of the value of O, or of the ratio O : H. This may be called the fundamental ratio, which underlies all others. If our knowledge of that ratio be inexact, then all deduced ratios, all our atomic weights, will be inexact in proportion, and the greater the atomic weight the greater will be the

actual error. The recognition of this fact has led, of late, to renewed attempts to determine, by experiments of the most accurate kind, the precise value of this ratio O : H. Among the workers in this field during the past year or two, may be specially mentioned Scott and Lord Rayleigh in England, Crafts in France, Keiser, Cooke and Richards in America. The results of these and other experiments may be summed up in the statement that, the value $\frac{O}{H}$ is between 16·01 and 15·869; and that the atomic weight of uranium (where the consequent error is necessarily greatest) is between 239·76 and 237·65. We must look to the future for further light.

A glance at the table of the elements, arranged according to the periodic law, shows it is far from complete. Many of the elements whose existence is indicated by the law are not actually known to exist. They have never yet been met with. Is this from lack of knowledge merely, or do the gaps occur in Nature? When this arrangement was first made use of, it was necessary to leave gaps where now we see the names of gallium, scandium, and germanium. May we not also expect the others to be filled up in a similar manner? Here is one below manganese, between molybdenum and the palladium metals, which wants filling by an element with an atomic weight of 99 or 100 and properties that might be fairly well pre-calculated. The most recent chemical journals that have reached us here in Melbourne, contain a brief preliminary notice of some results which Professor Krüss, of Munich, claims to have obtained in an investigation of cobalt and nickel. These elements have always been rather an enigma, from the fact of their possessing, not only very closely similar properties, but an almost identical atomic weight; and our great English chemist, Crookes, has even said of them, that they might have been still regarded as one and the same element, had only their salts possessed the same colour instead of colours which are approximately complementary. Professor Krüss now claims to have resolved the old cobalt and the old nickel each into two elements, one of which is common to

the two, so that, if he can substantiate his claim, we shall have three elements—one the true cobalt, another the true nickel, and one new one. The true cobalt and the true nickel will not have the atomic weights we are accustomed to associate with those names, and an old mystery may thus be cleared up. But further, the new element will want a place in the systematic classification, and it seems to me possible—just possible—that our friend the 99 or 100 gap may now be filled. Chemists await with keen anxiety the arrival of journals with Professor Krüss' complete accounts of his work; till then, we must be cautious, even to the point of incredulity.

But, after all, shall we have arrived at the end of things when all the elements are discovered and their atomic weights and all their physical and chemical properties have been accurately determined? Is there nothing behind the elements? What is the real nature of a so-called elementary atom, and what are we to understand by the phrase "atomic weights"?

The wonderful and laborious researches of Crookes, Krüss, Nilson, and of others, on the so-called "rare earths" have led the first of these chemists (who is remarkable alike for skill in experiment, and the strength of his power of generalisation) to put forward a theory that each resting point in the periodic classification marks the existence not of one element with an absolutely fixed atomic weight, but of a cluster of *meta*-elements as he calls them, substances barely distinguishable from one another by chemical means but capable of being differentiated by the spectroscope and of being separated by methods such as fractional precipitation, and that the atomic weight of an element is really only the mean of the atomic weights of the meta-elements which compose it—numbers varying from the mean within narrow limits. His theory further takes us into a most suggestive speculation concerning the genesis of the elements and their meta-elements from one primordial form of matter, to which he has given the name of *protyle*.

Such a notion of the oneness of matter is by no means new, though there is much that is new in Crookes' special hypothesis. It is interesting to find another investigator attacking the problem of the ultimate composition of the elements from a different point of view. Within the past two years, Professor Grünwald, of Prague, has published some most remarkable papers on the spectra of hydrogen, oxygen, carbon, magnesium, and cadmium; the results of which may be summarized in his own words:—"Many, perhaps all, bodies hitherto considered as elements are compounds composed of condensation forms of the primary elements *a* and *b* of hydrogen ($H = b\,a_4$) in various physical modifications." If this be proved, Grünwald will indeed have done a great work; but we must look to the future, and meanwhile keep our minds open.

SHORT ADDRESS ON RECENT PROGRESS IN BIOLOGY.

By A. H. S. Lucas.

In the unavoidable absence of Professor Spencer at our last meeting, I was asked by the Council to report on recent progress in Biology. It has been suggested to me that I should speak on the results of the "Challenger Expedition," inasmuch as the issue of the long series of Reports has come to an end, and the office in Edinburgh is now closed; and the suggestion accords with my own inclination the more, since I shall have an opportunity at an early date of speaking on the more interesting local biological work of the year in another place.

It were easy to fill ten minutes—my allotted time—in telling of this great enterprise, but it is not easy to compress

all that ought to be said into ten minutes. The publication of the Reports can only be compared with that of the "Systema Naturæ," or of the "Régne Animal," as a great epoch-marking work in biological science.

Considered merely in a mechanical and material way, the Reports consist of some 34 thick quarto volumes. One single volume contains 1800 pages. These are illustrated by about 2000 full-size lithographic plates, several of which are coloured with precision. They record the results of critical examination of the specimens preserved in 2270 large glass jars, 1749 smaller bottles, 1860 glass tubes, 356 tin cases, and 22 casks. The cost of publication has considerably exceeded £50,000.

Biologists owe much to the descriptions of the zoological and botanical specimens collected in the course of previous voyages, undertaken for scientific purposes. Systematists have continually to refer to the accounts of the voyage of the Erebus and Terror, the Astrolabe, the Novara, the Talisman, of the Wilkes' United States Exploring Expedition; of the Beagle, the Samarang, and the Herald; of the Lightning, Porcupine, and Knight Errant, of the United States Survey Expeditions, and of others; but the Challenger Expedition is to these as Leviathan amongst fishes.

There is scarcely a group of animals which is not reported on. There are memoirs relating to Man, and memoirs on the Foraminifera and the Radiolaria. Owing to the tardiness of information from Europe, I cannot give the precise number of the memoirs, but the number is something over sixty-four. These are all contributed by men who are recognised as prominent specialists in the particular group which they have undertaken to describe.

Professor Huxley, in a review of the first volume of the Reports, did not profess to have read it through, and disclaimed the zoological omniscience which would justify him in criticising its contents in detail. No one else, then, need profess to have read all the volumes, or venture to give the palm of merit to this or that memoir. At most, one can but

mention a few of those which have perhaps more generally or more strikingly attracted attention, some from the enormous labour involved in their preparation, some from the novelty of the material described, and others from the interest of the general conclusions which have been worked out by the authors. Amongst them we may mention Professor Haeckel's magnificently illustrated monograph of the "Radiolaria;" Mr. H. B. Brady's "Foraminifera," with its revelations of the pleomorphism of the group; Dr. P. H. Carpenter's "Crinoids,' of which beautiful forms he enumerates as many as 180 species, and reports that Australasia and Malaysia are amongst the strongholds of an order which was not so very long ago supposed to be on the verge of extinction; Dr. Gunther's "Deep Sea Fishes;" the three parts of Professor Herdman's "Tunicata;" the elaborate work on the "Echinoids" and "Ophiuroids" respectively; of the American naturalists, Agassiz and Lyman; the Sponge monographs of Sollas, Schulze, Polejaeff, Ridley, and Dendy; Professor Busk's "Polyzoa," and Professor Allman's "Hydroida;" Professor Moseley's beautiful work on "Millepora" and "Heliopora," and Mr. Botting Hemsley's comprehensive studies on the "Floras of Oceanic Islands."

In many cases the writer gives a complete summary of what is known from all sources on the order of animals, of which the memoir treats. Thus, the Pteropods are completely reviewed by Professor Pelseneer, who concludes that these delicate pelagic molluscs may be ranged in a very few genera, and that the entire order should be merged in the Gastropods. Professor Allman discusses in full the classification of the Hydroida, Dr. Lyman that of the Brittle Stars, and so on. Such memoirs give the series of Reports much of the nature of an Encyclopædia Zoologica.

A bare enumeration of the authors, and the titles of their treatises, may recall the monotony of Homer's list of his heroes. I can only excuse myself by retorting that, in my opinion, the workers of the Challenger *are* heroes, and that the great Zoological Reports constitute no mean epic.

Wherever opportunity offered, full anatomical details are given, as well as zoological characters. Indeed, it is hard to decide whether anatomists or systematists will be more helped by these publications. Embryological work is naturally scanty, but Professor W. K. Parker was enabled to make out the development of a type of Chelonia, which was previously but very imperfectly known. It is interesting to note that he refers to the Leathery Turtle (*Sphargis coriacea*), which is occasionally to be met with in our Melbourne Fish Market, as the living form which best retains the indications of its ancestry.

The voyage lasted from 1873 to 1876. The first Report appeared in 1880, and the work is just completed. Eminent foreign, as well as British, scients were invited to assist, and one result has been to show that English and American biologists are able to produce work which in magnitude, in thoroughness, and in artistic beauty, can compare favourably with that of any other workers in the world.

The naturalists who accompanied the Expedition were Sir Wyville Thomson, Mr. Moseley, Dr. Willemoes Suhm, and Mr. John Murray. The credit of the general direction of the zoological work belongs to Sir Wyville Thomson. We have to regret the early death of Dr. Willemoes Suhm. Just as the voyage in the Beagle exercised great influence in shaping Charles Darwin's powers, so to that of the Challenger is due that opportunity of expansion was given to Mr. (since Prof.) Moseley and Mr. John Murray. So well-equipped were the naturalists, and so judicious and careful was their work, that I believe one may say with strict accuracy, that no material which was acquired was lost to science.

Besides adding vast numbers of new species to our lists, the Challenger gained for the world nearly all that is known of the fauna of the ocean basins, and the form under which life is maintained under the singular conditions of abyssal existence. The relations of the abyssal fauna to light, the enormous development or the abortion of the eye, the existence of remarkable phosphorescent organs, consti-

tute a new and interesting chapter in the history of living organisms.

Much light has been thrown on many more general questions. The mode of formation of barrier reefs and of atolls, the constitution of the abyssal oozes and their slow increase in depth, the nature of the red clay, the ways and means of geographical distribution, have been carefully studied, and our knowledge of them greatly extended.

Here I must close, but not without recording my pleasure that we have two Challenger workers amongst us—Dr. Wild, who accompanied the Expedition, and Mr. Dendy, who described the Monaxonid sponges. It will also, I think, be of interest to members to know that several of the specialists who wrote for the Challenger, are assisting us in the identification of the forms obtained by your Port Phillip Biological Survey Committee.

SHORT ADDRESS ON THE RECENT DEVELOPMENTS IN PUBLIC HYGIENE.

By James Jamieson, M.D.

In the limited time at my disposal, it is most desirable that I should confine my remarks on recent hygienic progress, to one or two matters of large general interest.

Perhaps no fact, in connection with modern sanitation and its results, is more striking than the great improvement which has taken place of late years in the death rate in the great towns of England. In the ten years 1871–80, the mortality averaged 24 per 1000 of the population, while in the years 1881–87 it averaged only 21·4 per 1000, and in 1887 was as low as 20·8. A remarkable contrast is to be

found in the condition of Melbourne, which, as regards sanitation, seems as if it had been entirely out of the tide of progress. In the ten years 1871–80 the death rate was 20·36 per 1000; and in the eight years 1881–88 it averaged 20·21; the rate for 1887 being 21·25, and for 1888, 20·54. It cannot be said, of course, that nothing has been done to improve the public health; but, as the results are not to be seen in the figures just given, it must be concluded that our efforts, such as they have been, have simply prevented us from suffering fully the evil effects arising from increasing density of population and its associations.

A special instance may be taken, as helping to account for the remarkable difference which we have found to exist between our own "Marvellous Melbourne" and the English towns and cities. I prefer to take typhoid fever, as being with us a perennial subject of interest. In the years 1870–1877, the death rate from fever, chiefly typhoid, in the great towns of England, averaged 6 per 10,000 of the population, while in the years 1877–1886 it had fallen to 3·2, and in 1887, to 2·2 per 10,000.

The following has been the state of things in Melbourne, at corresponding periods. In the years 1871–1878, the typhoid mortality was in the proportion of 7·8 per 10,000 of the population, and in 1881–1888 it was 7·3; the rates for the last two years, 1887 and 1888, being respectively 9·1 and 7·7. While our typhoid mortality has remained practically the same, in the English towns it has been reduced to about one-third of what it was less than twenty years ago.

There can be no doubt, I think, that the sanitary improvements which have been operative in bringing about this great reduction in the prevalence of typhoid in the English towns, have also had the chief share in lowering the general death rate. It is of no small importance, therefore, to know the cause of our failure to attain a similar result. We know more now, than we did twenty years ago, about the nature and causes of the disease, and definite rules for its prevention

have been formulated, and generally accepted as correct; and yet, from all that increase of knowledge, we seem to have received no practical benefit. The reason is to be discovered from a consideration of the causes by which the spread of typhoid is chiefly favoured. One of these is a contaminated water supply, and an interesting confirmation has lately been supplied of the belief long held about its importance. There is very satisfactory evidence that the specific germ which produces the disease, has been discovered, and this typhoid bacillus has been repeatedly discovered in water, which had been used for drinking purposes, and which had been suspected as the cause of local outbreaks. But I greatly doubt, whether this cause plays any considerable part in bring about our high typhoid mortality. The sources are now more carefully guarded than they were a few years ago; and besides, the circumstances which attend its prevalence here are not those characteristic of epidemics due to contaminated water, as they have been seen in many places. Our outbreaks are not explosive; the disease, year after year, taking a decidedly epidemic character in November or December, increasing steadily in prevalence till about March, and then declining slowly till it almost ceases in the early winter months. Our water supply is certainly better than that of most European towns, and it is not likely to be materially improved; and so, unless there is some other cause in operation, we can hardly expect to see much lowering of our death rate.

The use of contaminated milk has for a considerable time been recognised as a mode by which typhoid is communicated. It may be accidental contamination through the medium of water, which has itself been polluted with typhoid discharges, or by gross carelessness on the part of those who handle milk after having been in contact with a patient, or with soiled linen, &c., from his person. Quite recently it has been alleged that cows suffer from a form of disease, such that their milk may be capable of producing typhoid in those who drink it. It has often been alleged,

also, that from the mere fact of a cow feeding on garbage of various kinds, its milk may acquire infective properties. If there were such different ways whereby the milk of cows is rendered infective, I can hardly think that it would be so difficult to get proof of the occurrence of outbreaks due unmistakably to contaminated milk. Since the Jolimont case, about ten years ago, there has not been a single instance traced out in this City, and my own experience has compelled me to conclude that milk contamination is actually a rare mode of spreading contagion, no single instance having come under my notice during my term of service as Health Officer of the City.

It is different, I believe, with another mode by which typhoid is spread, viz., as a result of bad or defective drainage. I have often been satisfied that there was no other cause in operation adequate to account for severe and persistent local outbreaks of the disease. Evidence has actually been supplied that the typhoid bacillus may live in ordinary well or river water; and the close association often found to exist between typhoid and sewer emanations supplies a strong probability, amounting almost to certainty, that they may live, and possibly multiply, not only in cesspits, drains, and sewers, but also in soil soaked with sewage matters. The bacilli have not been found in, and would be difficult to isolate from the combination of bacterial forms which find lodgment and breeding ground in sewage matter; but if they do happen to be present there, it is almost a certainty that they would escape in the currents of foul air which rise from the outlets of town sewers. Such air does contain many bacterial forms, as has lately been proved by the investigations of Dr. J. D. Robertson (*British Medical Journal*, 15th December, 1888). He did not find on his cultivation plates the bacillus of typhoid, doubtless, as he says, because there were no epidemics at the time of his observation; but he did recognise that in sewer air there is a larger proportion of bacilli compared with other organisms, than in the open

air of streets. It appears, therefore, that sewage matters provide a good breeding ground for that particular class of micro-organisms, to which the infecting agent of typhoid belongs. Evidence of an exact and positive kind is therefore accumulating in favour of the view which, in my opinion, hardly admits of doubt that—defective drainage is the real cause of the great prevalence of typhoid in Melbourne. In that, and in our bad system of nightsoil disposal, we have insanitary conditions fully adequate to account for the great and continued prevalence of the disease, and I can see no hope of such improvement as has come about in the English towns, till we adopt their sanitary methods. It is vain to put our trust in disinfectants. The cure consists in the adoption of a system of drainage, whereby all household slops, all liquid refuse, and nightsoil with it, are swept away at once from the neighbourhood of our houses. If that were done, our scavenging would also be comparatively an easy problem. An underground system of drainage can and must be carried out, and in the saving of life and health there would be ample repayment of the cost.

There are certain diseases of animals which human beings may acquire. In addition to various forms of parasites, mention need only be made of anthrax, glanders, hydrophobia, and the familiar cow-pox, which, by the method of vaccination, has come to be looked on rather as a preventive than as in itself a disease ; but in all these cases, the spread from animal to man is either a comparatively rare accident, or at least, as in the case of vaccination, has to be deliberately produced. It can hardly be said, indeed, that we are acquainted with any disease of this general class, which spreads freely from animals to human beings by what may be called ordinary methods of contagion. In the same way, none of the general zymotic diseases which affect human beings, spread easily to the lower animals if the latter, indeed, are susceptible of contagion at all. This circumstance has made, and will make, it difficult to obtain

conclusive evidence that such diseases as cholera, typhoid, small-pox, and measles owe their origin to living germs, the final test being that the germs, when cultivated pure, are capable, by inoculation or otherwise, of again producing the disease. Till quite recently, this want of relation with any disease of animals was held to be notably the case with scarlet fever. The chief mode by which it spreads, as an epidemic, is undoubtedly by way of direct or indirect contagion from person to person.

There have been a few instances, generally accepted as well authenticated, in which the contagion seemed to be conveyed through the medium of milk. But it was always taken for granted, even when it was not clearly proved, that the milk had become contaminated by access to it of scales from the skin, or other infecting particles from the body, of a patient suffering from the disease. It came, therefore, as a startling novelty, when, in 1886 it was announced, on good authority, that an outbreak of scarlet fever in a district of London, had not only been traced to the use of milk, but that this milk got its contagious properties, not by contamination with particles from a scarlatina patient, but by the circumstance that it was derived from diseased cows. Experiments were made by Dr. Klein, the well-known bacteriologist and microscopist, and the circumstances and surroundings of the dairy were carefully inquired into by Dr. Power, one of the most experienced Inspectors of the Local Government Board. The cows were found to be suffering, not only from general signs of illness, but from a disease affecting the udder and teats. From the sores on these parts, Dr. Klein obtained bacterial forms, which he declared to be similar to those which he also found in the bodies of scarlet fever patients. He further made pure cultures of the special organism from both sources, and by inoculation on calves, produced a form of illness, which resembled in different respects, both the scarlatina of man and the disease from which the cows had suffered. On inquiry, it did not appear that there were cases of scarlatina

at or near the dairy, from which contamination of milk in the way usually accepted, could have taken place. Dr. Buchanan, the head of the Medical Department under the Privy Council, accepted the evidence as conclusive, the medical world was taken by storm, and the "Hendon cow disease" was everywhere talked of as the clearly established source of an outbreak of milk scarlatina. It seemed proper that the veterinary authorities should make an independent inquiry, and the services of Professor Crookshank, a recognised authority on questions of bacteriology, were engaged. In the reports which have since been issued, it is stated that the so-called Hendon disease is well known to cow keepers and veterinary surgeons, who describe it as cow-pox, and the experiments made by Professor Crookshank were considered by him to establish this belief. It was further stated that there had been scarlet fever in a house not very far from the dairy, and that there had been constant communication between the two places. The very remarkable fact further came out, that though the milk was considered to have caused scarlet fever among persons living in London, it had no such effect among the persons living at or near the dairy, who regularly consumed it.

It was further stated that, in two adjacent dairies, the cows suffered from a similar disease to those at Hendon, but that there was never any suspicion that the milk from these had caused scarlet fever. So the question at present stands, after a good deal of heated controversy; and on a review of the whole evidence, it seems as if Drs. Klein and Power had been somewhat hasty in coming to conclusions, and the latest reports of outbreaks of scarlet fever, occurring more or less in coincidence with the occurrence of signs of illness among the cows supplying milk, are by no means conclusive. The question has great practical, as well as theoretical interest; for if such a dangerous disease as scarlet fever may be produced by the milk of cows suffering from some kind of disease, it is of the utmost importance that the nature and symptoms of that disease should be clearly defined, in order

that precautions may be taken. Its identification, too, might lead to important results, by bringing nearer the probability of attaining some system of prevention analogous to vaccination against small-pox. But another very important point is also raised. If scarlatina can actually be produced in this way, it will be necessary to go back and review the evidence, as to the mode of production of former milk epidemics. Were they really due, as supposed, to contamination of the milk with infecting particles from a scarlet fever patient? In that way, indeed, the whole question of the spread of disease by means of contaminated milk is again brought up for open discussion. The effect has been to call forth a quantity of evidence in opposition to the view that scarlatina is readily produced by contaminated milk. In the "Report on Eruptive Diseases of the Teats and Udders in Cows," recently issued by the Agricultural Department, there is given in an appendix a report by Dr. Hime, on his observations in Bradford during a very severe epidemic of scarlet fever in 1887. He narrates a number of instances of scarlet fever occurring among children living at dairies, and yet among the families supplied there was almost complete immunity from the disease. He had also occasion to inquire into the cause of outbreaks occurring among the customers of particular milksellers, without being able in any instance to discover that the suspicion which had fallen on the dairy was in any way well founded. His conclusion was that if, under conditions so favourable to the spread of infection, it did not occur, it is more than probable that there must be the greatest difficulty in milk becoming infected.

At a meeting of the Epidemiological Society of London in December last, a paper was read by Dr. Shirley Murphy, on "The Sanitary Administration of Dairy Farms." His object was to point out the need of legislation, to guard against the spread of disease among dairy cows, and against the infection of milk. Referring to the risk of milk becoming contaminated by particles from scarlet fever

patients, he gave his experience of a public institution, in which the milk was for years exposed daily to the risk of infection, by being carried through wards containing scarlet fever patients, without any appreciable effect upon persons who afterwards drank it. The milk was sometimes even further in danger of being contaminated by being served out by a woman who was actually attending on the patients, and yet it did not produce the disease. All this, of course, is only negative evidence, and Dr. Murphy's object was not so much to oppose the doctrine, that milk thus contaminated may cause scarlatina, as to enforce the need of careful examination of the cows themselves, whenever milk is suspected of being the medium of conveying infection. Under any circumstances, nothing but benefit to the public health can result from full inquiry into all such disputed questions. The whole matter shows further, how necessary it is to keep ourselves open to the influence of fresh knowledge, and be ready, if necessary, to amend even what we had come to look on as settled doctrines.

As regards the two diseases to which I have referred, the main points about their infectivity and mode of spread, remain untouched. In connection with typhoid, we have to guard against impure water supply and insanitary surroundings; and in the case of scarlet fever, we must trust to isolation and disinfection, on account of the intense contagiousness of the disease.

SHORT ADDRESS ON GEOLOGICAL PROGRESS.

By G. S. Griffiths, F.G.S.

The past year has been marked by no special feature as far as Australian Geology is concerned. The geological staffs of the various Colonies have continued to extend their surveys, whilst private observers have added to our knowledge of the interior and other parts. Mr. Jack's discovery of cretaceous fossils in the lower beds of the desert sandstone of Western Queensland—confirmed as the age of these has since been by Professor Tait, after an examination of the fossils—is an event of great importance. The chalk beds of the coasts of Victoria and South Australia, between Portland Bay and the Murray mouth, have been further investigated, and the fossils collected by Mr. Dennant and others have led Professor Tait to remove the lower stratum from the Miocene, to which the Rev. Julian Woods had assigned it, into the Eocene. In New South Wales, the finding of a well-preserved labyrinthodont at Biloela, enables Professor Stephens to confirm the Triassic age of the Hawksbury sandstone. Some very interesting remains of ganoid fishes have been unearthed near Mansfield by Mr. G. Sweet, who will shortly publish particulars of this Old Red Sandstone deposit. In Western Australia the carboniferous area on the coast is receiving attention, and Mr. R. M. Johnson, of Tasmania, is preparing a comprehensive work upon the geology of that island.

To turn from local developments to the recent history of the science in Europe, I notice that an important Congress of Geologists has been discussing the principles of geological map making, with a view to unify practice in relation to coloration and symbols, and to simplify the terminology. These objects must have our entire sympathy, and if they can be secured, the study of the science will be distinctly asssisted.

The important branch of Vulcanology has made an invaluable addition to its literature, with the publication, by the Royal Society of Great Britain, of the report of its Committee upon the Krakatoa eruption. That body comes to the conclusion, that the extrusion of the volcanic matter of an eruption is due, not to the presence of water in the magma, but to the occlusion of potentially gaseous compounds, formed by chemical interaction between some of the heated minerals. This important generalisation has been dubbed the "Cartridge theory," as it pre-supposes that there are in the crust of the globe certain strata which, being heated, generate within themselves explosive gases, which thereupon rend the overlying rocks, and then by their expansion, expel the molten magma in which they are entangled. According to this view, the paroxysmal outbursts which so frequently mark volcanic emissions, are due to the accidental admission to the lava of quarry water, which nearly always saturates all the rocks forming the walls of the upper part of the rent.

Another subject which was discussed at the recent Geological Congress, is the nature and origin of the crystalline schists. Whilst a great diversity of opinion prevailed between the greatest living geological authorities, in relation to many important but open questions bearing upon this class of rock, the tendency of the discussions reveals a widely held belief that the schistose characteristics of gneiss have been developed by the dynamic strains incidental to the process of mountain building; and also, that any kind of rock subjected to this intense pressure may be transformed into gneiss, whether it be of sedimentary, organic, or plutonic origin.

These matters are the principal points which come under notice in reviewing the geological progress made during the past year.

SHORT ADDRESS ON LITERATURE AND THE FINE ARTS.

By James Edward Neild, M.D.

The title of this short paper is comprehensive, and there is very much more to be said thereon than can be compressed in the ten minutes allotted to me; but as I have an end to serve, namely, the formulation of a section not as yet formulated, and as my purpose can be achieved as easily in ten minutes as in two hours, I accept the limitation. I will not attempt a history of the subject, even in epitome. I will not even try to describe what has recently been done in the domain of Literature and Art, for even within these confines it would be impossible to set forth, even categorically, what has of late been accomplished in the direction of books, pictures statues, and buildings. I will be provincial, and I will use only so much of the limited material at my command, as to draw attention to the much-regretted neglect by the Royal Society, of Section G, which, as you know, takes in Literature and the Fine Arts, including Architecture. And considering that the first clause of the Laws of the Society declares that the institution was founded for the advancement of Science, Literature, and Art, it is at least remarkable, that, hitherto, the operations of the Society have been almost exclusively confined to the consideration of the first of these subjects.

In Law 53, it will be observed, provision is made for departmental work, this being defined in an enumeration of eight sections, all of them, however, curiously enough, having reference to Science, except Section G, which, as I have intimated, deals with "Literature and the Fine Arts, including Architecture." I am quite sure it is not because these subjects have been considered of subordinate import-

ance that they have not been dealt with, neither has it been supposed, I think, that in a new country such as this, the *belles lettres* are incongruous or premature. It is possible that it may have been deemed unnecessary to take them into consideration, in the belief that societies exist here, having a special mission to concern themselves with Art and Literature. In any case, it is a cause of regret that Section G has, up to the present, never been developed. I should very much like, therefore, to assist in developing Section G.

I am aware that it has been asserted, sometimes regretfully, sometimes scornfully, that we have no Australian literature other than periodical literature, and that periodical literature comprises newspapers and very little else. It is true we do not produce many books, and it is not less true that of the books we do produce, some of them are not worth keeping. But after you have well sifted all the books which all the colonies have given to the Australian world, there will remain a residuum which, small as it is, represents a literature of its own kind. Among the many writers of verse, there have been some poets; among the numerous story-tellers, there have been a few whose tales are worth preserving; there are historians whose records it would be a calamity to lose, and we have had essayists whose writings deserve to become classical. In respect of dramatic writing, we have not achieved much distinction. In part proof of this, I may mention that, during the last twenty-five years, I have read about 300 plays in manuscript, and I am obliged to say that I could not recommend more than five of these to the consideration of managers, and even this recommendation was hesitatingly conceded. The bulk of our Australian literature, therefore, is periodical; that is to say, it consists of newspapers; and of this kind of literature, we have a good deal. I have to admit that a large proportion of it is of a superior kind, and that some of it is of a high-class character. I am not unaware that another proportion of it is of an opposite degree of excellence. I am not now speaking, nor need I be expected to speak, of the moral tone of Australian

newspapers, but only of their literary quality ; and, basing my assertion upon a good deal of experience, I say with confidence, that the literary quality of the newspapers, in Victoria at any rate, is, with exceptions of course, of a kind upon which we may congratulate ourselves. Whatever literary feeling there may be in Victorian society, therefore, is to a large extent derived from, and is built upon, the newspapers. We have proportionally a much larger number of newspapers than they have in the old country. There are hundreds of towns in England, of considerable size, that have no public journal whatever; whereas in this colony, the very smallest township has some kind of newspaper. There is thus an extensive diffusion of information, and every member of the community is indebted to the newspaper for a great deal of the knowledge he possesses.

But we also import books in great numbers from the old countries of the world, and it is by no means exceptional, nowadays, for persons of even moderate means to possess libraries often of considerable size. It is true that not a few persons of means that are much more than moderate, have no libraries at all, and that of those who have them, some never read them. The story is extant of a gentleman, belonging to the extremely wealthy lower orders, who, having been persuaded to include in the plan of a new house he was building a library, ordered his books from England by the ton. He said it simplified matters to send for two tons. I myself have been in houses where the decorator had carte blanche given him, but in which the library did not number more than fifty volumes.

For all this we are, by comparison, a reading people, and as far as reading may induce the literary faculty, a writing people. The letters that from time to time appear in the newspapers, may be accepted in demonstration of this latter proposition ; and they probably do not represent more than a tithe of those actually written. I am not going to say that all such letters indicate marked literary skill, but they certainly represent a good deal of such skill, and some of

them are veritable essays, not unworthy the trouble of preserving. It would be untrue to say, that a newspaper-reading people is of necessity a literary community. The Americans, as we all know, have more newspapers in proportion to population than any other nation in the world, but as a people, they cannot certainly be regarded as literary, and they themselves have confessed that they are not an educated people. I justify this statement by reminding you that a not undeservedly popular lecturer from the United States, who visited these colonies only a few years since, told us that 5,000,000 of the 50,000,000 of the great republic, over ten years of age, could not even read; that 6,250,000 could not write; that of the 10,000,000 of voters in the States, one in five could not write his name; that of the 10,000,000 of children enrolled in the public schools, 7,500,000 were in absolute ignorance of the English alphabet. He further said that in 34 cities, from 50 to 84 per cent. of the children were not enrolled in schools at all; that in 86 cities, the average attendance at school was only $\frac{2}{3}$ of the enrolment; that in New York, 200,000 children had never been to school at all; that in Chicago only a third of the children went to school; and that in St. Louis, out of a population of 106,000 persons, 50,000 were growing up literally savages. These particulars were offered only as samples of the literary destitution there prevailing, and they were supplied by an American. Now in Victoria, according to the last completed Year Book, nearly 95 per cent. of the children at the school age were being educated either at state or private schools.

It does not follow, of course, that education as we know it, confers the literary faculty, but at least it supplies a ground work for a beginning. We may claim, therefore, that as we have here educational facilities if not superior to those of other states, yet equal to most of those who are best supplied, we ought to be a literary community.

The misfortune is, that many who enter upon a literary career, appear to think that the calling requires no special

training. It is not objected that the calling is taken up in supplement of other callings, but because it is not the principal avocation, it seems as if it were regarded as unnecessary to study the art of literary composition systematically.

A well-known epigrammatist has said, that it requires five years to learn to be a cabinet-maker, but that one may become an author in half an hour. The reply to this was, that it was witty, but false, for that a literary man has to undergo a long apprenticeship. His school-life, his college-life, his travels, his hearing, seeing, reading, observing, suffering, all are parts of his training. Then with all this training, he has often to work at labour he does not love, and his writing has to be done furtively, or in the intervals of his enforced daily work.

Going back for historic examples, we find that Hesiod was an agriculturist, Thucydides a general, Xenophon a commander, Plato and Aristotle schoolmasters. Cicero morever, was a politician, Varro a soldier, Horace first a soldier, then a secretary. And to come nearer to our own times, La Rochefoucauld was a courtier, Montesquieu a judge, Chateaubriand a sub-lieutenant, and Balzac a reader of proofs. And then, as we know, Shakspeare was an actor, Byron a lord, Grote a banker, Dickens a reporter, Cooper a consul, Bancroft a minister, Emerson a pastor, and Oliver Wendell Holmes is a physician. I suppose no man, nor no woman, ever set out upon the journey of life, with the set purpose of being an author, and yet an author, worthy of the name, requires a training harder a great deal than that needed for any other vocation.

Professor Huxley recently said, "I fancy we are the only nation in the world who seem to think that composition comes by nature. The French attend to their own language, the Germans study their's, but Englishmen do not seem to think it worth their while." As Dogberry has it, so they apparently think that "reading and writing come by nature."

It is a melancholy thing, however, when a consciousness of the writing faculty prompts the possessor, he not being a poet, to make verses. Christopher North, it will be remembered by those who are familiar with his now not much read, but undeservedly neglected works, especially the *Noctes Ambrosianæ*, begins one of his reviews with this epigrammatic declaration—"All men, women, and children, are poets, except those who write verses." And at a somewhat later period, it will be remembered that Carlyle wrote, in acknowledgment of a sonnet he had received from his friend, Dr. W. C. Bennett, as follows:—"Your name, hitherto, is known to me chiefly as associated with verse. It is one of my constant regrets, in this generation, that men to whom the gods have given a genius, which means a light of intelligence, of courage and all manfulness, or else means nothing, will insist in such an earnest time as ours has grown, in bringing out their divine gift in the shape of verse, which now no man reads entirely in earnest. That a man has to bring out his gift in words of any kind, and not in silent divine actions, which alone are fit to express it well, seems to me a great misfortune for him; but that he should select verse with its half credibilities and other sad accompaniments, when he might have prose and be wholly credible, if he desired it, this I lay at the door of our Spiritual teachers (pedants mostly, and speaking an obsolete dialect), who thereby incalculably rot the world, making him who might have been a soldier and fighter (so terribly wanted just at present), a mere preacher and idle singer. This is a fixed perception of mine, growing ever more fixed these many years; and I offer it to you as I have done to many others in the like case, not much hoping that you will believe in it at once. But certainly a good, wise, earnest, piece in prose from you, would please me better than the musicalest verses could."

God forbid that I should discourage the true poet from scattering his pearls upon the earth. A genuine poet is a creature to be worshipped, but although there may be only

one real poet in a million of men, there may be many eloquent writers who are no poets; and of these, I am sure there is a large quota in Victoria. I should like to gather some of them together under Section G.

Then of the "Fine Arts, including Architecture." Concerning this latter, if I were to say all I think at this moment, I should make every Victorian architect my deadly enemy, for this Marvellous Melbourne, in my judgment, is only a large collection of architectural eyesores. It is an ocean of ugliness, with a very few small islets of beauty; a wilderness of brick and stucco, with here and there an oasis of honest masonry.

Of sculpture we have not much, and this little is chiefly imported. The examples at the National Gallery are many of them melancholy illustrations of probably good intention, but disastrous ill-judgment on the part of the buyer. I except the majority of the casts, especially from the antique. It is the marbles, for the most part, that make me sad. The latest of these illustrations of imperfect judgment in the selection is *The Bull and the Herdsman* by Boehm. The sculptor of this work, R.A. though he be, furnishes, I think, another instance of misdirected talent. It is especially the purpose of sculpture, I take it, to elevate, to refine, to exalt the mind above gross surroundings. And I do not think a bull and a bull-keeper suggest any thoughts that are elevated, refined, or exalted. The workmanship of this piece of statuary is excellent, no doubt. The thing is as like a bull as it is possible to make it in marble, but I will not believe that excellence of technical handicraft represents the highest condition of art. A turnip, a pumpkin, a mangel-wurzel, a stump of a tree, a sack of potatoes, a wheelbarrow, might all be carved in marble, and they might demand from the sculptor great manipulative skill, but what then? They would still be severally turnips, pumpkins, mangel-wurzels, tree-stumps, potato-sacks, and wheelbarrows. They would lead you up to nothing higher than themselves; and so of this marble bull. Such a work would be appropriate enough for a tavern sign, or as the centre-piece of an

agricultural hall; or a successful grazier might have it erected in his front garden, but it is only a perplexing incongruity where now it stands. It may help to teach a mere stone cutter, but not a sculptor.

We have a gallery of pictures, and some of them might well enough remain where they are, both to please the public and to instruct the students; others might be removed to a separate gallery, and kept as examples to show the students what to avoid. And, indeed, it would do a great many people, other than students, good to be taught what kind of pictures they should not hang up in their houses. In the dwelling-places of even well-informed people are to be found literally chambers of pictorial horrors, and yet they excite no distress in the minds of the possessors, because these ill-advised, although possibly inoffensive, persons do not know what a picture worthy of the name of picture is. But another class of people are even worse than these, for they suffer from a form of pictorial blindness, and variously paint, or buy, pictures which make a healthy-minded man shudder at the sight of them. We had some of these morbid specimens in the Grosvenor Gallery when it was with us twelve months ago, and I am afraid they did harm by demoralising the feeble art principles of divers invertebrate persons, who are much swayed by authority, and incapable of thinking for themselves. Happily, we have in Mr. Folingsby now a whole-souled, healthy-minded director of our art school, and the students he from time to time turns out are similarly whole-souled and healthy-minded too. They paint honest pictures, every one of which has a meaning, and sets you thinking of their meaning, an effect which every good picture is capable of doing. I do not think our art students are likely to be ever corrupted into the heresy of painting "Scapegoats," or "Triumphs of Innocents."

But Mr. Folingsby's good teaching should be extended, and made a more general use of. No doubt there are some good drawing masters in Victoria, but judging by such examples as I very often see, the drawing masters themselves

cannot draw. And as to teaching the principles of pictorial art, it is practically unthought of. For besides technical skill, a student should, I think, be instructed how to distinguish between what is essentially picturesque, and what is not.

Sala some years ago said, "He who can draw, be it ever so badly, has a dozen extra preference shares in every landscape, shares that are perpetually paying golden dividends. He can not only see the fields and mountains, the rivers and brooks, but he can eat and drink them. The flowers are a continual feast, and when the rain is on them, and after that the sun, they may be washed down with richest wines. To the artistic eye, there are inexhaustible pleasures to be found in the meanest objects. There are rich studies of colour in a brick wall; of form in every hedge and stunted pollard; of light and shade in every heap of stones on the macadamised road; of more than pre-Raffaelite stippling and finish in every tuft of herbage and wild flower. The shadow cast by a pigstye on a road; by an omnibus driver's reins on his horses' backs; the picturesque form of a donkey-cart; the rags of a travelling tinker; the drapery-folds in a petticoat hung out to dry on a clothes line in the back yard; the rugged angularities of the lumps of coal in the grate; the sharp light upon the decanters at home—all these are fruitful themes for musing and speculative pleasure. The fisherman who can draw, has ten times more enjoyment in his meditative pursuit, than the inartistic angler. An acquaintance with art, takes roods, perches, furlongs from the journey; for however hard the ground may be, however dreary the tract of country through which we journey, though our twenty miles may lie in the whole distance between dead walls, have we not always that giant scrap book the sky above us—the sky with all its varieties of colour, its rainy fringes, its changing forms and aspects? I would not have a man look upon the heavens in a purely paint-pot spirit; I would not have him consider every sky as merely so much Naples-yellow, crimson-lake, and cobalt-blue, with

flake-white clouds spattered over it by a dexterous movement of the palette knife; but I would have him bring an artist's eye, and an artist's mind to the heavens above."

Moreover, I would have students taught the reason why one class of lines, or forms, or colours, gratifies the eye more than another. Max Muller some time ago explained anatomically the reason of the universal admiration bestowed upon curves instead of straight lines. He told us, that the eye is moved in its orbit by six (*i.e.*, the four recti and the two oblique) muscles, of which four (the recti) are respectively employed to raise, depress, turn to the right, and to the left. The other two (the oblique) have an action contrary to each other, and roll the eye on its axis, or from the outside downward, and inside upward. When therefore an object is presented for inspection, the first act is that of circumvision on going round the boundary lines, so as to bring consecutively every individual portion of the circumference upon the most delicate and sensitive portion of the retina. Now, if figures bounded by straight lines be presented for inspection, it is obvious that but two of these muscles can be called into action, and it is equally evident that in curves of a circle or ellipse, all must alternately be brought into action; the effect then is, that if only two be employed, as in rectilinear figures, those two have an undue share of labour, and by repeating the experiment frequently, as we do in childhood, the notion of tedium is instilled, a distaste for straight lines is gradually formed, and we are led to prefer those curves which supply a more general and equable share of work to the muscles. This explanation, it will be seen, happily introduces science into the province of art, and there can be no question, that both high art and pure literature may occasionally profit by invoking aid from Science.

The drawing taught in our State Schools, and in the so-called Schools of Design, if we may judge by the work of the pupils occasionally exhibited, is of a very mechanical kind. The examples, for the most part, show neither taste, feeling, originality, nor technical facility. No art principles

appear to be inculcated, no obligation is enforced of the pupil thinking for himself. It is a neglect of this kind that I hope will be pointed out by means of this section, and in this way we may aid, not inconsiderably, in the general scheme of State education; a scheme which in particulars, other than those of art-knowledge, is greatly in need of amendment.

PROCEEDINGS.

ART. I.—*On the Discovery of Fossil Fish in the Old Red Sandstone Rocks of the Mansfield District.*

With Plates I, II, and III.

By GEORGE SWEET.

[Read April 6, 1889.]

SOME twenty-five years ago, the attention of Mr. Selwyn, then Director of the Geological Survey of Victoria, was directed to some specimens of a purplish red sandstone rock, containing a few fragments of plant remains from the Battery Hill, near Mansfield.* The fossils were submitted to Professor McCoy, who studied them, and in consequence, recommended Mr. Selwyn to colour the Mansfield area as Old Red Sandstone.

Some twenty years after, Mr. Reginald A. F. Murray, the present Government Geologist, during his geological examination of the district, obtained fossils which had been found by Messrs. Tolmie, sons of the then owner of the Dueran Station.†

These were also examined by Professor McCoy, who has been kind enough to write to me as follows concerning them:—"Mr. Murray brought me some vegetable fragments and the remarkable cephalic shield, to which I have given the name of *Rhytidaspis murrayi*, in his honour, as well as the first example of the large *Ichthyodorulite*, which you have since found in such abundance, so curiously resembling, both in size, shape, and tuberculation, the *Gyracanthus obliquus* (McCoy) from the base of the carboniferous series of the North of England, as to suggest that that genus might not be *Selachian*, but belong to the head and other parts of the body of fish of different affinities.‡" These relics were of too

* "Notes on the Physical Geography, Geology, and Mineralogy of Victoria," one of the International Exhibition Essays, 1866, by Mr. A. R. C. Selwyn.

† Memorandum of Mr. R. A. F. Murray, Geological Surveyor of the Department of Mines.

‡ Memorandum of Professor McCoy, C.M.G.

great interest to be forgotten; and, in the beginning of last year, at the instance of Professor McCoy and Mr. Murray, the Secretary for Mines, Mr. C. W. Langtree, provided funds for a further investigation.

The Rev. A. W. Cresswell accordingly visited the district. He spent a day or two or there, and searched along the Broken River, near its junction with the Bridge Creek, and some distance up the latter. He found some interesting fossils himself, and left two men under the supervision of Mr. P. Bromfield, the Shire Secretary, with directions to excavate for more*, with the result thus summed up by Professor McCoy:—The Rev. A. Cresswell procured some "scales" allied to those of *Glyptolepis* in appearance; and examples of still greater interest of Acanthodian fishes related to known Old Red Sandstones types. He also brought various examples of the *Lepidodendron mansfieldense* (McCoy), of which lithographic figures have been prepared for the Decades of Palæontology of Victoria, with all the details necessary for a satisfactory recognition of the species, which is quite distinct from the *Lepidodendron australe* (McCoy)† of the Avon River, Gippsland. Yet these were, except in the case of the *Lepidodendron* just referred to and an Acanthodian fish and one or two others, so fragmentary that determination was both difficult and hazardous.

Mr. Cresswell was, however, unable to spare time for further work in the field, and Professor McCoy did me the honour to suggest that I should undertake a more thorough examination of the rocks of that locality. The Secretary of the Mining Department, Mr. Langtree, promised to render every assistance, and to supply a limited sum to employ men to quarry. As I feel great interest in the ancient forms of life, and possess a certain amount of ambition to assist in obtaining more complete knowledge of the remains which are at present hidden in the rocks on this side of the globe, I consented to undertake the work. We left Melbourne on the eighteenth of December last, at which date only, the services of Mr. James Tolmie could be secured as guide, and reached Mansfield on the nineteenth.

The first characteristic purplish red sandstone rock makes its appearance on the roadways, having been used for repairing them, shortly after leaving the highly-inclined

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* Memorandum of Rev. A. W. Cresswell, M.A.

† Memorandum of Professor McCoy, C.M.G.

Upper Silurian strata of Maindample and Doon. Reaching an elevation in the track near the Paps (a considerable hill to our right, terminating in two peaks), other striking features of this district come into view; its beautiful park-like character, well grassed and thinly timbered, with fair sized red gums; while beyond, the distant hills, with their slightly inclined strata and almost horizontal tops, can be plainly seen. Mount Timber Top is seen straight before us some distance away. Slightly to the left, and apparently near by Mansfield, but proving on closer acquaintance to be a mile or two distant from the township, is the conspicuous Battery Hill, called by way of compliment Mount Battery; while farther back, and more to the left and north, range in apparently close proximity the Wombat, Table Top, and Hat Hill, all more or less conspicuous from their almost horizontal tops, and occasional long lines of shelf-like projecting rocks. These attract more and more attention till we reach Mansfield. From the township, a walk of a few minutes only brings us to Ford's Creek, on the Benalla Road, where we are face to face with broad surfaces of flat sandstone rock, many yards in width, visible for a considerable distance in its bed. To the north-east, at a short distance, is the Mount Battery, whence the fossil plants came which attracted the attention of Mr. Selwyn. In a northerly direction, to the summit of the Wombat, Timber Top, and Hat Hill, attaining an altitude of from 2000 to 3000 feet, every creek, cutting, or protruding rock exhibits hard gritty flagstones of reddish brown to purplish red, with chocolate and claret coloured fine grained sandstones (some having a micaceous character), interstratified with very thick beds of rubbly shale and mudstone, resembling rocks I have seen at the Iguana Creek, and the Avon River in Gippsland.

Examining the formation along the Broken River, from the old bridge at Dueran to the spot searched by Mr. Cresswell, and on to Mr. P. O'Halloran's selection, and into the enclosure known as the Tannery Paddock, being part of what is now Mr. Mitchell's Dueran Estate, I found them composed of chocolate coloured rubbly shales changing to a purplish tint, interstratified with beds of much harder material, showing in places ripple and other markings. Having reached the spot shown to me by Mr. James Tolmie, where he found the fragment of *Ichthyodorulite*, resembling *Gyracanthus*, I ascertained them all to have been found as freestones, and not *in situ*.

The Broken River, for a considerable distance in this neighbourhood, runs approximately from east to west, while the strata dip at an angle of from 4° to 8° to the south-west, the general inclination of the land surface on the north, as of the strata, from the tops of the Hat Hill, Table Top, &c., six miles distant, except where denuded and scooped out to form the deep valleys which can often be observed, is toward the river.

The western boundary of these rocks, north of the Broken River, is approximately along the line of the Blue Range Creek, where they abut on, and appear to overlap, the granite rocks which culminate in the Blue Ranges.

The strata on the south side of the river continue to dip, wherever seen, in the same direction, and at about the same angle as on the north side. The land surface generally, however, rises slowly from the river for a few miles, till it reaches the watershed of the Delatite River and its tributaries, not, however, without an occasional hill, evidently the remains of an extensive and almost horizontal area, which the denuding agency of the receding waters failed to remove. By far the most conspicuous of such, is the Battery Hill before referred to, and several others on the north of Broken River, including the Hat Hill, Table Top, &c. The small hill, also on the north of the Broken River, and to the west of Bridge Creek, visited by Mr. Cresswell, is one example; and the somewhat larger hill, a mile further east, close to the river, forming a part of Mr. P. O'Halloran's and Mr. Mitchell's properties, and containing an area of about one hundred and twenty acres, is another. It is with these two last-named elevations, and chiefly the latter, that this paper is concerned, as it was this place which appeared to me to present the greatest facilities for ascertaining the succession of the various strata, and obtaining fossils.

Our camp was fixed at 11 (Plate I) on the south side of the river, so as to be near at hand. The wisdom of this was soon apparent, as we were thus enabled to use all available daylight for our work. For though the employés worked but eight hours per day, my investigations occupied me nearly double that time, daylight being supplemented by the lamp, for some of the work that had to be done.

If we start from the point at which the line Y Y bisects the hill on its western side, the site of No. 1 in sketch, indicating the first excavation, and look south-west, we at once notice a steep embankment, which slopes some thirty

feet down to the river flats below, and forming the upper ledge of this embankment, and immediately below the surface, a band of hard rock four feet in thickness, which has served to protect the underlying beds from denudation, and has thus played an important part in determining the present conformation of the hill. Looking north-east, the hill rises before us in a plane, closely parallel to the plane of stratification of this band. If we now walk along the embankment with the hill on our left, we gradually come down to the level of the river, and obtain evidences of its action. Some of the rocks have been undermined by the flood waters, and stand out in bold projections; others lie with their upper surface exposed in large flags, which occasionally show ripple-markings, and an innumerable number of what seem to be fucoids or the castings of worms. As we come round the hill, and approach the point, No. 9, where the line Z Z^{II} crosses the river, the rocks form its bed for a short reach, and pass out of sight on the other side. Beds, superior to any now remaining on this hill, have been revealed by the flood waters on the other side of the river; while a little to the east of this line, clear evidence exists that the river has cut for itself a considerable depth and width through the hard rocks into the softer rubbly shale or mudstone.

The general appearance of the locality favours the view, that at no very distant period of time the flats above this point were occupied by the waters of a lake, extending over the Tannery Paddock and beyond. These flats are in winter almost a swamp, and where it is cut by the river, I found that the alluvial deposits attain a depth of some twenty feet. The erosion of the hard rocks at this lower extremity has, I think, drained the lake.

Continuing on the north side of the river, along the embankment, which now becomes more steep with the projecting rocks shelving out, several lower beds show themselves along the escarpment, marked No. 8. A short distance from here, the embankment ceases to be precipitous, and slopes out a long way to the flats. On reaching the point marked Z^{II}, the aneroid indicated one hundred and forty feet above the river. Hence, to the point of commencement, the north sides of this isolated remnant of what was once an extensive plateau, stretch away to the lower land. A survey of the country around, from the highest part of this hill, gives evidence of its former continuity with several other elevations

on the north of the river. The sloping surfaces of the hills are seen to be nearly in one plane, including that visited by Mr. Cresswell, to the west, and the Hat Hill. It reveals also the chief cause of their isolation, which is clearly the extensive denudation which has taken place during the slow elevation of the land through the waters, intensified by more recent causes. The action referred to has removed the rock for a depth of one hundred and thirty feet from the top of this hill (marked Z^{II} on sketch) to the flats below, exposing a series of twenty-four beds of varying thickness.

As will be observed from the specimens exhibited, the prevailing rock of the north-east of this declivity of the hill is a rubbly and nodular shale or mudstone, of chocolate, claret, or purplish-red, and in one or two cases of a pale green and greenish-blue colour, so much so, that of the twenty-four beds of rock, thirteen, having an aggregate thickness of one hundred and fifty-two feet, are of this character, interstratified with eleven beds of different rocks.

These eleven contain a thickness of only eight feet six inches, giving a total thickness of beds of all kinds of one hundred and sixty feet, but which, owing to the inclination of the beds, and the five upper beds not being found till the summit of the hill is passed, gives but one hundred and thirty feet as the altitude of the hill above the river flats.

Let me now direct attention to the various strata, their general character, and the fossils found in each, beginning at the lowest stratum observed, at the north-east of the hill indicated by Z^{I} on the line $Z\ Z^{II}\ Z^{I}$.

The lowest member of the series observed (Plate 2, A) was a dull red dense micaceous sandstone. In this, no fossil remains were detected, and the lower limit was not seen, but a few feet being exposed. Resting on this is a bed, thirty feet thick, of the dull purplish, rubbly, nodular, and calcareous shale or mudstone before referred to. Next, we reach six feet (B) of a bluish-green calcareous mudstone shale, slightly micaceous, and retaining the rubbly and nodular character of the thirty feet bed of mudstone rock on which it rests. Then follow fifteen feet (C) of rock similar to A, bearing on it one foot (D) similar to B, and then another fifteen feet (E) similar to A. We now reach a six inch stratum (F) of much harder rock, which has resisted the action of the weather more than any of those named, and projects out in a long yellow line. This, when broken into, displays a bluish-grey arenaceous limestone, slightly micaceous, chang-

ing to light yellowish-brown on exposure and loss of lime. No. 5 excavation was on this bed.* Then twenty feet of rock (G) similar to A, are met with. We now reach a most interesting bed (H) (excavation No. 4) about nine inches in thickness, of calcareous and micaceous sandstone, of varying colour; the prevailing rock being of a dense, dark, bluish-grey, having lenticular patches, some of a yellowish, and others of a green tint.

Material similar to the lower bed A was then passed through in bed I for twenty feet.

J is a six-inch bed of brecciated fine-grained calcareous sandstone, resisting the action of the weather, and ledging out, having a very mottled appearance.

K is eight feet of similar rock to A.

L is a six-inch mottled bed similar to J.

M has six feet of similar material to A, except that it is lighter, being more of a chocolate colour; and in N for four inches J is repeated. O again repeats M.

P is an eight-inch stratum, similar to J in being mottled, though of a lighter colour, changing to a yellowish-brown on exposure, but having on its under side lenticular masses of siliceous and calcareous breccia of a dark purplish colour, on which No. 6 trench and excavation were made.

Q has four feet more of the chocolate-coloured rubbly shales similar to M; and in R we have the bed in which the greatest amount of excavation was done, as on it were situated Nos. 2, 3, and 7. It is a six-inch, highly-laminated, chocolate-coloured shale, slightly calcareous, scaling off in thin flakes, and containing oval-shaped lenticular masses of dense, dark purplish calcareous sandstone, changing to a lighter colour on exposure.

The S bed immediately above this again resembles M for four feet, and then a nine-inch bed (T) of dense dark stone, changing to light chocolate or claret-coloured ferruginous and micaceous sandstone is seen.

Resting on this is a twelve feet bed (U), similar to M.

V is a two-feet stratum of irregularly-bedded ferruginous sandstone shale.

Above this is another two-feet bed (W), and highest of the series on this side of the river, though occurring only on the

* The numbers of the excavations are in the order of their commencement. For facilitating recognition by the workmen, and the correct reference of the fossils to their proper beds, the numbers of the excavations were fixed to each specimen.

lower part of the hill, no great distance above the river, apparently composed of similar material to the last, but more dense and compact; so much so that in quarrying, in one or two cases, blocks were dislodged some tons in weight, and very difficult to break up.

Some idea of the extent of the operations may be gained from the fact that the ten hands engaged, beside searching the surface over a large area, removed, in the five weeks during which the operations were continued, over five hundred tons of earth and rock, much of the latter having to be carefully broken and searched, to obtain the three hundred specimens with which our labour was rewarded.

Having determined these various strata, I now needed to obtain palæontological evidence of their age. There are considerable quantities of freestone on the surface, from which, occasionally, very interesting fossil specimens were, with considerable search, obtained.

On the evening of December 23rd, during a walk among some large heaps of stone collected from a patch of cultivated land below and to the north of "7," I had, looking between the stones as the setting sun cast its light in the interstices, espied distinct fish scale markings on an under stone, and on removing the stones pressing on it, found it to be the cast of a fish differing in appearance from any I had before seen. It was about thirteen inches long and four inches broad, with the scales and scale-markings deeply and plainly pitted in the stone. Neither the head nor tail are perfect, but the anal fin is both large and distinct, and the dorsal fin can also be discerned. This specimen has since been named *Cosmolepides sweeti* (McCoy).

Yet the importance of tracing these remains to their natural bed, and of obtaining them *in situ*, was fully recognised. To effect this, efforts were continued for some days, with the result that one bed (P) was suspected to be the one from which certain remains had come.

On the horizon of K, I had discovered portions of fish with a form of scale much smaller, but in other respects like that I had found on the 23rd, and retaining in this case their bony structure. I had set a man to work to trench up the hill side, hoping to strike the bed from whence they had come. While he was thus engaged on the morning of the 26th of December last, continuing myself the surface search near to him, I opened a stone by splitting it along the beding plane, and to my delight, a half of one of the

Ganoid fishes, some ten inches long and three inches broad, with its heterocercal tail, and portion of the trunk clearly defined, was exposed, also a portion of the anal fin; and on the stone being fully opened, it displayed in its scale-markings the same rhomboidal character observed in the large fish, with the osseous structure noticed in the smaller one discovered a few days before.

These were as finely sculptured, the form in some being very distinct. The scaly trunk is well shown, some of the scales in counterpart, with most of the head portions of the pectoral, anal, and caudal fins and gill plates. Nothing was observed of the internal skeleton of the trunk, and no traces of ossified ribs were seen. The fins, where not removed, have distinct rays. The specimen is in the hands of Professor McCoy, for complete description, by whom it has been named *Cosmolepides sweeti* (McCoy). The search was continued till the highly-laminated shale (R), with its oval-shaped lenticular masses on the under-side of varying thickness and size, from a few inches to three or four feet were met with. This bed was followed for some distance, when lenticular stones were opened, having the same lithological character as that in which the first whole fish was found, and in such masses we subsequently found most of the fish remains of that bed. When it had been proved that this was the bed from which the lenticular masses containing the fish had come, the discovery of the other fossil-bearing beds soon followed, so that now I am in a position to point out the several beds in which the particular fossils were found.

Several other trenches were opened up in the course of the search, for similar purposes.

We now come to observe the fossils found *in situ* at the various beds.

In the thirteen beds of rubbly shale, with an aggregate thickness of one hundred and fifty-two feet, but few organic remains were seen, except on the line of contact between them and the adjoining beds.

The first bed in ascending order containing many fossils was F. From this bed were obtained several *Ichthyodorulites*, a portion of large *Gyracanthus*-like spine, and a large bone belonging to the head of a *Ganoid* fish, with other large undetermined Ichthyic remains, now in the hands of Professor McCoy. A few scales, some an inch and a half in diameter, allied to *Glyptolepis*, and a tooth, about an inch in length of a conical form, curved and hollow, with a few

more fossils. But, owing to one part of the matrix being very hard, and the other quite soft, great difficulty was experienced, when after long search specimens were obtained, in preventing their destruction in relieving them sufficiently of the matrix to be recognisable.

In H, there are, here and there, patches an inch in thickness of comminuted fish-scales and bones, covered by a yellowish, pale green film; and in this film, as also occasionally in the lower parts of the bed, several fish were found, resembling *Cosmolepides sweeti* (McCoy), similar to that found near to and in No. 2. But though so thin, yet so refractory was this film found to be, that even when the dim outline of a fish could be seen, it was often found impossible to clear the film away and get at the fish without destroying it.

However, by removing a few scores of tons of earth and rock, and after expenditure of much labour, several specimens were secured, containing different parts, and in the aggregate, every part of the fish. It was here that a large heterocercal tail was found, measuring about six inches across, apparently *Cosmolepides sweeti* (McCoy). It was also near this horizon that the first larger fish of the same species was met with on December 23rd.

Large scales were rare in this bed, but one or two conical teeth were found here, and several spines, like those of *Gyracanthus obliquus* (McCoy).

P was found to be important, from its containing isolated patches of fossils of a species of very large fish, with large scales so nearly resembling, in some respects, the rare *Phyllolepis*, as to give one or two geologists an impression in favour of its identity with that little known species, or *Glyptolepis*.

These clusters provided considerable material for investigation, including large bony plates, one, eight inches by four, still retaining much of its original appearance and structure; large opercular plates, one probably the quadrate bone, exhibiting their radiating appearance and slightly corrugated edges; also one very large mass of bones of the skull of an undetermined fish; several detached, curved, and conical teeth about an inch long; large bones of the head of Rhizodont fish, and large portions of another jaw, with the teeth in position, and showing their internal structure. (These are now in Professor McCoy's hands).

Two specimens of jaws have since been found in softer stone, which I have succeeded in relieving from their matrix,

so that the whole of this portion of jaw can be inspected—one, showing twenty teeth of a conical shape, from one-quarter to three-eighths of an inch in height; the other, with a large double-pointed tooth with the apices missing, still about one inch by half an inch thick at the base, and one inch and three-quarters high, having portions of other much smaller teeth adjoining it. Also some constricted bones of various size from one inch to two inches in length —"probably hyoid bones of large fish"—and some long, fine, cylindrical bony spines, like detached branchiostegal rays have been found.

R.—This is the bed before referred to, as being the first in which I found the approximately complete fossil fish, *Cosmolepides sweeti*. From this bed, also, a sufficient number of specimens were obtained, to enable the whole of the parts to be fully made out. Conspicuous in this bed are the bi-lobed pittings everywhere observed, and covering every leaf of shale. It is here, also, that we find the first plant impressions *in situ*, lying in the same plane of bedding as the fish, and one or two specimens exhibiting unmistakable *Lepidodendron* characters. They are, however, of comparatively small size.

This bed has also yielded several specimens of a pitted structure like *Bothriolepis*, but in reality *Bothriobolus* (McCoy), but of different nature (Professor McCoy thinks it possibly ova, but its structure has not yet been made out). These are seen of large size, one being seven inches wide, nine inches long, and one and a half inches thick, but incomplete in length; and a shield-like form, about ten inches long by five inches broad (nearly perfect). Also several conical teeth like those before mentioned, from half an inch to an inch in length, with large plates retaining their bony structure, probably *Cephalaspidan*. Some others resembling, at a cursory glance, oblong shells; and the large scales, probably of *Glyptolepis*, were here obtained; also a portion of fish allied to *Scaphaspis*, and specimens of an Acanthoid fish. Another Acanthoid fish was obtained from here, about ten inches in length in its incomplete state, but it has apparently been about fourteen inches when the whole of the tail was intact. This shows most of the fins, retaining their bony spines *in situ*, and it is considered by Professor McCoy a very interesting specimen. He has in honour of Mr. Langtree, the energetic Secretary for Mines, named it *Chiraiapolus langtrei*. Some large gill-like plates, with radiating fibrous tissue, were

obtained here; also a fragment of jaw, showing internal structure of one large and one small tooth. A specimen, ten inches by six, showing parallel (apparently oblique) lines of very small shagreen-like scales; also many "cylindrical bones, probably of *Colocanth* fish showing canals." It was near this zone that I found a stone, containing casts of "nail-headed neural and hemal spines of *Colocanth* fish," in position, as when attached to the cartilaginous vertebra, which has left no imprint whatever; also a "portion of the trunk of a fish, allied to *Glyptolepis*," showing the large scales in position, and a small fish, "probably the body of a *Cephalaspidan*." These, with many *Gyracanthus*-like spines, and several other fossils, were all obtained from this bed.

T contained in parts numerous plants, which here attain a large size, one specimen left with Professor McCoy, being nine inches across, and one seen as a freestone was over twelve inches across. These specimens are found, in some cases, of considerable length, Professor McCoy having one of about four inches across, and over two feet in length; and longer fractured specimens were left behind.

V.—This bed gave us portions of a jaw, showing the dentition, and several *Gyracanthus* spines, with some undetermined structures; and scales of fish an inch and a quarter in diameter, and teeth. Portions of *Acanthoid* fish were obtained by Mr. Cresswell at this bed, near 10, in which sufficient of the structure can be made out to clearly discern the lateral line of enlarged scales; Professor McCoy has named this *Eupleurosmus cresswelli*. I also found portions of similar remains in this bed near 8. I found here also portions of a fish, having the same character as *Cosmolepides sweeti* (McCoy); a portion of fish allied to *Scaphaspis*, and a stone, eight inches by five inches, with tubercular elevations undetermined.

The W bed is the highest of the series on this side the river, and contains fossils in some respects similar to those described in the bed on which it rests, and apparently differing from it, only in that it seemed to contain less of the remains of the small and fragile fish, and more of the stronger bones, spines, &c., of the larger fish; and these seem to have attained a greater size at the period in which this bed was laid down, than when that below it was deposited. This yielded (at 9) a very large spine, resembling *Gyracanthus obliquus* (McCoy), about nine inches in length, with both the base and point perfect.

I have described the rocks of the one hill to the east of Bridge Creek, but an examination of the strata and fossils of the hill to the West of Bridge Creek shows unmistakably its relation to this one. Certainly, all the beds are not observable, as the river flats (recent) overlap the lower members of the group, but between those that are observable, there is perfect agreement.

It would be highly interesting and important to ascertain if the high hills to the north also contain these same beds, as, if they do, being so much higher than these, they should, on their northern or north-eastern flanks, present even better prospects of great results than did either of the hills which have been here described.

While in the locality, I succeeded in tracing the *Lepidodendra* along the eastern side of the Blue Range Creek to the top of the Hat Hill (over two thousand feet high), and brought back specimens which have been forwarded to Professor McCoy, who has identified some as the *Lepidodendron mansfieldense*. Time forbade me staying longer then, but I hope to be able (should no one more capable undertake the work) at no very distant date to return, and taking up the work where I left off, go on into the country beyond, and ascertain if any interesting geological features still remain to be observed and described, and if so, what.

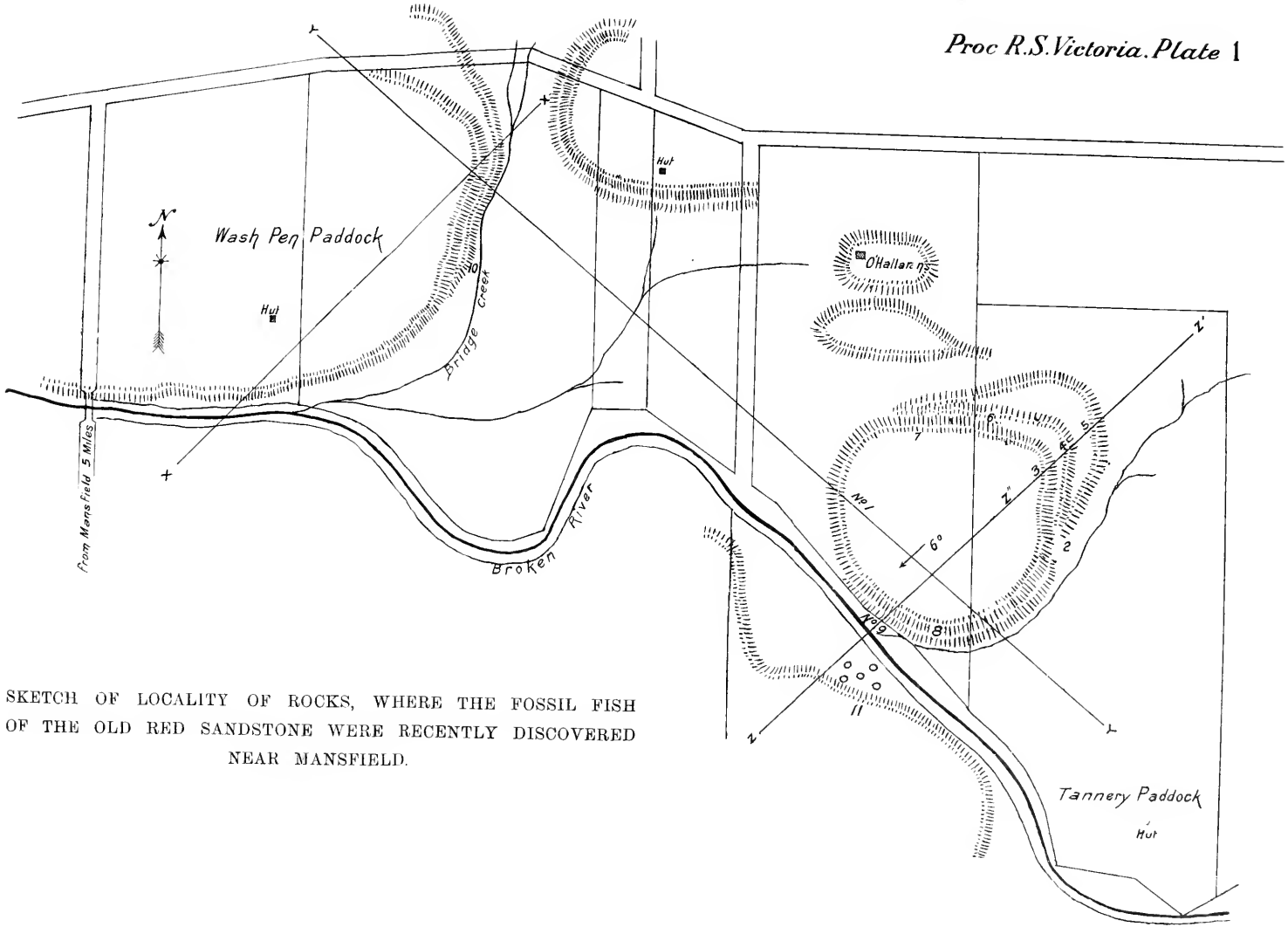
Although at the risk of appearing egotistical, I think I can best summarise the general results of my work in the words of Professor M'Coy, who has provided me with the following, as well as other information, and wishes me to make this use of it :—

"The magnificent collections both of *Lepidodendron* and fish which you have made, and the pains and trouble which you have bestowed on the working out of many of these, and observing and plotting accurately on paper all the fossiliferous strata of the locality, deserve the warmest praise and thanks both from myself and the Department. You have satisfactorily determined the general fact, as I expected, of the superior position of the *Lepidodendra* to the majority of the fish beds; but, further, with a highly intelligent appreciation of the great geological interest of the point, you have proved—what was before uncertain—that they belonged to the same formation, by preserving and bringing down a slab of rock in which the remains of the vegetables and fishes were embedded together. In addition to a large series of all the organic remains found by your predecessors,

you have obtained evidence of several entirely new fishes of great interest, one of the most striking of which I have great pleasure in dedicating to you, as a memorial of your successful labours in clearing up this difficult piece of local geology and palæontology. You have also thrown a flood of light on the other species, by your skilful putting together of the fragments, and showing the relations of many parts by your painstaking clearing of these brittle remains from the hard matrix.

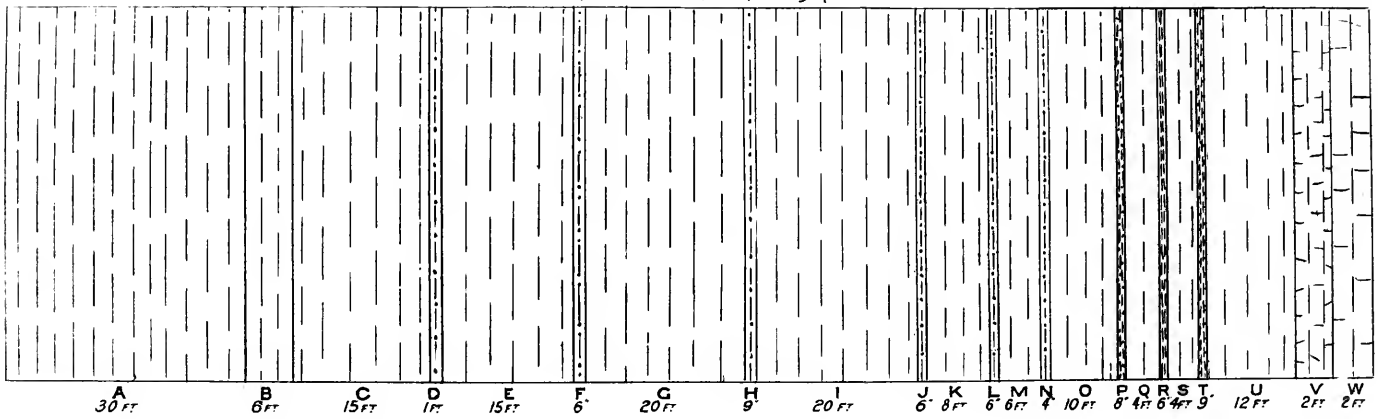
"The whole of these organic remains are now being carefully figured for the next decade of the Palæontology of Victoria, in which further acknowledgment will be made of the value of your friendly help."

In conclusion, my thanks are due, especially to Professor McCoy, in whose hands the specimens have been placed for description, and to whom I am indebted for the names and descriptions of various forms. To Mr. Murray, for the ready and thorough manner in which he employed his knowledge to assist me in finding the exact locality, &c., whence the first fossils found were obtained. To the Rev A. W. Cresswell, M.A., for information as to locality and notes of fossils found by him. To Mr. D. Mitchell, for permission to quarry on his estate; and to his managers, Mr. P. F. Nembegin and Mr. Loveband, for their kind assistance. To Mr. P. O'Halloran, for permission to quarry, and assistance. To Mr. McCartney, for permission to camp on the Battery Estate. To Mr. A. H. S. Lucas, M.A., B. Sc., and to Professor Spencer, for encouragement and advice, without whose kindly help, this paper would not, I think, have been presented, they being of opinion that the record of my work would be of interest and value.



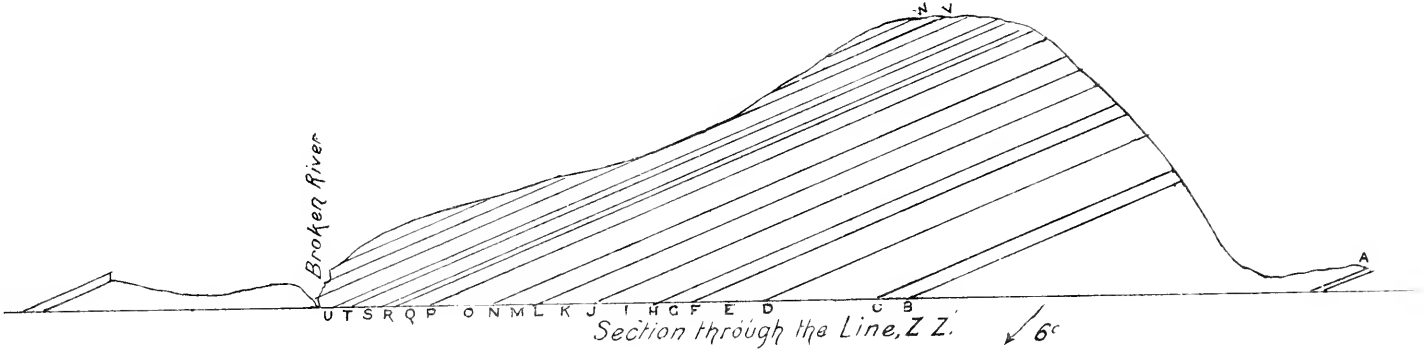
SKETCH OF LOCALITY OF ROCKS, WHERE THE FOSSIL FISH OF THE OLD RED SANDSTONE WERE RECENTLY DISCOVERED NEAR MANSFIELD.

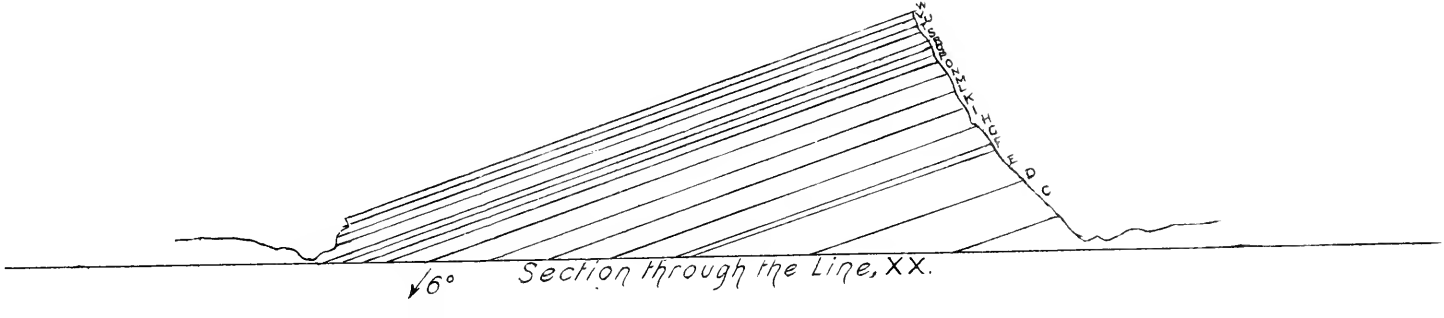
Section of rocks through ZZ'Z'



Section through the Line, YY.

SKETCH OF SECTIONS.





Art. II.—*A Systematic Census of Indigenous Fish, hitherto recorded from Victorian Waters.*

By A. H. S. Lucas, M.A., B. Sc.

[Read April 6th, 1889.]

Introduction.

The classification followed in this Census is that adopted by the Hon. Sir William Macleay in his "Descriptive Catalogue of Australian Fish." It is, in the main, that of Dr. Günther, as elaborated in his "Catalogue of Fishes of the British Museum."

To each species is appended :—(1) The name of the author who, either originally described it, or who gave the *specific* name finally accepted, and an exact reference to the work in which the description or denomination first appeared, with the date of publication. (2) References to the more important synonyms, in cases where it was thought any ambiguity might exist. (3) A reference to the figure in case of those fish which have been figured. Where a fish has been figured more than once, usually only the latest or most accessible figure is recorded. The most important of these illustrations are the figures in the Plates of Professor M'Coy's "Prodromus of Victorian Zoology." (4) The localities from which the species have been obtained, as far as known with precision. (5) The vernacular name as used in Victoria. Those species of which only single specimens have been obtained appear in parentheses, as do any others of whose occurrence in Victorian waters there is any doubt. Amongst these last, I have included all the species described or labelled as coming from Hobson's Bay or Port Phillip by Dr. Klünzinger, in the "Archiv. f. Naturg. xxxvii," 1872, since it seems probable that some South Australian fish have been confused with others sent to the Stuttgart Museum from Victoria. It seemed wiser to incorporate in the Census the species as given by so considerable an authority as Dr. Klünzinger, but questions of local distribution can only be satisfactorily settled by resident local workers, and it remains for evidence to be forthcoming to vindicate Dr. Klünzinger's Victorian records.

As it stands, the list includes 233 species. There can be no doubt but that many additions will be made, especially of smaller species, and of species living in deeper waters, which require the use of the trawl for their capture. On the other hand, it seems highly probable that several forms ranked as species are really but varieties. This is notably the case in the genera Monacanthus, Labrichthys and possibly Galaxias.

Our Fish Fauna has been very tardily worked out, and much remains to be done even now. A few of our fish are world-wide in their distribution, and the species thus secured the great Linnæus as their sponsor. The first strictly Australian species described are, I believe, to be found in the pages of "White's Journal to New South Wales," published in 1790. Amongst these, a very few Victorian forms are figured, in company with the Great Brown Kingfisher, and other "*species non-descripti*," as White terms them. As expeditions from Europe became more frequent, Australian fish appear in the systematic works, first of Bloch and of Lacépède, and later on of Cuvier and Valenciennes. The voyages of the Freycinet Expedition, of the Astrolabe, Beagle, Erebus and Terror, added a large number of Australian species in the Zoological Appendices to their Narratives. To Drs. Quoy and Gaimard, to Jenyns, and to Sir John Richardson, we owe thus a number of descriptions. To the latter too, were forwarded several consignments of Tasmanian fish, and of course many of these are common to Victoria and Tasmania; but it was not until 1872 that a serious study was made of Victorian forms proper. In that year Count F. de Castelnau, well-known for his previous researches on the fish of South America and of the Cape of Good Hope, published in the "Proceedings of the Zoological Society of Victoria," descriptions of about 150 species, which he had obtained, mostly from the Melbourne Fish Market. In the succeeding year, he added notes on more species. The Count's labours have made the work of those who follow him mainly of a supplementary nature Amongst others who have worked during the last twenty years at our fishes, have been Drs. Günther, Steindachner, Klünzinger, and especially the Hon. Sir William Macleay, of Sydney, who has done so much for Australian Ichthyology in many ways, and most of all by the publication of his excellent "Descriptive Catalogue of Australian Fish." Finally, Professor M'Coy has given detailed descriptions and figures, usually in colours, of over 50 species of our Victorian fish.

SUB-CLASS I.—TELEOSTEI.

ORDER I.—ACANTHOPTERYGII.

Division I.—Acanthopterygii Perciformes.

FAMILY PERCIDÆ.

Lates, Cuvier.

L. colonorum, Günther, A.M.N.H., p. 114, 1863.
Macleay Cat. 2.
Figured, M'Coy, Prodr. Zool. Vict., pl. 14.
Loc.—Gippsland Lakes. Occurs also at Sandridge and at the mouth of the Saltwater River, M'Coy, l.c.
Vernacular name—*Gippsland Perch.*

L. similis, Castelnau, P.Z.S. Vict. I, p. 44, 1872.
Macleay Cat. 3.
Loc.—Gippsland Lakes, scarce, Castelnau, l.c.

L. antarcticus, Castelnau, P.Z.S. Vict. I, p. 44, 1872.
Macleay Cat. 4.
Syn.—*L. colonorum, var.*, M'Coy, l.c.
Vernacular name—*Sea Perch.*

L. victoriæ, Castelnau, P.Z.S. Vict. I, p. 45, 1872.
Macleay Cat. 5.

Microperca, Castelnau.

M. yarræ, Castelnau, P.Z.S. Vict. I, p. 48, 1872.
Macleay Cat. 12.
Loc.—Lower Yarra, Castelnau, l.c.

Enoplosus, Lacépède.

E. armatus, White sp., Voyage to N.S.W., 1790.
Günther Cat. I, p. 81 ; Macleay Cat. 13.
Figured, White, Voy. to N.S.W., pl. 39.
Loc.—*Passim.*
Vernacular name—*Bastard Dorey, Old Wife, Zebra-fish.*

(Anthias, Bloch.)

(*A. rasor*, Richardson, P.Z.S., p. 95, 1839.)
Günther Cat. I, p. 93 ; Macleay Cat. 16.
Figured, Richardson, T.Z.S., 1849, pl. 4.
Loc.—One specimen from Western Port, Castelnau, P.Z.S. Vict. I, p. 51.
Vernacular name—*Tasmanian Red Perch* or *Barber.*

(Nannoperca, Günther.)

(*N. obscura*, Klünzinger, Archiv. f. Naturg., xxxviii., 1872.)
Macleay Cat. Sup. 1144.
Loc.—"Yarra Lagoon," Klünzinger, l.c.

APOGON, Lacépède.

A. güntheri, Castelnau, P.Z.S. Vict. I, p. 46, 1872.
Macleay Cat. 91.
Syn.—Perhaps—*A. novæ hollandiæ*, Val. (Macleay, l.c.)

(*A. conspersus*, Klünzinger, Archiv. f. Naturg., xxxviii., 1872.)
Macleay Cat. Sup. 1141.
Loc.—Port Phillip, Klünzinger, l.c.

ARRIPIS, Jenyns.

A. truttaceus, Cuv. et Val., Poissons III, p. 50, 1829.
Günther Cat. I, p. 253; Macleay Cat. 112.
Syn.—Includes *A. salar*, Richardson, T.Z.S. III, p. 78.
Figured, M'Coy, Prodr. Zool. Vict., pl. 16, 17.
Loc.—*Passim.*
Vernacular name—*Salmon* and *Salmon-trout.*

A. georgianus, Cuv. et Val., Poissons VII, p. 451, 1831.
Macleay Cat. 111.
Figured, Richardson, Voy. Erebus and Terror, pl. 54.
Loc.—Common according to Count Castelnau. I have not seen it.
Vernacular name—*Roughey.*

OLIGORUS, Günther.

O. macquariensis, Cuv. et Val., Poissons III, p. 58, 1829.
Günther Cat. I, p. 251; Macleay Cat. 114.
Figured, M'Coy, Prodr. Zool. Vict., pl. 85, 86.
Loc.—Murray and tributaries; now Yarra.
Vernacular name—*Murray Cod.*

O. mitchellii, Castelnau, P.Z.S. Vict. II, p. 150, 1873.
Macleay Cat. 115.
Loc.—Murray R., Castelnau, l.c.
Vernacular name—*Murray Perch.*

CTENOLATES, Günther.

C. ambiguus, Richardson, Voy. Erebus and Terror, p. 25, 1846.
Günther Cat. I, p. 270; Macleay Cat. 118.
Figured, M'Coy, Prodr. Zool. Vict., pl. 84.
Syn.—*Dules auratus*, Castelnau, P.Z.S. Vict. I, p. 55.
Loc.—Murray and tributaries.
Vernacular name—*Murray Golden Perch.*

FAMILY PRISTIPOMATIDÆ.

MURRAYIA, Castelnau.

M. güntheri, Castelnau, P.Z.S. Vict. I, p. 61, 1872.
Macleay Cat. 121.
Loc.—Murray R., Castelnau, l.c.

M. cyprinoides, Castelnau, P.Z.S. Vict. I, p. 62, 1872.
Macleay Cat. 122.
Loc.—Murray R., Castelnau, l.c.
Vernacular name—*Murray Carp.*

M. bramoides, Castelnau, P.Z.S. Vict. I, p. 63, 1872.
Macleay Cat. 123.
Loc.—Murray R., Castelnau, l.c.
Vernacular name—*Murray Bream.*

M. riverina, Krefft, P.Z.S., p. 943, 1867.
Macleay Cat. 124.
Loc.—Murray and tributaries, Macleay, l.c.

(RIVERINA, Castelnau.)

(*R. fluviatilis*, Castelnau, P.Z.S. Vict. I, p. 64, 1872.)
Macleay Cat. 137.
Loc.—One specimen, Murray R., Castelnau, l.c.

THERAPON, Cuvier.

T. richardsoni, Castelnau, P.Z.S. Vict. I, p. 60, 1872.
Macleay Cat. 138.
Loc.—Murray R., Castelnau, l.c.
Vernacular name—*Murray Silver Perch.*

T. niger, Castelnau, P.Z.S. Vict. I, p. 59, 1872.
Macleay Cat. 139.
Loc.—Murray R., rare, Castelnau, l.c.
Vernacular name—*Murray Black Perch.*

HISTIOPTERUS, Richardson.

H. recurvirostris, Richardson, Voy. Erebus and Terror, p. 34, 1846.
Macleay Cat. 156.
Vernacular name—*Boar-fish.*

H. labiosus, Günther, P.Z.S. p. 658, 1871.
Macleay Cat. 157.
Figured, P.Z.S. 1871, pl. 59.
Loc.—Western Port and Port Phillip, Castelnau, P.Z.S. Vict. I, p. 112.

GERRES, Cuvier.

G. melbournensis, Castelnau, P.Z.S. Vict. I, p. 158, 1872.
Macleay Cat. 173.
Loc.—Victorian seas, Castelnau, l.c.

FAMILY NANDIDÆ.

RUPPELIA, Castelnau.

R. prolongata, Castelnau, P.Z.S. Vict. II, p. 51, 1873.
Macleay Cat. 218.
Loc.—Victorian seas, Castelnau, l.c.
Vernacular name—*Devil-fish* (Castelnau).

FAMILY MULLIDÆ.

UPENEOIDES, Bleeker.

U. vlamingii, Cuv. et Val., Poissons III, p. 452, 1829.
Günther Cat. I, p. 400 ; Macleay Cat. 222.
Figured, Cuv. et Val., l.c. pl. 71.
Loc.—Victorian seas, Castelnau, P.Z.S. Vict. II, p. 39.
Vernacular name—*Red Mullet.*

UPENEICHTHYS, Bleeker.

U. porosus, Cuv. et Val., Poissons III, p. 455, 1829.
Günther Cat. I, p. 400 ; Macleay Cat. 227.
Loc.—Victorian seas ; not very common.
Vernacular name—*Red Gurnet, Red Mullet.*

FAMILY SPARIDÆ.

GIRELLA, Gray.

G. tricuspidata, Cuv. et Val., Poissons VI, p. 372, 1830.
Günther Cat. I, p. 428 ; Macleay Cat. 231.
Figured, Richardson, Voy. Erebus and Terror, pl. 25.
Vernacular name—*Rock* or *Black Perch.*

G. simplex, Richardson, Voy. Erebus and Terror, p. 25, 1846.
Günther Cat. I, p. 429 ; Macleay Cat. 232.
Figured, M'Coy, Prodr. Zool. Vict., pl. 73.
Loc.—Gippsland Lakes ; not very uncommon in Port Phillip.
Vernacular name—*Ludrick.*

(*G. blackii*, Castelnau, P.Z.S. Vict. II, p. 41, 1873.)
Macleay Cat. 234.
Loc.—"The specimen," Castelnau, l.c.

NEOTEPHRŒOPS, Castelnau.

N. zebra, Richardson, Voy. Erebus and Terror, p. 70, 1846.
Günther Cat. I, p. 432 ; Macleay Cat. 239.
Loc.—*Passim.*
Vernacular name—*Zebra-fish.*

PAGRUS, Cuvier.

P. unicolor, Cuv. et Val., Poissons VI, p. 162, 1830.
Günther Cat. I, p. 468 ; Macleay Cat. 255.
Loc.—Port Phillip, and off south coast.
Vernacular name—*Schnapper* or *Snapper.*

CHRYSOPHRYS, Cuvier.

C. australis, Günther Cat. I, p. 494, 1859.
Macleay Cat. 259.
Figured, M'Coy, Prodr. Zool. Vict., pl. 4; Günther Cat. pl. 28.
Loc.—*Passim.*
Vernacular name—*Bream.*

(HAPLODACTYLUS, Cuv. et Val.)

(*H. mœandratus*, Solander (Richardson), T.Z.S. III, p. 83, 1849.)
Macleay Cat. Sup. 1161.
Loc.—Hobson's Bay, Klünzinger, Archiv. f. Naturg. xxxviii.

FAMILY CIRRHITIDÆ.

CHIRONEMUS, Cuv. et Val.

C. marmoratus, Günther Cat. II, p. 76, 1860.
Macleay Cat. 263.
Loc.—Victorian seas, Castelnau, P.Z.S. Vict. I, p. 73.
Vernacular name.—*Kelp-fish.*

CHILODACTYLUS, Cuvier.

C. macropterus, Richardson, P.Z.S., p. 62, 1850.
Günther Cat. II, p. 78; Macleay Cat. 267.
Syn.—*C. aspersus*, Richardson. (Johnston, Report of Royal Commission on Fisheries of Tasmania, 1883.)
Loc.—Off South Coast, Castelnau, P.Z.S. Vict. I, p. 74.

C. nigricans, Richardson, P.Z.S., p. 63, 1850.
Günther Cat. II, p. 79; Macleay Cat. 269.
Loc.—*Passim.*
Vernacular name—*Butter-fish*

C. carponemus, Cuv. et Val., V, p. 362, 1830.
Günther Cat. II, p. 78; Macleay Cat. 266.
Figured, M'Coy, Prodr. Zool. Vict., pl. 173, 174.
Loc.—Port Phillip Heads, rare.

C. gibbosus, Richardson, T.Z.S. III, p. 102, 1849.
Günther Cat. II, p. 84; Macleay Cat. 271.
Figured, P.Z.S., 1859, pl. 2.
Loc.—Victorian, Castelnau, P.Z.S. Vict. I, p. 75.
Vernacular name—*Magpie Perch.*

C. spectabilis, Hutton, Fishes of N.Z., p. 8, 1872.
Macleay Cat. 272.
Loc.—Port Phillip, Macleay, l.c.

(*C. nebulosus*, Klünzinger, Archiv. f. Naturg., xxxviii, 1872.)
Macleay Cat. Sup. 1164.
Loc.—Queenscliff, Port Phillip, Klünzinger, l.c.

LATRIS, Richardson.

L. hecateia, Richardson, P.Z.S., p. 99, 1839.
Günther Cat. II, p. 86; Macleay Cat. 276.
Figured, T.Z.S. III, pl. 6.
Loc.—Bass' Straits, occasionally in Hobson's Bay, Castelnau, P.Z.S. Vict. I, p. 77.
Vernacular name—*Hobart Town Trumpeter.*

L. forsteri, Castelnau, P.Z.S. Vict. I, p. 77, 1872.
Macleay Cat. 278.
Loc.—"Said to be common on Gippsland Coast," Castelnau, l.c.
Vernacular name—*Bastard Trumpeter.*

(*L. bilineata*, Castelnau, P.Z.S. Vict. I, p. 79, 1872.)
Macleay Cat. 279.
Loc.—One specimen from Western Port, Castelnau, l.c.

(*L. inornata*, Castelnau, P.Z.S. Vict. I, p. 79, 1872.)
Macleay Cat. 280.
Loc.—One specimen from Western Port, Castelnau, l.c.

(LACEPEDIA, Castelnau.)

(*L. cataphracta*, Castelnau, P.Z.S. Vict. II, p. 43, 1873.)
Macleay Cat. 281.
Loc.—One specimen stuffed, Castelnau, l.c.

FAMILY SCORPÆNIDÆ.

SEBASTES, Cuv. et Val.

S. percoides, Richardson, Voy. Erebus and Terror, p. 23, 1846.
Günther Cat. II, p. 101; Macleay Cat. 282.
Figured, Voy. Erebus and Terror, pl. 15; M'Coy, Prodr. Zool. Vict., pl. 33.
Loc.—Port Phillip, Macleay, l c.
Vernacular name—*Gurnet.*

S. allporti, Castelnau, P.Z.S. Vict. II, p. 40, 1873.
Macleay Cat. 283.
Loc.—Victorian seas, Castelnau, l.c.

SCORPÆNA, Artedi.

S. cruenta, Solander, A.M.N.H. IX, p. 217, 1842.
Günther Cat. II, p. 112; Macleay Cat. 284.
Syn.—*S. militaris*, Richardson, Voy. Erebus and Terror, p. 22.
Loc.—Port Phillip, Macleay, l.c.
Vernacular name—*Red Rock Cod.*

CENTROPOGON, Günther.

C. scorpœnoides, Guichenot, Mém. Soc. Imp. des Sci. Nat., Cherbourg.
Macleay Cat. 298.
Syn.—*C. australis*, Castelnau, P.Z.S. Vict. I, p. 81.
Vernacular name—*Gurnet.*

PENTAROGE, Günther.

P. marmorata, Cuv. et Val., Poissons IV, p. 416, 1829.
Günther Cat. II, p. 132; Macleay Cat. 300.

FAMILY TEUTHIDÆ.

TEUTHIS, Linnæus.

T. javus, L, Syst. Nat. I, p. 507.
Günther Cat. III, p. 315; Macleay Cat. 306.
Loc.—Hobson's Bay, Macleay, l.c.

DIVISION II.—ACANTHOPTERYGII BERYCIFORMES.

None recorded.

DIVISION III.—ACANTHOPTERYGII KURTIFORMES.

None recorded.

DIVISION IV.—ACANTHOPTERYGII POLYNEMIFORMES.

None recorded.

DIVISION V.—ACANTHOPTERYGII SCIÆNIFORMES.

FAMILY SCIÆNIDÆ.

SCIÆNA, Cuv.

S. antarctica, Castelnau, P.Z.S. Vict. I, p. 100, 1872.
Macleay Cat. 329.
Syn. — Probably, *Corvina antarctica*, Steindachner, Sitzungsb. ak. Wiss. Wien, 1866.
Loc.—Occasional visitor in Bass's Straits, Castelnau, l.c.
Vernacular name—*King-fish.*

DIVISION VI.—ACANTHOPTERYGII XIPHIIFORMES.

None recorded.

DIVISION VII.—ACANTHOPTERYGII TRICHIURIFORMES.

FAMILY TRICHIURIDÆ.

THYRSITES, Cuv. et Val.

T. atun, Cuv. et Val., Poissons VIII, p. 196, 1831.
Günther Cat. II, p. 350; Macleay Cat. 336.
Syn.—*Scomber atun*, Vetensk. Acad. xii.; *T. altivelis*, Richardson, P.Z.S., 1839.

Figured, Cuv. et Val., Poissons, pl. 219 ; M'Coy, Prodr. Zool. Vict., pl. 44.
Loc.—Off south coast ; Bass's Straits.
Vernacular name—*Barracouta* or *Barracoota.*

DIVISION VIII.—ACANTHOPTERYGII COTTOSCOMBRIFORMES.

FAMILY CARANGIDÆ.

TRACHURUS, Cuv. et Val.

T. trachurus, Cuv. et Val., Poissons IX, p. 11, 1833.
Günther Cat. II, p. 419 ; Macleay Cat. 347.
Syn.—*Caranx declivis*, Jenyns, Zool. Beagle Fish, p. 68, pl. 14 ; *Scomber trachurus*, Lin. Syst. Nat. i., p. 494.
Figured, Cuv. et Val., pl. 246 ; M'Coy, Prodr. Zool. Vict., pl. 18.
Loc.—Port Phillip, M'Coy.
Vernacular name—*Horse Mackerel.*

CARANX, Cuv. et Val.

C. georgianus, Cuv. et Val., Poissons IX, p. 85, 1833.
Günther Cat. II, p. 440 ; Macleay Cat. 350.
Figured, Voy. Erebus and Terror, pl. 58.
Loc.—Port Phillip, and off south coast.
Vernacular name—*Silver Trevally.*

SERIOLA, Cuvier.

S. lalandi, Cuv. et Val., Poissons V, p. 208, 1830.
Günther Cat. 463 ; Macleay Cat. 365, 368.
Syn.—*S. grandis*, Castelnau, P.Z.S. Vict. I, p. 115.
Figured, M'Coy, Prodr. Zool. Vict., pl. 172.
Vernacular name—*Yellow Tail*, or *King-fish.*

NEPTONEMUS, Günther.

N. travale, Castelnau, P.Z.S. Vict. I, p. 118, 1872.
Macleay Cat. 372.
Vernacular name—*Trevally.*

TEMNODON, Cuv. et Val.

T. saltator, Bl. syst. Ichthyol (Schneider), p. 35, 1801.
Günther Cat. II, p. 479; Macleay Cat. 375.
Loc.—Queenscliff.
Vernacular name—*Skipjack.*

(PAREQUULA, Steindachner.) (?)

(*P. bicornis*, Steindachner, Sitzungsb. ak. Wien, 1867.)
Macleay Cat. Sup., p. 25.
Loc.—Hobson's Bay. Requires confirmation.

FAMILY CYTTIDÆ.

ZEUS, Cuvier.

Z. australis, Richardson, Voy. Erebus and Terror, p. 136, 1846.
Macleay Cat. 386.
Syn.—Günther considers = *Z. faber*, *L.*, Cat. II, p. 393.
Vernacular name—*Southern John Dorey.*

CYTTUS, Günther.

C. australis, Richardson sp., Voy. Erebus and Terror, p. 137, 1846.
Günther Cat. II, p. 396; Macleay Cat. 387.
Syn.—*Capros australis*, Richardson, l.c.
Loc.—Hobson's Bay, M'Coy, Rep. Intercol. Exh., 1866.
Vernacular name—*Bastard Dorey.*

FAMILY CORYPHÆNIDÆ.

BRAMA, Risso.

B. raii, Bloch, Syst. Ichth. (Schneider), p. 99, 1801.
Günther Cat. II, p. 408; Macleay Cat. 389.
Figured, M'Coy, Prodr. Zool. Vict., pl. 133.
Loc.—Portland, 1884, M'Coy, l.c.
Vernacular name—*Ray's Sea Bream.*

FAMILY SCOMBRIDÆ.

SCOMBER, Artedi.

S. australasicus, Cuv. et Val., Poissons VIII, p. 36, 1831.
Günther Cat. II, p. 359; Macleay Cat. 392.
Syn.—*S. pneumatophorus*, De la Roche (M'Coy).
Figured, M'Coy, Prodr. Zool. Vict., pl. 28.
Loc.—Rarely in Hobson's Bay, in considerable numbers when it does appear; M'Coy, l.c.
Vernacular name—*Southern Mackerel.*

(*S. antarcticus*, Castelnau, P.Z.S. Vict. I, p. 106, 1872.)
Macleay Cat. 393.
Loc.—One specimen seen in Melbourne market, Castelnau.

(*S. janesuba*, Bleeker, Japan, p. 406, 1858.)
Günther Cat. II, p. 359; Macleay Cat. Sup. 1186.
Loc.—Hobson's Bay, Klünzinger.

(*S. tapeino-cephalus*, Bleeker, Japan, p. 407, 1858.)
Günther Cat. II, p. 361; Macleay Cat. Sup. 1188.
Loc.—Hobson's Bay, Klünzinger.

THYNNUS, Cuv. et. Val.

T. m'coyi, Castelnau, P.Z.S. Vict. I, p. 104, 1872.
Macleay Cat. 396.
Syn.—*T. thynnus, L.* (M'Coy).
Figured, M'Coy, Prodr. Zool. Vict., pl. 44.
Loc.—Hobson's Bay, Portland, Bass Straits, Queenscliff, M'Coy, l.c.
Vernacular name—*Tunny.*

(PELAMYS, Cuv. et Val.)

(*P. schlegelii*, M'Coy, Prodr. Zool. Vict., 1888.)
Syn.—Perhaps, *P. orientalis*, Schlegel (M'Coy.)
Figured, M'Coy, Prodr. Zool. Vict., pl. 155.
Loc.—Only one specimen caught in Port Phillip Bay, 1877, M'Coy, l.c.

(CYBIUM, Cuv.)

(*C. commersonii*, Lacép. Hist. des Poissons II, p. 600, 1800.)
Günther Cat. II, p. 370 ; Macleay Cat. 400.
Figured, M'Coy, Prodr. Zool. Vict., pl. 154.
Loc.—Only one specimen caught near Queenscliff, 1887, M'Coy, l.c.
Vernacular name—*Commerson's Mackerel.*

FAMILY TRACHINIDÆ.

KATHETOSTOMA, Günther.

K. lœve, Bloch, Syst. Ichth. (Schneider), p. 47, 1801.
Günther Cat. II, p. 231 ; Macleay Cat. 406.
Figured, Bloch, l.c., pl. 8.
Vernacular name—*Stone Lifter.*

(PSEUDAPHRITIS, Castelnau.)

(*P. bassii*, Castelnau, P.Z.S. Vict. I, p. 92, 1872.)
Macleay Cat. 411.
Loc.—One specimen taken in Bass's Straits, Castelnau.

SILLAGO, Cuv.

S. punctata, Cuv. et Val., Poissons III, p. 413, 1829.
Günther Cat. II, p. 245 ; Macleay Cat. 413.
Figured, Voyage Astrolabe, pl. 1.
Loc.—*Passim.*
Vernacular name—*Melbourne Whiting.*

(*S. maculata*, Quoy et Gaim., Exp. Freycinet Zool., p. 261, 1834.)
Günther Cat. II, p. 245 ; Macleay Cat. 412.
Figured, Q. et G., l.c., pl. 53.
Loc.—Seen only once, Castelnau, P.Z.S. Vict. I, p. 94.

(BOVICHTHYS, Cuv. et Val.)

(*B. variegatus*, Richardson, Voy. Erebus and Terror, p. 56, 1846.)
Günther Cat. II, p. 250; Macleay Cat. 419.
Figured, Voy. Erebus and Terror, pl. 34.
Loc.—One dried specimen from Hobson's Bay, Castelnau, P.Z.S. Vict. II, p. 45.

FAMILY PEDICULATI.

CHIRONECTES, Cuvier.

C. bifurcatus, M'Coy, Prodr. Zool. Vict., Decade 13, 1886.
Figured, M'Coy, Prodr. Zool. Vict., pl. 123.
Loc.—Port Phillip, M'Coy, l.c.

FAMILY COTTINA.

PLATYCEPHALUS, Bl.

(*P. speculator*, Klünzinger, Archiv. f. Naturg., 1872.)
Macleay Cat. Sup. 1197.
Loc.—Hobson's Bay, Klünzinger.

P. bassensis, Cuv. et Val., Poissons IV, p. 247, 1829.
Günther Cat. II, p. 179; Macleay Cat. 444.
Syn.—*P. tasmanius*, Richardson, Voy. Erebus and Terror, p. 23.
Figured, Voy. Erebus and Terror, pl. 18.
Loc.—Port Phillip.
Vernacular name—*Flathead.*

P. fuscus, Cuv. et Val., Poissons IV, p. 241, 1829.
Macleay Cat. 445.
Figured, Voy. Astrolabe, pl. 10.
Loc.—Port Phillip.
Vernacular name—*Grass Flathead.*

P. lævigatus, Cuv. et Val., Poissons IV, p. 243, 1829.
Günther Cat. II, p. 179; Macleay Cat. 446.
Loc.—Port Phillip, Western Port.
Vernacular name—*Rock Flathead.*

(*P. proximus*, Castelnau, P.Z.S. Vict. I, p. 85, 1872.)
Macleay Cat. 447.
Loc.—Only seen once in Melbourne market, Castelnau, l.c.

P. richardsoni, Castelnau, P.Z.S. Vict. I, p. 82, 1872.
Macleay Cat. 448.

P. grandis, Castelnau sp., P.Z.S. Vict. I, p. 87, 1872.
Macleay Cat. 457.
Syn.—*Neoplatycephalus grandis*, Castelnau, l.c.

LEPIDOTRIGLA, Günther.

(*L. phalæna*, Cuv. et Val., Poissons IV, p. 83, 1829.)
Günther Cat. II, p. 197 ; Macleay Cat. 459.
Loc.—Melbourne, Günther (quoted by Macleay, l.c.)

(*L. sphynx*, Cuv. et Val., Poissons IV, p. 83, 1829.)
Günther Cat. II, p. 197 ; Macleay Cat. 460.
Loc.—One specimen, Castelnau, P.Z.S. Vict. I, p. 89.

L. vanessa, Richardson, Trans. Z.S. III, 1849.
Günther Cat. II, p. 197 ; Macleay Cat. 461.
Figured, M'Coy, Prodr. Zool. Vict., pl. 5.
Loc.—Hobson's Bay.
Vernacular name—*Butterfly Gurnard.*

TRIGLA, Artedi.

T. kumu, Less. and Garn., Voy. de la Coquille, Poissons, pl. 19, 1826–30.
Günther Cat. II, p. 204 ; Macleay Cat. 463.
Figured, M'Coy, Prodr. Zool. Vict., pl. 6.
Loc.—Hobson's Bay, M'Coy, l.c.
Vernacular name—*Kumu Gurnard.*

T. polyommata, Richardson, T.Z.S. III, p. 96, 1839.
Günther Cat. II, p. 204 ; Macleay Cat. 464.
Figured, Richardson, T.Z.S. III, pl. 5.
Vernacular name—*Flying Gurnard.*

DIVISION IX.—ACANTHOPTERYGII GOBIIFORMES.

FAMILY GOBIIDÆ.

GOBIUS, Artedi.

(*G. bifrenatus*, Kner., Voy. Novara, Fishes, p. 177, 1868.)
Macleay Cat. 476.
Syn.—*G. bassensis*, Castelnau, P.Z.S. Vict. I, p. 123.
Figured, Voy. Novara, pl. 7.
Loc.—Only seen once, Castelnau, l.c.

G. castelnaui, Macleay Cat. 477, 1881.
Loc.—Hobson's Bay, Castelnau, l.c., p. 124.

(*G. pictus*, Castelnau, P.Z.S. Vict. I, p. 124, 1872.)
Macleay Cat. 479.
Loc.—One specimen, Castelnau, l.c., p. 124.

G. pulchellus, Castelnau, P.Z.S. Vict. I, p. 125, 1872.
Macleay Cat. 480.
Loc.—Western Port, Castelnau, l.c.

(*G. caudatus*, Castelnau, P.Z.S. Vict. II, p. 47, 1873.)
Macleay Cat. 481.
Loc.—Apparently only one specimen. See Castelnau, l.c.

(*G. nebulo-punctatus*, Cuv. et Val., Poissons XII, p. 58, 1837.)
Günther Cat. III, p. 26; Macleay Cat. Sup. 1202.
Loc.—King George's Sound and Victoria, Klünzinger.

ELEOTRIS, Gronov.

E. nudiceps, Castelnau, P.Z.S. Vict. I, p. 126, 1872.
Macleay Cat. 520.
Loc.—Very common in Lower Yarra, Castelnau, l.c.
Vernacular name—*Big-head*, Castelnau.

(*E. cyprinoides*, Cuv. et Val., Poissons XII, p. 248, 1837.)
Günther Cat. III, p. 118; Macleay Cat. Sup. 1206.
Figured, Klünzinger, Sitzb. k. Ak. Wiss., Wien., 1879, pl. 5.
Loc.—Murray River, Klünzinger, l.c.

CALLIONYMUS, L.

(*C. calauropomus*, Richardson, Voy. Erebus and Terror, p. 10, 1846.)
Günther Cat. III, p. 147; Macleay Cat. 540.
Figured, Voy. Erebus and Terror, pl. 7.
Loc.—One specimen from Hobson's Bay, Castelnau, P.Z.S. Vict. II, p. 49.

C. papilio, Günther, A.M.N.H. XIV., p. 197, 1864.
Macleay Cat. 541.
Syn.—*C. ocellifer*, Castelnau, P.Z.S. Vict. II, p. 49.
Loc.—Hobson's Bay, Castelnau.

DIVISION X.—ACANTHOPTERYGII BLENNIIFORMES.

FAMILY BLENNIIDÆ.

(SALARIAS, Cuv. et Val.)

(*S. mulleri*, Klünzinger, Sitzb. d. k. Ak. Wiss., Wien., p. 388, 1879.)
Macleay Cat. Sup. 1215.
Loc.—Hobson's Bay, Klünzinger, l.c.

CLINUS, Cuv.

C. despicillatus, Richardson, Zool. Journ., p. 90, 1839.
Günther Cat. III, p. 271; Macleay Cat. 572.
Figured, T.Z.S. III, pl. 6.
Loc.—Recorded as Victorian by Castelnau, P.Z.S. Vict. I, p. 129.

(*C. marmoratus*, Klünzinger, Archiv. f. Naturg., 1872.)
Macleay Cat. Sup. 1217.
Loc.—Port Phillip, Klünzinger, l.c.

CRISTICEPS, Cuv. et Val.

C. howittii, Castelnau, P.Z.S. Vict. II, p. 48, 1873.
Macleay Cat. 582.
Loc.—Western Port, Castelnau, l.c.

C. robustus, Günther, A.M.N.H. XX, p. 62, 1867.
Macleay Cat. 583.
Loc.—Melbourne, Günther, l.c.

C. multifenestratus, Castelnau, P.Z.S. Vict. I, p. 131, 1872; II, p. 48, 1873.
Macleay Cat. 586.

(*C. amœnus*, Castelnau, P.Z.S. Vict. II, p. 48, 1873.)
Macleay Cat. 587.
Loc.—One specimen, Victorian, Castelnau, l.c.

(*C. forsteri*, Castelnau, P.Z.S. Vict. I, p. 132, 1872.)
Macleay Cat. 588.
Loc.—One specimen, Melbourne, Castelnau, l.c.

(*C. tristis*, Klünzinger, Archiv. f. Naturg., 1872.)
Macleay Cat. Sup. 1218.
Loc.—Murray R., Klünzinger, l.c.

DIVISION XI.—MUGILIFORMES.

FAMILY SPHYRÆNIDÆ.

SPHYRÆNA, Artedi.

S. novæ-hollandiæ, Günther Cat. II, p. 335, 1860.
Macleay Cat. 603.
Loc.—*Passim.*
Vernacular name—*Pike.*

LANIOPERCA, Günther.

L. mordax, Günther, A.M.N.H., X, p. 183, 1872.
Macleay Cat. 608.
Syn. —*Dinolestes müllerii*, Klünzinger; *Neosphyræna multiradiata*, Castelnau.
Figured, M'Coy, Prodr. Zool. Vict., pl. 115.
Loc.—Port Phillip.

FAMILY ATHERINIDÆ.

ATHERINICHTHYS, Bleeker.

A. modesta, Castelnau, P.Z.S. Vict. I, p. 136, 1872.
Macleay Cat. 620.
Loc.—Hobson's Bay and Lower Yarra, Castelnau.

A. picta, Castelnau, P.Z.S. Vict. I, p. 137, 1872.
Macleay Cat. 622.
Loc.—Capt. Synnot's Dock, Lower Yarra, Castelnau.

A. cephalotes, Castelnau, P.Z.S. Vict. I, p. 137, 1872.
Macleay Cat. 623.
Loc.—Hobson's Bay, Castelnau.

(ATHERINOSOMA, Castelnau.)

(*A. vorax*, Castelnau, P.Z.S. Vict. I, p. 138, 1872.)
Macleay Cat. 627.
Loc.—One specimen from Cape Schanck, Castelnau, l.c.

FAMILY MUGILIDÆ.

MUGIL, Artedi.

(*M. peronii*, Cuv. et Val., Poissons II, p. 138, 1836.)
Macleay Cat. 635.
Loc.—One specimen from Western Port, Castelnau, P.Z.S. Vict. II, p. 151.

M. grandis, Castelnau, P.L.S. N.S.W. III, p. 386, 1879.
Macleay Cat. 629.
Loc.—*Passim.*
Vernacular name—*Sand Mullet.*

(*M. gelatinosus*, Klünzinger, Archiv. f. Naturg., 1872.)
Macleay Cat. Sup. 1225.
Loc.—Hobson's Bay, Klünzinger, l.c.

AGONOSTOMA, Günther.

A. diemensis, Richardson, Zool. Trans. III, p. 123, 1849.
Günther Cat. III, p. 465; Macleay Cat. 641.
Syn.—*A. forsteri*, Bleeker.
Loc.—*Passim.*
Vernacular name—*Mullet.*

A. lacustris, Castelnau, P.Z.S. Vict. I, p. 142, 1872.
Macleay Cat. 642.
Loc.—Gippsland Lakes.

MYXUS, Günther.

M. elongatus, Günther, P.L.S., N.S.W. IV, p. 426, 1879.
Günther Cat. III, p. 466; Macleay Cat. 643.
Loc.—Hobson's Bay, Günther, l.c.

DIVISION XII.—ACANTHOPTERYGII GASTEROSTEIFORMES.

None recorded.

DIVISION XIII.—ACANTHOPTERYGII CENTRISCIFORMES.

None recorded.

DIVISION XIV.—ACANTHOPTERYGII GOBIESOCIFORMES.

None recorded.

DIVISION XV.—ACANTHOPTERYGII CHANNIFORMES.

None recorded.

DIVISION XVI.—ACANTHOPTERYGII TÆNIIFORMES.

FAMILY TRACHYPTERIDÆ.

(REGALECUS, Brünn.)

(*R. banksii*, Cuv. et Val., Poissons X, p. 365, 1835.)
Günther Cat. III, p. 309.
Figured, M'Coy, Prodr. Zool., pl. 145.
Loc.—Bass' Straits, one specimen, M'Coy, l.c.
Vernacular name—*Oar Fish;* probably *Sea Serpent*, M'Coy.

TRACHYPTERUS, Gouan.

T. tænia, Bl. Schn., p. 480, 1801.
Günther Cat. III, p. 302.
Figured, M'Coy, Prodr. Zool. Vict., pl. 122.
Loc.—Portland, M'Coy.

DIVISION XVII.—ACANTHOPTERYGII NOTACANTHIFORMES.

None recorded.

ORDER ACANTHOPTERYGII PHARYNGOGNATHI.

FAMILY POMACENTRIDÆ.

GLYPHISODON, Cuvier.

G. victoriæ, Günther, A.M.N.H. II, p. 116, 1862 (XI, 1873, p. 115).
Macleay Cat. 676.
Vernacular name—*Rock Perch.*

FAMILY LABRIDÆ.

LABRICHTHYS, Bleeker.

Vernacular name.—*Wrasses, or Parrot-fish.*

(*L. psittacula*, Richardson, P.Z.S., p. 26, 1840.)
Günther Cat. IV, p. 114 ; Macleay Cat. 696.
Figured, Voy. Erebus and Terror, pl. 56 ; Günther Cat. pl. 59.
Loc.—Only one specimen, Castelnau, P.Z.S. Vict. II, p. 52.

L. laticlavius, Richardson, Voy. Erebus and Terror, p. 128, 1846.
Günther Cat IV, p. 115 ; Macleay Cat. 698.
Figured, M'Coy, Prodr. Zool. Vict., pl. 163.
Loc.—Hobson's Bay, M'Coy, l.c.

L. bleekeri, Castelnau, P.Z.S. Vict. I, p. 148, 1872.
Macleay Cat. 705.
Figured, M'Coy, Prodr. Zool. Vict., pl. 134.
Loc.—Port Phillip.

L. richardsoni, Castelnau, P.Z.S. Vict. I, p. 150, 1872.
Macleay Cat. 706.
Loc.—Port Phillip.

L. ephippium, Günther, A.M.N.H. XI, p. 116, 1863.
Macleay Cat. 707.
Syn.—*L. vestita*, Castelnau, P.Z.S. Vict. I, p. 151, 1872.
Loc.—Port Phillip.

(*L. cuvieri*, Castelnau, P.Z.S. Vict. II, p. 53, 1873.)
Macleay Cat. 708.
Loc.—One specimen, Phillip Island, Castelnau, l.c.

(HETEROSCARUS, Castelnau.)

(*H. macleayi*, M'Coy, Prodr. Zool. Vict., Decade 17, 1888.)
Figured, M'Coy, Prodr. Zool. Vict., pl. 164.
Loc.—One specimen from Portland, M'Coy, l.c.

ODAX, Cuv. et Val.

O. richardsoni, Günther Cat IV, p. 241, 1862.
Günther Cat. IV, p. 241; Macleay Cat. 753.
Loc.—*Passim.*
Vernacular name—*Stranger.*

O. obscurus, Castelnau, P.Z.S. Vict. I, p. 154, 1872.
Macleay Cat. 756.

OLISTHEROPS, Richardson.

O. cyanomelas, Richardson, A.M.N.H., p. 291, 1851.
Günther Cat. IV, p. 243; Macleay Cat. 760.

ORDER ANACANTHINI.

FAMILY GADOPSIDÆ.

GADOPSIS, Richardson.

G. marmoratus, Richardson, Voy. Erebus and Terror, p. 122, 1846.
Gunther, Cat. 4, p. 318; Macleay Cat. 763.
Figured, Voy. Erebus and Terror, pl. 59.
Loc.—*Passim*, Victorian streams, especially south of Dividing Range.
Vernacular name—*Black-fish.*

FAMILY GADIDÆ.

LOTELLA, Kaup.

L. callarias, Günther, A.M.N.H., p. 116, 1863.
Macleay Cat. 766.
Figured M'Coy, Prodr. Zool. Vict., pl. 19.
Loc.—Port Phillip, M'Coy, l.c.
Vernacular name—Small-scaled *Rock Cod.*

PSEUDOPHYCIS, Günther.

P. barbatus, Günther, A.M.N.H., p. 116, 1863.
Macleay Cat. 769.
Figured, M'Coy, Prodr. Zool. Vict., pl. 20.
Loc.—*Passim.*
Vernacular name—*Rock Cod.*

(PHYSICULUS, Kaup.)

(*P. palmatus*, Klünzinger, Archiv. f. Naturg., xxxviii, 1872.)
Macleay Cat. Sup. 1244.
Loc.—Port Phillip, Klünzinger.

FAMILY OPHIDIIDÆ.

GENYPTERUS, Philippi.

G. australis, Castelnau, P.Z.S. Vict. I, p. 164, 1872.
Macleay Cat. 771.
Syn.—*G. tigerinus*, Klünzinger, Archiv. f. Naturg, 1872.
Figured, M'Coy, Prodr. Zool. Vict., pl. 27.
Loc.—*Passim.*
Vernacular name—*Rockling.*

FAMILY PLEURONECTIDÆ.

(PSEUDORHOMBUS, Bleeker.)

(*P. mulleri*, Klünzinger, Archiv. f. Naturg., xxxviii, 1872.)
Macleay Cat. Sup. 1247.
Loc.—Hobson's Bay, Klünzinger, l.c.

RHOMBOSOLEA, Günther.

R. flesoides, Günther, A.M.N.H. II., p. 117, 1863.
Macleay Cat. 788.
Loc.—Port Phillip, Günther.

R. bassensis, Castelnau, P.Z.S. Vict. I., p. 167, 1872.
Macleay Cat. 789.
Loc.—*Passim.*
Vernacular name—*Sole.*

R. victoriæ, Castelnau sp., P.Z.S. Vict. I., p. 168, 1872.
Macleay Cat. 790.
Loc.—*Passim.*
Vernacular name—*Flounder.*

NOTE.—Prof. M'Coy considers *R. victoriæ*, Castelnau = *R. flesoides*, Günther.

ORDER IV.—PHYSOSTOMI.

FAMILY SILURIDÆ.

COPIDOGLANIS, Günther.

C. tandanus, Mitchell Exp. I, p. 95, 2nd ed., 1839.
Günther Cat. V, p. 26; Macleay Cat. 806.
Figured, Mitchell Exp., pl. 6.
Loc.—Murray R. and tributaries.
Vernacular name—*Murray Cat-fish.*

FAMILY HAPLOCHITONIDÆ.

PROTOTROCTES, Günther.

P. marena, Günther Cat. V, p. 382, 1864.
Macleay Cat. 824.
Loc.—Southern rivers of Victoria, formerly in Yarra.
Vernacular name—*Yarra Herring.*

FAMILY SCOPELIDÆ.

AULOPUS, Cuv.

A. purpurissatus, Richardson, Icon. Pisc., p. 6, 1843.
Günther Cat. V, p. 403; Macleay Cat. 832.
Figured, M'Coy, Prodr. Zool. Vict., pl. 54, 55.
Loc.—Hobson's Bay, M'Coy, l.c.
Vernacular name—*Sergeant Baker* (at Sydney).

FAMILY GALAXIDÆ.

GALAXIAS, Cuv.

G. attenuatus, Jenyns, Zool. Beagle, Fishes, p. 121, 1842.
Günther Cat. VI, p. 210; Macleay Cat. 843.
Figured, Zool. Beagle, pl. 22.
Syn.—*G. scriba*, Richardson, Voy. Erebus and Terror, p. 75; *G. maculatus*, Richardson, Voy. Erebus and Terror, p. 76.
Loc.—Very common in Lower Yarra, Castelnau, P.Z.S. Vict. I, p. 177.
Vernacular name—*Yarra Gudgeon.*

G. ocellatus, M'Coy, Internat. Exch. Essays, p. 14, 1866-7.
Macleay Cat. 852.
Loc.—R. Yarra.
Vernacular name—*Yarra Trout.*

G. cylindricus, Castelnau, P.Z.S. Vict. I, p. 177, 1872.
Macleay Cat. 853.
Loc.—R. Yarra, Castelnau, l.c.

G. delicatulus, Castelnau, P.Z.S. Vict. I, p. 178, 1872.
Macleay Cat. 854.
Loc.—R. Yarra, Castelnau, l.c.

G. amœnus, Castelnau, P.Z.S. Vict. I, p. 178, 1872.
Macleay Cat. 855.
Loc.—R. Yarra, Castelnau, l.c.

(*G. versicolor*, Castelnau, P.Z.S. Vict. I, p. 176, 1872.)
Macleay Cat. 856.
Loc.—One specimen from marsh near St. Kilda, Castelnau, l.c.

G. ornatus, Castelnau, P.Z.S. Vict. II, p. 153, 1873.
Macleay Cat. 857.
Loc.—Cardinia Creek, Castelnau.

(*G. rostratus*, Klünzinger, Archiv. f Naturg., p. 41, 1872.)
Macleay Cat. Sup. 1265.
Loc.—Murray R., Klünzinger, l.c.

(*G. obtusus*, Klünzinger, Archiv. f. Naturg., p. 41, 1872.)
Loc.—Yarra Lagoon, Klünzinger, l.c.

FAMILY SCOMBRESOCIDÆ.

SCOMBRESOX, Lacép.

S. forsteri, Cuv. et Val. XVIII, p. 481, 1846.
Günther Cat. VI, p. 258; Macleay Cat. 866.
Syn.—*S. saurus* (Bloch sp.), var. *forsteri* (Cuv. et Val.), according to M'Coy.
Figured, M'Coy, Prodr. Zool. Vict., pl. 135.

HEMIRAMPHUS, Cuvier.

H. intermedius, Cant., A.M.N.H. IX, p. 485, 1842.
Günther Cat. VI, p. 260; Macleay Cat. 867.
Syn.—*H. melanochir*, Cuv. et Val.
Figured, M'Coy, Prodr. Zool. Vict., pl. 135.
Vernacular name—*Gar-fish.*

FAMILY CYPRINIDÆ.

NEOCARASSIUS, Castelnau.

N. ventricosus, Castelnau, P.Z.S. Vict. I, p. 237, 1872.
Macleay Cat. 881.
Loc.—Saltwater R., Castelnau, l.c.

FAMILY GONORHYNCIDÆ.

GONORHYNCUS, Gronov.

G. greyi, Richardson, Voy. Erebus and Terror, p. 44, 1846.
Günther Cat. VII., p. 373; Macleay Cat. 883.
Syn.—*G. brevis*, Kner. Voy. Novara, p. 342.
Figured, Voy. Novara, pl. 16.
Loc.—*Passim.*
Vernacular name—*Sand-eel.*

FAMILY CLUPEIDÆ.

ENGRAULIS, Cuv. et Val.

E. antarcticus, Castelnau, P.Z.S. Vict. I, p. 186, 1872.
Macleay Cat. 885.
Syn.—*E. encrasicholus, var. antipodum*, Günther.
Loc.—*Passim.*
Vernacular name—*White-bait.*

(*E. heterolobus*, Rüpp.)
Günther Cat. VII, p. 392; Macleay Cat. Sup. 1272.
Loc.—Hobson's Bay, Klünzinger, Archiv. f. Naturg. 1872.

CHATOESSUS, Cuv. et Val.

C. richardsoni, Castelnau, P.Z.S. Vict. II, p. 144, 1873.
Macleay Cat. 888.
Loc.—Murray R., Castelnau.

CLUPEA, Cuvier.

C. sagax, Jenyns, Zool. Beagle, p. 134, 1842.
Günther Cat. VII, p. 443; Macleay Cat. 890.
Syn.—*Alosa melanosticta*, Cuv. et Val., Poissons XX, p. 444
Loc.—*Passim.*
Vernacular name—*Pilchard.*

C. vittata, Castelnau, P.L.S. N.S.W., IV, p. 379, 1879.
Macleay Cat. 896.
Vernacular name—*Smelt*, Castelnau, P.Z.S. Vict. I, p. 190.

FAMILY MURÆNIDÆ.

ANGUILLA, Cuvier.

A. reinhardtii, Steind. Sitzb. Ak. Wiss., Wien, 1867.
Günther Cat. VIII., p. 27; Macleay Cat. 910.
Loc.—From Western Port, and also, I believe, from the Mordialloc R., Castelnau, P.Z.S. Vict. I., p. 193.
Vernacular name—Confused with the common *Eel*, Castelnau, l.c.

A. australis, Richardson, Voy. Erebus and Terror, p. 112, 1846.
Günther Cat. VIII., p. 36; Macleay Cat. 911.
Figured, Voy. Erebus and Terror, pl. 45.
Loc.—Fresh waters *passim.*
Vernacular name—*Common Eel.*

CONGER, Cuvier.

C. wilsoni, Castelnau, P.Z.S. Vict. I., p. 193, 1872.
Macleay Cat. 914.
Loc.—*Passim.*
Vernacular name—*Silver Eel.*

(Congromuræna, Kaup.)

(*C. habenata*, Richardson, Voy. Erebus and Terror, p. 109, 1846.)

Gunther Cat. VIII., p. 42 ; Macleay Cat. 916.

Figured, Voy. Erebus and Terror, pl. 50.

Loc. — One specimen seen in Melbourne market, Castelnau, P.Z.S. Vict. I., p. 195.

(Muræniehthys, Bleeker.)

(*M. macropterus*, Bleeker, Atlas Ichthy., p. 31.)

Günther Cat. VIII, p. 52 ; Macleay Cat. Sup. 1278.

Figured, Bleeker Atlas, pl. 7.

Loc.—Port Phillip, Klünzinger, Archiv. f. Naturg. 1872.

FAMILY PEGASIDÆ.

Pegasus, L.

P. lancifer, Kaup. Wiegm. Archiv., p. 117, 1868.

Günther Cat. VIII, p. 149 ; Macleay Cat. 946.

Loc.—Port Phillip, not uncommon.

ORDER V.—LOPHOBRANCHII.

FAMILY SYNGNATHIDÆ.

Group Syngnathina.

Syngnathus, Artedi.

S. semifasciatus, Günther Cat. VIII., p. 162, 1870.

Günther Cat. VIII., p. 162 ; Macleay Cat. 947.

Syn.—*S. semistriatus*, Kaup (Macleay.)

Loc.—Port Phillip.

Vernacular name—*Pipe-fish.*

(*S. caretta*, Klünzinger, Sitzb. der K. Ak. Wiss., Wien, p. 419, 1879.)

Macleay Cat. Sup. 1281.

Loc.—Port Phillip, Klünzinger, Archiv. f. Naturg., 1872.

Urocampus, Günther.

U. carinirostris, Castelnau, P.Z.S. Vict. I., p. 200, 1872.

Macleay Cat. 961.

Loc.—Port Phillip, Castelnau, l.c.

(Leptoichthys, Kaup.)

(*L. fistularius*, Kaup, Lophobr, p. 51.)

Günther Cat. VIII, p. 187 ; Macleay Cat. 962.

Loc.—Port Phillip, Klünzinger, Archiv. f. Naturg., 1872.

STIGMATOPHORA, Kaup.

S. argus, Richardson, T.Z.S. III., p. 183, 1849.
Günther Cat. VIII, p. 189; Macleay Cat. 965.
Figured, T.Z.S. III., pl. 7.
Loc.—Sandridge (specimens in Melbourne Museum).

S. nigra, Kaup, Lophobr, p. 53.
Günther Cat. VIII, p. 190; Macleay Cat. 966.
Loc.—Sandridge (specimens in Melbourne Museum).

Group Hippocampina.

(GASTROTOKEUS, Kaup.)

G. gracilis, Klünzinger, Archiv. f. Naturg., p. 44, 1872.
Loc.—Port Phillip, Klünzinger, l.c.

(SOLENOGNATHUS, Kaup.)

S. spinosissimus, Günther Cat. VIII, p. 195, 1870.
Günther Cat. VIII, p. 195; Macleay Cat. 973.
Loc.—Port Phillip, Klünzinger, l.c.

PHYLLOPTERYX, Kaup.

P. foliatus, Shaw, Gen. Zool. V, p. 456, 1803.
Günther Cat. VIII, p. 196; Macleay Cat. 974.
Figured, M'Coy, Prodr. Zool., pl. 65.
Loc.—*Passim.*
Vernacular name—*Sea-dragon.*

HIPPOCAMPUS, Leach.

H. abdominalis, Kaup, Lophobr., p. 17.
Günther Cat. VIII, p. 199; Macleay Cat. 978.
Loc.—Port Phillip, Klünzinger. J. Bracebridge Wilson dredged it outside the Heads, 1888.
Vernacular name—*Sea-horse.*

H. breviceps, Peters, Monatsber. Ak. Wiss., Berlin, p. 710, 1869.
Günther Cat. VIII, p. 200; Macleay Cat. 980.
Figured, M'Coy, Prodr. Zool. Vict., pl. 65.
Loc.—*Passim.*
Vernacular name—*Short-headed Sea-horse.*

H. novæ-hollandiæ, Steind., Sitzungsb. Ak. Wiss., Wien, p. 474, 1866.
Günther Cat. VIII, p. 201; Macleay Cat. 982.
Loc.—Port Phillip, Macleay.
Vernacular name—*Sea-horse.*

(*H. tristis*, Castelnau, P.Z.S. Vict. I, p. 197, 1872.)
Macleay Cat. 983.
Loc.—One specimen from Port Phillip, Castelnau, l.c.

ORDER VI.—PLECTOGNATHI.

FAMILY SCLERODERMI.

MONACANTHUS, Cuvier (Leather Jackets).

M. hippocrepis, Quoy and Gaimard, Voy. Uran. Zool., p. 212, 1824.
Günther Cat. VIII, p. 246; Macleay Cat. 992.
Syn.—*Aleuterius variabilis*, Richardson, Voy. Erebus and Terror, p. 67.
Figured, Voy. Erebus and Terror, pl. 53; M'Coy, Prodr. Zool. Vict., pl. 125.

(*M. convexirostris*, Günther Cat. VIII, p. 248, 1870.)
Günther Cat. VIII, p. 248; Macleay Cat. 994.
Loc.—Port Phillip, Hobson's Bay, Klünzinger, Archiv. f. Naturg., 1872.

M. güntheri, Macleay Cat. 998, 18 .
Syn.—*M. peronii*, Günther Cat. VIII, p. 249.
Figured, M'Coy, Prodr. Zool. Vict., pl. 143.
Loc.—Port Phillip Heads, Warrnambool, M'Coy, l.c.

M. browni, Richardson, sp., Voy. Erebus and Terror, 1846.
Figured, M'Coy, Prodr. Zool. Vict., pl. 124.
Loc.—Bass's Straits, M'Coy.

(*M. maculosus*, Richardson, Voy. Erebus and Terror, p. 67, 1846.)
Macleay Cat. 1001.
Figured, Voy. Erebus and Terror, pl. 39; Hollard, Ann. Sci. Nat. Zool. 1854, pl. 14.
Loc.—Port Phillip, Klünzinger, Archiv. f. Naturg., xxxviii.

(*M. forsteri*, Castelnau, P.Z.S. Vict. I, p. 204, 1872.)
Macleay Cat. 1005.
Loc.—One specimen, Castelnau, l.c.

(*M. prasinus*, Castelnau, P.Z.S. Vict. I, p. 205, 1872.)
Macleay Cat. 1006.
Loc.—Only seen once, Castelnau, l.c.

(*M. baudini*, Castelnau, P.Z.S. Vict. II, p. 55, 1873.)
Macleay Cat. 1007.
Loc.—One specimen from coast of Victoria, Castelnau, l.c.

(*M. lesueurii*, Castelnau, P.Z.S. Vict. II, p. 56, 1873.)
Macleay Cat. 1008.
Loc.—One specimen from Western Port, Castelnau, l.c.

M. sancti-joanni, Castelnau, P.L.S. N.S.W. II, p. 246, 1877.
Macleay Cat. 1012.
Loc.—Hobson's Bay, Castelnau, l.c.

(*M. granulatus*, White, Voy. N.S.W., p. 295, 1790.)
Günther Cat. VIII, p. 243; Macleay Cat. 1019.
Figured, Voy. Erebus and Terror, pl. 40.
Loc.—Port Phillip, Klünzinger, Archiv. f. Naturg., xxxviii.

M. rudis, Richardson, Voy. Erebus and Terror, p. 65, 1846.
Günther Cat. VIII, p. 244; Macleay Cat. 1020.
Loc.—Bass's Straits, Castelnau, P.Z.S. Vict. II, p. 54.

M. trossulus, Richardson, Voy. Erebus and Terror, p. 68, 1846.
Günther Cat. VIII, p. 234; Macleay Cat. 1025.
Loc.—Victoria, Macleay, l.c.

OSTRACION, Artedi.

O. auritus, Shaw, T.Z.S. III, p. 160, 1849.
Günther Cat. VIII, p. 266; Macleay Cat. 1036.
Figured, T.Z.S. III, pl. 9.
Loc.—Port Phillip, Phillip I.

O. amœnus, Castelnau, P.Z.S. Vict. I, p. 207, 1872.
Macleay Cat. 1039.
Loc.—Port Phillip.

FAMILY GYMNODONTES.

TETRODON, Bibr.

T. hamiltoni, Richardson, Voy. Erebus and Terror, p. 63, 1846.
Günther Cat. VIII, p. 280; Macleay Cat. 1045.
Figured, Voy. Erebus and Terror, pl. 39.
Loc.—Port Phillip.
Vernacular name—*Toad-fish.*

(*T. richei*, Fréminv, Nouv. Bull. Philom. II, p. 250.)
Günther Cat. VIII, p. 285; Macleay Cat. 1046.
Figured, Bleeker, Atlas, pl. 9.
Loc.—Port Phillip, Klünzinger, Archiv. f. Naturg. xxxviii.

T. hispidus, L. Syst. Nat. I, p. 411.
Günther Cat. VIII, p. 297; Macleay Cat. 1053.

DIODON, Linnæus.

D. spinosissimus, Cuv. Mém. Mus., p. 134, 1818.
Günther Cat. VIII, p. 307; Macleay Cat. 1060.
Loc.—Port Phillip, Castelnau, P.Z.S. Vict. I, p. 2.

D. blochii, Castelnau, P.Z.S. Vict. I, p. 210, 1872.
Macleay Cat. 1062.
Loc.—Port Phillip, Castelnau, l.c.
Vernacular name—*Porcupine-fish.*

(CHILOMYCTERUS, Bibr.)

(*C. jaculiferus*, Cuv. Mém. Mus., p. 130, 1818.)
Günther Cat. VIII, p. 313; Macleay Cat. 1063.
Loc.—One specimen from Hobson's Bay, Castelnau, P.Z.S. Vict. I, p. 211.

ORTHAGORISCUS, Bloch., Syst. Ichthy. Ol. (Schneider), p. 510, 1801.

O. mola, L.
Günther Cat. VIII, p. 317; Macleay Cat. 1063.
Vernacular name—*Sun-fish.*

SUB-CLASS II.—PALÆICHTHYES.

ORDER I.—GANOIDIÆ.

None recorded.

ORDER II.—CHONDROPTERYGII.

FAMILY CHIMÆRIDÆ.

CALLORHYNCUS, Gronovius.

C. antarcticus Lacépède Hist. Poissons I, p. 400, 1798.
Günther Cat. VIII, p. 351; Macleay Cat. 1070.
Syn.—*C. peronii*, Dum.
C. capensis, Dum.
C. australis, Shaw and Owen.
C. tasmanius, Richardson.
Loc.—Port Phillip Heads and S. Coast.
Vernacular name—*Elephant-shark.*

FAMILY CARCHARIIDÆ.

(CARCHARIAS, Cuvier.)

(*C. melanopterus*, Muller and Henle, p. 43, 1841.)
Günther Cat. VIII, p. 369; Macleay Cat. 1077.
Loc.—One specimen from Hobson's Bay, M'Coy.

GALEUS, Cuvier.

G. australis, Macleay Cat. 1079, 1880.
Figured, M'Coy, Prodr. Zool. Vict., pl. 64.
Loc.—*Passim.*
Vernacular name—*Tope.*

ZYGÆNA, Cuvier.

Z. malleus, Shaw, Nat. Misc.
Günther Cat. VIII, p. 381 ; Macleay Cat. 1080.
Figured, M'Coy, Prodr. Zool. Vict., pl. 56.
Loc.—Port Phillip.
Vernacular name—*Hammer-headed Shark.*

MUSTELUS, Cuvier.

M. antarcticus, Günther Cat. VIII, p. 387, 1870.
Macleay Cat 1081.
Figured, M'Coy, Prodr. Zool. Vict., pl. 87.
Loc.—*Passim.*
Vernacular name—*Smooth-hound, Gummy.*

FAMILY LAMNIDÆ.

CARCHARODON, Muller and Henle.

C. rondeletii, Muller and Henle, p. 70, 1841.
Günther Cat. VIII, p. 392 ; Macleay Cat. 1083.
Figured, M'Coy, Prodr. Zool. Vict., pl. 74.
Loc.—Hobson's Bay, M'Coy, l.c.
Vernacular name—*White Shark.*

ODONTASPIS, Agassiz.

O. americanus, Mitch. sp., Phil. and Lit. Trans. New York, I, p. 483.
Günther Cat. VIII, p. 392 ; Macleay Cat. 1084.
Syn.—*O. taurus*, Muller and Henle, p. 73.
Figured, M'Coy, Prodr. Zool. Vict., pl. 64.
Loc.—Hobson's Bay, M'Coy, l.c.

ALOPECIAS, Muller and Henle.

A. vulpes, L. Syst. Nat. Cuv. Gmelin I, p. 1496, 1788.
Günther Cat. VIII, p. 393 ; Macleay Cat. 1085.
Figured, M'Coy, Prodr. Zool. Vict., pl. 88.
Loc.—Hastings, M'Coy, l.c. ; Queenscliff, J. Bracebridge Wilson.
Vernacular name—*Thresher Shark.*

FAMILY NOTIDANIDÆ.

NOTIDANUS, Cuvier.

N. indicus, Cuvier, Regne Animal, 1830.
Günther Cat. VIII, p. 398 ; Macleay Cat. 1086.
Figured, M'Coy, Prodr. Zool. Vict., pl. 43.
Loc.—Hobson's Bay, M'Coy, l.c.

FAMILY SCYLLIDÆ.

PARASCYLLIUM, Gill.

P. nuchale, M'Coy, A.M.N.H. XIII, p. 15, 1874.
Macleay Cat. 1090.
Figured, M'Coy, l.c., pl. 2.
Loc.—Port Phillip, M'Coy, l.c.

CROSSORHINUS, Muller and Henle.

C. barbatus, L. Syst. Nat. Cuv. Gmelin, p. 1493, 1788.
Günther Cat. VIII, p. 414; Macleay Cat. 1095.
Figured, M'Coy, Prodr. Zool. Vict., pl. 43.
Loc.—Hobson's Bay, M'Coy, l.c.
Vernacular name—*Carpet Shark, Wobbigong.*

FAMILY CESTRACIONTIDÆ.

HETERODONTUS, De Blainville.

H. phillipii, Lacépède, Hist. des Poissons I, p. 218, 1798.
Macleay Cat. 1097.
Figured, M'Coy, Prodr. Zool. Vict., pl. 113.
Loc.—*Passim.*
Vernacular name—*Port Jackson Shark, Pig-fish.*

FAMILY SPINACIDÆ.

ACANTHIAS, Muller and Henle.

A. vulgaris, L. Syst. Nat., p. 397.
Günther Cat. VIII, p. 418; Macleay Cat. 1099.
Figured, M'Coy, Prodr. Zool. Vict., pl. 75.
Loc.—Hobson's Bay, M'Coy, l.c.
Vernacular name—*Picked Dog-fish.*

(ECHINORHINUS, De Blainville.)

(*E. spinosus*, L. Syst. Nat. Cuv. Gmelin I, p. 1500, 1788.)
Günther Cat. VIII, p. 428.
Figured, M'Coy, Prodr. Zool. Vict., pl. 144.
Loc.—One specimen from Portland, M'Coy, l.c.

FAMILY RHINIDÆ.

RHINA, Klein.

R. squatina, L. Syst. Nat. I, p. 398.
Günther Cat. VIII, p. 430; Macleay Cat. 1103.
Figured, M'Coy, Prodr. Zool. Vict., pl. 34.
Loc.—Not very uncommon in Hobson's Bay and around our coasts, M'Coy, l.c.
Vernacular name—*Angel Fish.*

FAMILY PRISTIOPHORIDÆ.

PRISTIOPHORUS, Muller and Henle.

P. nudipinnis, Günther Cat. VIII, p. 432, 1870.
Günther Cat. VIII, p. 432; Macleay Cat. 1105
Figured, M'Coy, Prodr. Zool. Vict., pl. 56.
Loc.—*Passim.*
Vernacular name—*Saw-fish.*

FAMILY SELACHIDÆ.

(CETORHINUS, De Blainville.)

(*C. maximus*, Günner, Trondj. Selsk. Skrift, III, p. 33, 1765.)
Günther Cat. VIII, p. 394; Macleay Cat. Sup. 1285.
Figured, M'Coy, Prodr. Zool. Vict., pl. 104.
Loc.—One specimen, Portland, M'Coy, l.c.
Vernacular name—*Basking Shark.*

FAMILY RHINOBATIDÆ.

TRYGONORHINA, Muller and Henle.

T. fasciata, Muller and Henle, p. 124.
Günther Cat. VIII, p. 448; Macleay Cat. 1111.
Figured, Muller and Henle, pl. 43.
Loc.—"Common in S. part of Port Phillip," J. Bracebridge Wilson.
Vernacular name—*Fiddler Ray.*

FAMILY TORPEDINIDÆ.

NARCINE, Henle.

N. tasmaniensis, Richardson, T.Z.S. III, p. 178, 1849.
Günther Cat. VIII, p. 452; Macleay Cat. 1112.
Figured T.Z.S. III, pl. 11.
Loc.—One specimen St. Kilda Beach; also in Bass's Straits, Castelnau, P.Z.S. Vict. I, p. 223.

FAMILY RAJIDÆ.

RAJA, Cuvier.

R. lemprieri, Richardson, Voy. Erebus and Terror, p. 43, 1846.
Günther Cat. VIII, p. 463; Macleay Cat. 1114.
Figured, Voyage Erebus and Terror, pl. 23.
Loc.—*Passim.*
Vernacular name—*Thornback Ray.*

(*R. dentata*, Klünzinger, Archiv. f. Naturg. xxxviii, p. 46, 1872.)
Macleay Cat. Sup. 1289.
Loc.—"Port Phillip," Klünzinger, l.c.

R. scabra, Douglas Ogilby, Cat. Fishes in Australian Museum, Part I, 1888.
Macleay Cat. 1115.
Syn.—*R. rostrata*, Castelnau, P.Z.S. Vict. II, p. 57.
Loc.—Port Phillip, Castelnau.

FAMILY TRYGONIDÆ.

UROLOPHUS, Muller and Henle.

U. testaceus, Mull. and Henle, p. 174, 1841.
Günther Cat. VIII, p. 486; Macleay Cat. 1121.
Figured, Mull. and Henle, pl. 56.
Loc.—Port Phillip (Morton, Lucas.)

FAMILY MYLIOBATIDÆ.

MYLIOBATIS, Cuvier.

M. nieuhofii, Cuv. Régne Animal, 1830.
Günther Cat. VIII, p. 491; Macleay Cat. 1123.
Loc.—*Passim.*
Vernacular name—*Eagle Ray, Sting Ray.*

(*M. australis*, Macleay Cat. 1124, 1880.)
Figured, M'Coy, Prodr. Zool. Vict. pl. 63.
Loc.—One specimen Queenscliff, M'Coy, l.c.

SUB-CLASS III.—CYCLOSTOMATA.

FAMILY PETROMYZONTIDÆ.

MORDACIA, Gray.

M. mordax, Richardson, Voy. Erebus and Terror, 1846.
Günther Cat. VIII, p. 507; Macleay Cat. 1127.
Figured, Voy. Erebus and Terror, pl. 38.
Loc.—Lower Yarra, Castelnau, P.Z.S. Vict. I, p. 229.
Vernacular name—*Lamprey.*

(NEOMORDACIA, Castelnau.)

(*N howittii*, Castelnau, P.Z.S. Vict. I, p. 232, 1872.)
Macleay Cat. 1128.
Loc.—One specimen, Cape Schanck, Castelnau, l.c.

GEOTRIA, Gray.

G. australis, Gray, P.Z.S., p. 238, 1851.
Günther Cat. VIII, p. 508; Macleay Cat. 1129.
Loc.—Saltwater R., Castelnau, P.Z.S. Vict. I, p. 227.

(YARRA, Castelnau.)

(*Y. singularis*, Castelnau, P.Z.S. Vict. I, p. 231, 1872.)
Macleay Cat. 1132.
Loc.—One specimen, Lower Yarra, Castelnau, l.c.

SUB-CLASS IV.—LEPTOCARDII.

FAMILY CIRROSTOMI.

BRANCHIOSTOMA, Costa.

B. lanceolatum, Pallas, Spicil. Zool. X, p. 19, 1769.
Günther Cat. VIII, p. 513; Macleay Cat. 1133.
Figured, E. Ray Lankester, Q.J.M.S., 1889.
Loc.—Port Phillip and Western Port (if our species be identical with above).
Vernacular name.—*Lancelet.*

ART. III.—*On the Occurrence of Kraussina lamarckiana, Davidson, at Williamstown, with a Census of the Victorian Brachiopoda.*

By A. H. S. LUCAS, M.A., B.Sc.

[Read April 11, 1888.]

It was with much pleasure that, while searching under the stones, rendered accessible by low tide at Williamstown, for some of the gastropods usually obtained there, I found large numbers of the small brachiopod, *Kraussina lamarckiana*, Davidson. This was in the summer of 1884, and I have usually met with numerous examples in each summer visit to the locality. I am not aware of the species being recorded before as Victorian, but whether or not, have thought it would be of interest to members, to learn of the existence of a species of brachiopod in considerable numbers, in a part of Port Phillip so near to Melbourne.

It will be convenient here, to give a census of the species hitherto recorded from Victorian seas. All belong to the division denominated *Clistenterata*, by King.

ORDER.—BRACHIOPODA.

DIVISION.—CLISTENTERATA.

TEREBRATULINA, D'Orbigny.

T. cancellata, Koch, in Küster's Conchyl. Cat. VI, p. 36, pl. 2B, figs. 11–13.
Figured, Challenger Zoology Report I, pl. 1, figs. 11–16.
Loc.—At or near Port Phillip Heads (J. Bracebridge Wilson, Victorian Naturalist IV, p. 118, 1887); off E. Moncœur I, Bass's Straits (Challenger Zoology Report I, p. 37).

WALDHEIMIA, King.

W. flavescens, Val. apud Lamarck, An. sans Vert. VI, p. 246, 1819.
Syn.—*Ter. australis*, Quoy et Gaimard, 1834.
T. recurva, Quoy et Gaimard, 1834.
T. dentata, Val., 1819.

Figured, Challenger Zoology Report I, pl. 3, figs. 10–12.
Loc.—Western Port abundant; Port Phillip Heads (J. Bracebridge Wilson, Victorian Naturalist IV, p. 118).

MAGASELLA, Dall.

M. cumingi, var *fibula*, Davidson, Challenger Zoology Report I, 1880.
Syn.—*Bouchardia fibula*, Reeve, Conch. I. con., pl. 7, fig. 30, 1861.

Magasella cumingi, Davidson, P.Z.S., p. 78, pl. 14, 1852.
Figured, as above.
Loc.—One specimen only known, British Museum: probably only a very large specimen of *M. cumingi*, and not a *Bouchardia*; from Bass's Sts. (Davidson, l.c.)

MEGERLIA, King.

M. willemoesi, Davidson, P.R.S. XXVII, p. 438, 1878.
Figured, Challenger Zoology Report I, pl. 4, figs. 1–3 (in the plate entitled *Magasella willemoesi* by printer's error).
Loc.—Three or four specimens from off Twofold Bay, N.S.W. (Challenger Report, l.c.)
Dredged by Mr. Bracebridge Wilson, at Port Phillip Heads (Victorian Naturalist IV, p. 118).

KRAUSSINA, Davidson.

K. lamarckiana, Davidson, P.Z.S. p. 80, pl. 14, figs. 22, 23, 1852.
Figured, Challenger Zoology Report, pl. 4, fig. 9.
Loc.—Under stones at low water, Williamstown; from Tasmania, S.E. Australia and New Zealand (Tenison Woods, Census of Marine Shells of Tasmania, 1877).

Art IV.—*Observations on the Australian Species of Peripatus.*

By Arthur Dendy, M. Sc., F.L.S.

[Read July 11, 1889.]

Part I.—Historical—Habitat—Specific Characters—Variation in External Characters.

In the January number of the *Victorian Naturalist*, and also in *Nature* for February 14, 1889, I published a short account of the discovery of two specimens of *Peripatus* at Warburton, on the Upper Yarra, which presented external colour markings so well pronounced, and so different from what had usually been described in the only known Australian species, *P. leuckartii*, that I considered the two specimens as probably belonging to a new species. Mr. Sedgwick, in response to my letter, published a note in *Nature* (February 28, 1889), in which he expressed the opinion that the species probably was subject to considerable range of variation in colour. Since the publication of my first account, I have been in correspondence on the subject with Mr. Fletcher, who is well acquainted with the New South Wales specimens of *Peripatus*, and who most kindly sent me a specimen from his collection, and also copies—some in advance of publication—of his own notes on the subject. Mr. Fletcher also tells me, in a letter dated February 22, 1889, that "the New South Wales specimens of *Peripatus* undoubtedly present very considerable variation in colour and markings, and this is true of specimens from the same locality, whereas specimens from different localities can be very fairly matched." This remark is based upon the examination of a specimen sent by Mr. Olliff to Mr. Sedgwick, a specimen in the Australian Museum, and nine specimens in Mr. Fletcher's own collection, which were all that were known at the time he wrote.

A few weeks ago, my friends, Mr. Edward Nye and Mr. D. Avery, of Queen's College, Melbourne University, discovered, after much patient searching, eleven specimens of *Peripatus* at Brown Hill, in the vicinity of Ballarat,

which they kindly placed at my disposal in a living and healthy condition. From the examination of these specimens, I have been able to gain a fairly good idea of the extent of variation in colour markings which the species undergoes; and also to make some observations on the internal anatomy. I have come to the conclusion that there is only one Australian species yet known, and the present appears to me to be a good opportunity for bringing together our scattered knowledge concerning it, and recording my own observations. The anatomical part of my paper is not yet ready, although I have already carefully studied the anatomy, by means of dissection and serial sections, but I hope to publish it at a future date, and also to be able to give an account of the development.

History of our Knowledge of Peripatus leuckartii.

The species was originally described by Saenger, in 1869. I have not been able to see the original paper, but Sedgwick gives the title as follows:—"Description of a *Peripatus* from Australia," "Transactions of the Russian Assembly of Naturalists," held at Moscow in 1867, Moscow, 1869 (Russian).

This paper was preceded by a preliminary account by the same author, as I learn from the *Archiv für Naturgeschichte* (*Jahrgang* 35, Band 2, p. 277), in which Leuckart, in his "Bericht üb. d. Leist. in d. Naturgeschichte der niederen Thiere während der J. 1868–69," remarks:—"*Onychophori.* Der seit Grube (1853) nicht wieder untersuchte Peripatus wird auf Anregung des Ref. von Saenger zum Gengenstand einer anatomischen Untersuchung gemacht, deren Hauptresultate vorläufig in den Protocollen der Moskauer Naturforscherversammlung mitgetheilt sind." A brief abstract of the paper then follows.

Saenger's complete paper is also noticed in the *Archiv für Naturgeschichte* (Jahrgang 37, Band 2, p. 406.) The notice runs as follows:—"*Onychophori.* Sänger's Untersuchungen über 'Peripatus capensis Gr. und P. Leuckartii,' die wir nach einer vorläufigen Mittheilung schon im letzten Jahresberichte anzogen, sind in den Verhandlungen der Moskauer Naturforscherversammlung, Abth. Zoologie S. 237–262. Tab. XII u. XIII inzwischen ausführlich veröffentlicht. Die neue Art, die aus Neu-Holland stammt, wird folgendermaassen beschrieben: Fünfzehn Paar Fusstummel, von denen das letzte Paar die Geschlechtsöffnung zwischen sich nimmt.

Auf der Unterseite der Füsse drei Erhebungen, von denen die eine lang und bogenförmig ist, während die zwei andern kurz und gerade sind. Länge 21 Mm., grösste Breite 3·05 Mm."

In 1887, Mr. Henry Tryon published an interesting paper "On *Peripatus* and its Occurrence in Australia," in the "Proceedings of the Royal Society of Queensland" (Vol. IV., p. 78). In this paper he announces the re-discovery of *Peripatus* in Australia, and gives a brief account of its structure, habits, and distribution, and to this paper I would especially call the attention of Australian naturalists. In 1886, Mr. Tryon found two specimens of *Peripatus* in a collection of invertebrata from the Cardwell district, sent to the Queensland Museum. These specimens were unfortunately lost in Sydney. A single specimen of *Peripatus* was next found by Mr. Tryon under dead wood in a gully in Victoria Park, Brisbane; and later on several specimens were obtained under stones within a short distance of the General Hospital. The author points out the great resemblance between the Australian and New Zealand species. He likewise observed the important fact that "the external jaw claw is simple, with a slight elevation at the base of the claw proper"; but he did not recognise this character as a distinction between the Australian and New Zealand species, as was subsequently done by Sedgwick.

Concerning the colouration of the body, Mr. Tryon says the species "exhibits the same variation in colouring which occurs in the different species of the genus. . . . The Australian species is very dark blue, almost black, with a few rust-like spots here and there, and lighter coloured beneath; or dark fuscous, with a still darker line along the back."

In the *Annals and Magazine of Natural History* for September of the same year (1887), Professor F. Jeffrey Bell published a very brief note (p. 252) on the "Habitat of *Peripatus Leuckarti*," in which he says:—"Dr. E. P. Ramsay, F.R.S.E., has lately been so kind as to send me two specimens of *Peripatus Leuckarti*, Sänger. Professor Leuckart's only information with regard to the place of origin of his specimen was 'Neu Holland.' It may therefore be of interest to state that Mr. Ramsay's examples were taken in the Queensland Scrubs, near Wide Bay."

The next discovery of *Peripatus leuckartii* took place in Victoria, and is recorded by Mr. Fletcher in the "Proceedings of the Linnean Society of New South Wales" (Vol. II.,

Part I., 1887). Mr. Fletcher observes:—"The specimen which I exhibit this evening was given to me a fortnight ago by my friend Mr. R. T. Baker, of Newington College, who had obtained it a few days previously either in or under a rotten log at Warragul, Gippsland, Victoria. It has fifteen pairs of claw-bearing appendages, and has nearly the same dimensions as are given in the abstract referred to. It is, therefore, in all probability an example of *P. Leuckartii*, Sänger." The specimen was received by Mr. Fletcher in a dried-up condition, so that he was not able to make any further observations upon it.

At a meeting of the Linnean Society of New South Wales, on November 27, 1887, Mr. A. Sidney Olliff exhibited and read a note upon a specimen of *Peripatus leuckartii* which had been obtained by himself and Mr. H. Merewether at the foot of a grey gum tree at Cassilis, on the banks of the Mounmoura Creek, a tributary of the Goulburn River. This is the first recorded discovery of *Peripatus* in New South Wales. Mr. Olliff says in his note:—"During life my specimen was coloured as follows:—Shining slaty-brown above, dusted with brick-red, with a dusky-red patch on the head, and a moderately distinct dusky-red lateral line on each side extending throughout its entire length; below, pinkish grey; the antennæ dark brown. It measured 21 mm. when fully extended."

In April 1888, Mr. Sedgwick's beautiful "Monograph on the Species and Distribution of the Genus *Peripatus* (Guilding)" was published in the *Quarterly Journal of Microscopical Science*. The author's observations on *P. leuckartii* were confined to the two specimens sent by Mr. Ramsay to Professor Bell, and the only locality which he gives for the species is "near Wide Bay, Queensland." The species is diagnosed as follows:—"Australasian Peripatus, with fifteen pairs of legs, an accessory tooth on the outer blade of the jaw, and a white papilla on the ventral side of the last leg of the male." Professor Bell's two specimens are described, and a few anatomical details are given. The species is not figured.

At the meeting of the Linnean Society of New South Wales of June 27th, 1888, Mr. Fletcher exhibited and described seven more specimens of *Peripatus*, obtained on a country road near Wollongong, New South Wales. Three of the specimens he preserved alive, and he gives a detailed account of the size and colouration of these.

On October 31, 1888, the same author exhibited some young specimens, the progeny of one of the three exhibited at the last meeting. The size and colouration of these young specimens (four in number) is briefly noted.

On November 28, 1888, again, Mr. Fletcher exhibited at the same Society's meeting two living specimens of *Peripatus leuckartii* from Burrawang, County of Camden, and their general colouration is briefly noted.

Peripatus leuckartii was next met with again by myself in Victoria; from which colony, it will be remembered, it was hitherto represented only by a single dried-up specimen from Gippsland. In December last, I found two specimens in a fern-tree gully at Warburton, on the Upper Yarra; and I recorded the discovery, with a brief account of the specimens, in the *Victorian Naturalist* and *Nature* (*locc. citt.*). Owing to the very distinct and definite markings on both of my specimens, I thought that they would probably prove to belong to a species distinct from *P. leuckartii*. Subsequent research, however, has shown that this is not the case.

Finally, the latest literature on the subject is a short letter in *Nature*, by Mr. A. Sedgwick, F.R.S., in reply to my own, in which he says:—"The Victorian and New South Wales localities are recorded in a postscript appended to my monograph of the genus as reprinted from vol. iv. of the "Studies from the Morphological Laboratory of the University of Cambridge." . . . . . The New South Wales species is, I think, identical with that found in Queensland, and I should be inclined to doubt the distinctness of the Victorian species recorded by Mr. Dendy in *Nature* (p. 366), and previously by Mr. Fletcher. Mr. Dendy appears to lay some stress on the differences of colour as between his specimen and the specimens of *P. leuckarti* hitherto described, but it must be remembered that in some species of Peripatus—*e.g. capensis* and *novæ-zealandiæ*—the range of individual colour-variation is very considerable." Mr. Sedgwick concludes—"Its development cannot fail to be of the greatest interest, and it is sincerely to be hoped that the Australian zoologists will lose no time in working it out."

In the present paper, as already mentioned, I have to record the discovery of eleven more specimens of *Peripatus* in Victoria, obtained by Messrs. Nye and Avery (of Queen's College), at Brown Hill, near Ballarat. The examination of these specimens leaves no doubt as to the correctness of

Mr. Sedgwick's views as to the specific identity of all the Australian specimens.

Habitat of Peripatus leuckartii.

The animal is generally found beneath either stones or logs—either in open places, or in sheltered ones, such as gullies. They appear to be more frequently met with under stones than in any other situation. The first Victorian specimen was found either in or under a rotten log at Warragul, and the two which I found were both under logs, in a fern-tree gully at Warburton. The animals obtained by Messrs. Nye and Avery were, however, nearly all found under stones, and those gentlemen have kindly furnished me with the following note concerning the habitat of their specimens:—

"Whilst out on an expedition at Brown Hill in the vicinity of Ballarat, in turning over some large silurian stones, we found a *Peripatus* beneath one sunk an inch or so into the earth. On subsequent expeditions, we found ten more—nine of them beneath silurian stones—some under large, and some under small stones, some being sunk in moss and grass, and some lying in bare spots almost devoid of vegetation. The greater part of the range where the *Peripati* were found is bare, and covered with silurian sandstone; further on, it becomes covered with scrubby gum trees, about six to ten feet high, and over-grown with mosses and lichens. Here we found only two.

All these *Peripati* were found beneath silurian, and though quartz and granite were plentiful, in no case did we find any beneath them. Sometimes the *Peripati* were beneath the stones, sometimes clinging to them, and again, in the rubbish around them.

"In one case only did we find two beneath the same stone, and they were small ones. The blue and bluish-brown ones were found in a spot covered with more vegetation and bracken.

"We searched the foot of this range for about a mile and a half here, and then proceeded a couple of miles further along to a part better timbered. Here we found two—one beneath a decaying log, and the other beneath a silurian stone in an open spot. There were few fallen logs, so we had little chance to look for *Peripati* beneath them.

"The range is about three miles N.E. of Ballarat, and runs about east and west, so that the *Peripati* were found

at the foot of the south side. A small creek runs along the foot of the range."

Specific Characters of Peripatus leuckarti.

I have already quoted Sedgwick's definition of the species —"Australasian Peripatus, with fifteen pairs of legs, an accessory tooth on the outer blade of the jaw, and a white papilla on the ventral side of the last leg of the male." This author states that, after careful search, he has only been able to find three minute points of real difference between the Australian species *(P. leuckartii)* and the New Zealand species (*P. novæ-zealandiæ.*) These are :—

"(1) The outer blades of the jaws have an accessory tooth at the base of the main tooth, as in the Cape species.

"(2) The male has a rounded white papilla on the ventral face of the fifteenth leg, on each side of the genital opening. It is in the same position with regard to the leg as the corresponding structure in the Cape males.

"(3) The pigment on the ventral surface is much less conspicuous in this than in the New Zealand species, so that the mottled appearance presented by the ventral surface of the latter species is not found in these specimens. The pigment on the ventral surface of these specimens is much more marked in the lower parts of the papillæ than elsewhere. In the skin between the papillæ and at the apices of the papillæ the pigment is so faint as to be hardly discernible. The result is that to the naked eye the ventral surface appears quite pale with coloured papillæ projecting from it. The predominant pigment of the ventral surface is the blue, but orange is present. The hind end of the ventral surface in the region of the last three legs is darker than elsewhere, in consequence of the great number of the pigmented papillæ.

"In addition to the above characters, it may be mentioned that the genital papilla of the female is remarkably prominent, and bears at its free end a longitudinally disposed slit. In the male the genital papilla is fairly prominent, but its aperture is wider and more rounded, resembling the same structure in both sexes of the New Zealand species."

The presence of an accessory tooth on the outer blade of the jaw, and of a white papilla on the ventral surface of the fifteenth leg of the male ; * and the prominence of the

* I have only seen one small male specimen ; which I judge to be a male from the presence of the white papillæ, as mentioned, and the less prominent genital papilla (*vide* description of specimen *i*).

genital papilla in the female, are all characters of the Victorian specimens examined by me.

The third diagnostic character given by Sedgwick, however—namely, that concerning the colouration of the ventral surface, and the absence of a mottled appearance therefrom—no longer holds good, as will be seen later on, from the description of the colouration of the Victorian specimens.

Concerning the external anatomy Sedgwick also mentions the following points, all of which I am able to confirm in the case of Victorian specimens:—"The genital papilla . . . is between the legs of the fifteenth pair. The feet and legs resemble exactly, so far as could be made out, those of the New Zealand species. The feet have the median dorsal papilla so characteristic of that species; there are three pads on the legs, and a patch of blue pigment round the opening of the nephridia."

It is, perhaps, still doubtful whether any constant specific characters can be derived from the colouration of *Peripatus leuckartii*, but in the next section of my paper I shall endeavour to show that the colour and markings, however they may vary, are in all cases deducible from a typical and characteristic pattern.

Variation in Size and Colour Markings of Peripatus leuckartii.

The variation in size and colouration of the species is amply illustrated by the thirteen Victorian specimens which I have been able to examine in the living condition, and I shall therefore confine my description to these. As I have already pointed out, Mr. Tryon, Mr. Olliff, and Mr. Fletcher have also given some account of the colouration of their specimens, which seem to agree with one or other of the Victorian ones. The size of the specimens probably depends principally upon their age.

The following is a brief account of the Victorian specimens. It will be seen that they form a series with two extremes—(1) the red, and (2) the blue (which becomes so dark as to appear black when the specimen is examined as an opaque object). I will begin with the red specimens:—

(a, b) The two specimens obtained at Warburton. The general tint is brownish-red, with only traces in one specimen of the bluish colour. The markings on the body are

singularly distinct and well defined, and identical in the two specimens. All down the dorsal surface there runs a median, broad, reddish-brown or chestnut-coloured band, divided into a series of diamond-shaped patches by regular lateral indentations—one diamond corresponding to each pair of legs. In the middle of this band there is a thin, median, whitish line. On either side, the chestnut-coloured band is edged by a narrow black line, which follows the indentation of its margin; and outside of this comes a broad band of darker brown, and then at the edge of the dorsal surface a narrow band of light brown. The ventral surface is light yellowish-brown, speckled with spots of very dark pigment, especially abundant at the base of each leg. In the mid-ventral line there is a row of white spots, one between the two legs of each pair, except the first (?), and the last, where, of course, the genital opening is situated. The antennæ are light brown, closely ringed all the way up with very dark brown or black. One of these specimens, when crawling, measured thirty-nine millimetres in length.

All the remaining specimens are from near Ballarat, obtained by Messrs. Nye and Avery.

(c) Very much resembles the Warburton specimens.

Dorsal Surface.—General colour, chestnut. The diamond-shaped segmental markings are continuous and very strongly marked, of a rich chestnut-red colour, edged with black shading off into dull red. A thin median white line is present, edged with grey.

Ventral Surface.—Much lighter. General appearance yellowish; spotted with yellow papillæ. There is a dark bluish-black spot at the base of each pair of legs, continued up the leg as a thin line. There is an oblong spot of a light yellowish colour between each pair of legs but the last. The legs are planted on a dark line, and the ventral surface of the legs is pale reddish-yellow. Genital papilla cream-coloured. Antennæ pale reddish-yellow, ringed with bluish-black.

Length, when crawling, thirty millimetres.*

(d) General appearance dark, blackish. Markings as in *c*, but with the red much duller and less conspicious. There is a small light spot at the apex of each triangular half of each diamond-shaped patch on the dorsal surface. These spots appear to be present in most, if not all, specimens where the

* Length always exclusive of antennæ.

diamond markings are visible. The genital papilla is cream-coloured, with a slight orange tinge; and the antennæ are reddish towards the base, and black at the tips.

Length, when crawling, twenty-three millimetres.

(*e*) This specimen was light coloured, and translucent in appearance.

Dorsal Surface.—There is a very strongly-marked continuous band down the middle, formed of a series of segmentally-arranged diamond-shaped patches of pale reddish yellow, edged by light, dull, indigo blue, shading off into pale yellowish red, with dull indigo blue papillæ. A thin median light line is just visible.

Ventral Surface.—Lighter. Pale, dull bluish, with a row of pale reddish-yellow areas, one between each pair of legs. A dark patch at the base of each leg continued up the leg for a little distance as a thin stripe. Ventral surface of legs pale reddish-yellow. The legs are planted on a darker stripe of dull indigo blue. Genital papilla, orange. Antennæ, pale reddish-yellow, ringed with dull indigo blue.

Length, when crawling, twenty-two millimetres.

(*f*) This was a very young specimen. It had apparently just died, but was in a perfectly fresh condition, when I came to examine it. Its general appearance was dark.

Dorsal Surface.—Dark, dull blackish, with a thin median lighter bluish line, with brownish-red papillæ so disposed as to form segmentally-arranged diamond-shaped patches, one over each pair of legs, as usual.

Ventral Surface.—Dull blackish, with a tinge of indigo blue; thickly spotted with greyish-yellow papillæ. There is a median row of lighter, brownish-grey areas, one between each pair of legs but the last. Genital papilla, orange. Ventral surface of legs chiefly reddish-yellow. Antennæ black.

Length, when lying still, seven millimetres.

(*g*) *Dorsal Surface.*—General appearance almost black, dull, with a slight dull reddish tinge. A very thin, light median line, edged with black, is scarcely visible. Segmentally-arranged diamond-shaped patches, one over each pair of legs, are faintly indicated as redder splotches, each divided into two triangular lateral areas edged with black.

Ventral Surface.—General appearance light reddish, with yellowish papillæ. There is an elongated lighter spot between each pair of legs but the last; and there are dark

spots at the base of each leg, each continued some way up the leg as a thin, dark stripe. Ventral surface of legs pale yellowish-grey, with perhaps a dull bluish tinge. Genital papilla, orange. Antennæ grey, ringed with black.

Length, when crawling, thirty millimetres.

(h) General appearance dark, blackish.

Dorsal Surface.—Dull black, with tinges of indigo blue and red, and with the faintest possible indications of diamond-shaped markings. A thin median lighter stripe is present.

Ventral Surface.—Paler. Blackish, with a reddish tinge and pale yellow papillæ. There is a dark patch at the base of each leg, continued up the leg as a fine stripe, and a pale reddish spot, divided transversely into two halves, between each pair of legs but the last. Ventral surface of legs pale yellowish-red. Genital papilla, orange. Antennæ yellowish-grey, ringed with black.

Length, when crawling, thirty-two millimetres.

(i) This was a small specimen, which died just before I came to examine it in detail, possibly from too much handling. There is a small white papilla on the ventral surface of each leg of the last pair, on each side of the genital aperture, and the genital papilla is less prominent than usual; hence the specimen is doubtless a male. It presented a peculiar character, which I have noticed in no other case, namely, that the eyes were bright red.

Dorsal Surface.—General colour dull indigo blue, rather pale. There is a median, thin, white line; with a row of yellowish spots on each side of it, placed one over each leg and each formed of a single papilla. There is a lighter band of blue over the rows of legs, which are themselves planted on a darker line.

Ventral Surface.—Paler blue, with light yellowish papillæ. A row of median light yellowish spots, one to each pair of legs, and a darker patch at the base of each leg as usual Ventral surface of legs pale yellowish, with a blue tinge Genital papilla, cream-coloured.

Length, in spirit, ten millimetres.

(k) Dorsal Surface.—General appearance black, with a greenish tinge, especially pronounced on the antennæ. A thin median light line is present, and on each side of it a row of small, pale red spots, one over each leg, and each, apparently, consisting of a single papilla.

Ventral Surface.—Grey, with pale yellow papillæ, and, perhaps, a tinge of bluish. A median row of yellowish spots as usual, and also a darker patch at the base of each leg, continued up the leg as a thin dark line. The ventral surface of the legs is pale yellowish towards the apex, and the genital papilla pale orange.

Length, when crawling, twenty-four millimetres.

(l) Dorsal Surface.—As in *k*, with identical markings.

Ventral Surface.—Paler, with same markings as in *k*, but more greenish-blue. Genital papilla, cream-coloured.

Length, when lying still (dead?), ten millimetres.

(m) This specimen was killed, apparently by having the secretion from the oral papillæ of another specimen ejected over it.

Dorsal Surface.—General appearance black, with a thin median light line, as usual. The diamond-shaped patches are represented, as in the last described specimens, by a row of light red spots down each side.

Ventral Surface.—Paler. Blackish, with pale yellow papillæ scattered over it. A median row of lighter yellowish spots present as usual.

Length (dead) seven millimetres.

(n) Dorsal Surface.—Black, with a median thin light line and a row of red spots down each side, one over each leg.

Ventral Surface.—Black, spotted with pale yellow papillæ. A median row of lighter grey patches, one between each pair of legs. Ventral surfaces of legs yellowish-grey. Genital papilla, yellowish-grey.

Length, when lying still (dead?), seven millimetres.

From these descriptions, it appears that the following are more or less constant characters of the species with regard to colour and markings:—

(1) The predominant colours are red and indigo blue—the former passing into yellow, and the latter into black in some specimens.

(2) There is a thin median light line down the dorsal surface.

(3) The characteristic pattern on the remainder of the dorsal surface is a series of segmentally-arranged diamond-shaped patches, in which the red colour is

predominant. In some cases, viz., the darkest specimens, these patches are represented only by a row of small, light coloured, yellow or red spots on each side of the middle line. Each of these spots is situate in the position of the apex of each triangular half of one of the characteristic diamond-shaped patches found in other specimens.

(4) The ventral surface is lighter than the dorsal.

(5) There is on the ventral surface a median row of spots or areas usually paler than the rest of the surface, placed one between the legs of each pair but the last.

(6) At the base of each leg, around the aperture of the nephridium, there is a dark patch of indigo blue.

Whether or not the red colour of the eyes of the male will prove to be a constant character, I am unable to say, as I have only seen one male specimen as yet.

It will be seen, by reference to Mr. Sedgwick's beautiful illustrations, that the pattern on the ventral surface of *P. novæ-zealandiæ* is essentially the same as in *P. leuckartii;* while on the dorsal surface it appears to be very different, though the thin median light line is present in both species.

Mr. Fletcher tells me that he is inclined to think that the median dorsal white line (which is mentioned by Mr. Sedgwick as occurring in the Australian species) is a post-mortem character, due to imperfect preservation, as he has recently examined three moderately well preserved specimens from Queensland (probably from the same locality as Mr. Sedgwick's examples), and these have a distinct dorsal median dark line. Concerning his own Victorian specimen, Mr. Fletcher also says, in one of his published notes:—"A whitish median dorsal line visible in part of the body only is evidently due to bleaching, though in the rest of its course a nodose black line is not well defined." I cannot agree with Mr. Fletcher's views on this point. I have already pointed out that the white line is very thin, and sometimes edged by a dark line on each side. The white line might, I believe, be hidden by contraction in spirit specimens, and the presence of the dark lines edging it may account for the median dark line described by Mr. Fletcher.

ART. VI.—*On some additions to the Fish Fauna of Victoria.*

By A. H. S. LUCAS, M.A., B.Sc.

[Read April 11, 1889.]

1. *Ostracion (Aracana) lenticularis*, Richardson, P.Z.S. p. 21, 1841.

   Günther Cat. VIII, p. 268 ; Macleay Cat. 1038.

   Loc.—I had a single specimen forwarded to me in 1884, which had been thrown up on the beach of Phillip Island. The length of the specimen is about 220 mm.

2. *Chilobranchus rufus*, Macleay Cat. 909, 1881.

   This species was dredged freely by Mr. J. Bracebridge Wilson, in the Summer of 1887–8, at several stations near the Heads, including Simon's Channel, Limeburner's Channel, Capel Sound, and the Pinnace Channel. Macleay described it from Port Jackson and Tasmanian specimens. I submitted some of our forms to him, and he confirms my identification. It is often met with at Cheltenham.

3. *Sticharium dorsale*, Günther, A.M.N.H. xx, p. 63, 1867 ; Macleay Cat. 597.

   We dredged this species in numbers in Laverton Bay, in October 1867. It was identified by the Hon. W. Macleay.

Art. VI.—*On a New Species of Bicellaria.*

By J. Bracebridge Wilson, M.A., F.L.S.

[Read April 11, 1889.]

I have to report the occurrence of a new *Bicellaria*, which I found growing on a sponge at Station 1 (off Point Nepean). It is a very minute form, but very beautiful, and is specially interesting from its ringed stem, resembling that of *Stirparia*; and suggesting, if not the identity of, at least the close connection between, the two genera *Bicellaria* and *Stirparia*.

I have handed this new Polyzoon to Dr. P. H. MacGillivray for description and figuring.

Art. VII.—*On some New Species of Marine Mollusca.*

By J. Bracebridge Wilson, M.A., F.L.S.

[Read April 11, 1889.]

The following new species of Marine Mollusca, were dredged in Port Phillip Bay by me in the early part of 1888. The descriptions are by Professor Ralph Tate, F.L.S., F.G.S., and appear in the "Transactions of the Royal Society of South Australia":—

Kellia rostellata spec. nov.—

Shell minute, rather thin, semi-translucent, broadly heart-shaped, a little longer than high, inequilateral and moderately convex. The dorsal margin is oblique on both sides, longer behind than in front, and excavated in front of the beaks.

The ventral margin is rounded and curves upwards to the narrow and subrostrated anterior margin. The umbos are prominent, rather obtuse at the apex, approximate, not curved in front, and situated well in advance of the middle line. The surface is finely and closely concentrically striated; the colour is yellowish horn, umbos and hinge-line brown with a vertical ray of the same colour, increasing in breadth from the umbo to the ventral margin.

Dimensions.—Antero-posterior diameter about 2·5 millimetres; umbo-ventral diameter 2 millimetres; sectional diameter of united valves 2 millimetres.

Locality.—Dredged in life 7 to 9 fathoms, attached to seaweed, Port Phillip Heads, Victoria. J. Bracebridge Wilson.

This species has a general resemblance to *Lasæa rubra*, but, apart from the difference of dentition, it is distinguished by its subrostrated anterior side.

Montacuta semiradiata spec. nov.—

Shell minute, transversely ovate, moderately convex; umbos antemedian, thick and rounded; anterior and posterior margins rounded, ventral margin slightly curved outwards, posterior slope gently descending. Surface smooth shining, of a chocolate brown colour, more or less translucent white medially, with a few distant angular threads appearing as pellucid rays, radiating from the umbo to the posterior half of the ventral margin.

Dimensions.—Antero-posterior diameter 2 millimetres; umbo-ventral diameter 1·5 millimetres.

Locality.—Parasitic on *Echinocardium*, East of Mud Island, Port Phillip, in 7 to 10 fathoms. J. Bracebridge Wilson.

Stylifer brunneus spec. nov.—

Shell sub-globose; spire short, acuminately produced; apex cylindrical, styliform; the other whorls are convex, of moderate increase, slightly depressed at the posterior suture; sutures linear. Last whorl large, faintly angulated at the base, and depressed at the suture; and in consequence, having a perceptibly sub-quadrate outline. Outer lip thin, regularly curved, acutely angled posteriorly; columella thin, slightly elevated, defined by a superficial groove behind. Colour

dark brown, shining black-brown around the suture, marked with microscopic crowded obliquely transverse lines, and with distant spiral lines. Animal with a large expanded disk-like mantle.

Dimensions.—Length 5 millimetres; breadth 3·5 millimetres.

Locality.—Parasitic on *Strongylocentrotus*, invariably on the periproct in 8 to 10 fathoms, Capel Sound, Port Phillip. J. Bracebridge Wilson.

This new species resembles in its squat shape *S. Turtoni*, *S. astericola*, *S. ovoideus*, and *S. dubia*; but it has not the insinuated outer lip, obtusely-angled posteriorly of those species. In its regular curved outer lip and general shape it agrees with *S. Stimpsoni* Verrill, and *S. Orbignyanus* Hupe; but the more rapidly enlarging whorls and sub-quadrate last whorl distinguish it from them.

Umbrella corticalis spec. nov.—

Shell orbicular in outline, moderately elevated, with the apex prominent, somewhat incurved and a little excentric; covered, except apex, with a well developed epidermis, which extends about half as far again as the shell. The epidermis is raised into about 20 broad rays, diverging from the apex, and is concentrically lamellose. It is pellucid white, but encircled with a band of maroon colour, corresponding with the edge of the shell; it is very tough, and can be readily removed in one piece. The shell is of a primrose yellow colour, thin, concentrically striated, and with a few obscure radial ridges. The animal is of a deep port wine colour; the foot is circular in outline, with an extended margin; the under side of the mantle is covered with small white caruncule.

Dimensions.—Transverse diameters 19 and 15 millimetres; height 4 millimetres.

Locality.—Lower end of the South Channel of Port Phillip, 7 to 16 fathoms, sand and weed. J. Bracebridge Wilson.

Lobiger Wilsoni spec. nov.—

Animal with the body produced into a very narrow pointed smooth tail, of a green colour, shortly extended beyond the shell. Foot with two oblong rounded and pale green lobes, which are somewhat attenuated into a broadish

stalk. Shell thin, flexible, straw-yellow; spire rudimentary, but involute; somewhat pyriform, slightly attenuated in front, and truncated apically; aperture narrow ovate, truncate behind. Surface finely striated.

Dimensions.—Length 8 millimetres; width 5 millimetres.

Locality.—Lower end of the South Channel of Port Phillip, 7 to 16 fathoms. J. Bracebridge Wilson.

Besides the above, there is an *Emarginula*, which appears to be new, but which Professor Tate has not yet described. This is a very small but very beautiful species, bright rose-red in the living state. It occurs in the South Channel, (Station 9), and Capel Sound (Station 10).

Kellia rostellata is found abundantly at Station 1, attached by means of a small byssus to seaweed. It is also met with less commonly at Stations 3, 5, and 8.

Montacuta semiradiata has, as yet, only been seen by me at Station 14, but I presume it is likely to occur at other stations where its host, the *Echinocardium*, is common.

Stylifer brunneus has been collected by me only at Station 10. As stated by me, when handing it to Professor Tate, it occurs as a rule only on the periproct of the common *Strongylocentrotus*. I have this season observed one instance of an individual straying away among the spines. Clumps of eggs frequently occur, presumably those of *Stylifer*, among the spines surrounding the periproct.

Of *Umbrella corticalis* and *Lobiger Wilsoni*, I have not as yet been fortunate enough to collect any specimens this year.

ART. VIII.—*Remarks on some New Tables for Finding Heights by the Barometer.*

By E. J. WHITE, F.R.A.S.

[Read May 9, 1889.]

Since the memorable 19th of September, 1648, when the celebrated Pascal ascended the Puy de Dome, in the French Province of Auvergne, and found, as he had anticipated, that the mercury in his barometer fell as he rose, the barometric method of measuring heights has been extensively used, and in many instances, it is the only one available. Until about thirty years ago, only mercurial barometers were used for this purpose. They are still the most accurate, and should always be employed where the utmost precision of this method of measuring is required, but they have the disadvantage of being expensive, bulky, and fragile. At the period mentioned above, the aneroid, which had been invented in 1850 by M. Vidi, came into general use, and of late years it has become so popular, that as a weather-glass, or tourist's companion for measuring elevations, it has nearly superseded the tube of mercury. Almost the sole reason for this preference, is its portability; good aneroids are made that will go into the waistcoat pocket, while others are small enough to be used as charms to be suspended from the watch chain; these latter, however, are to be considered more as trinkets than as philosophical instruments. On the other hand, it is not an independent instrument, but has to have its scale originally marked off, and its errors from time to time found, from comparison with the mercurial barometer, than which it is also more complicated and less stable.

The mathematical part of the subject has been treated by many eminent writers; but since the time of Laplace, his formula has formed the basis of the investigations. If air was an incompressible fluid like water, the law would be very simple; the pressures would be proportional to the

heights, and if its density was throughout the same as at the surface of the earth, it would be all contained within a limit of about five miles. Air, however, is an elastic fluid, subject to Mariotte's law, and has therefore its density proportional to the pressure to which it is subjected, and if there were no disturbing elements, the law would still be a simple one. The heights would be in arithmetical progression, while the pressures would be in geometrical progression, thus having the nature of a table of logarithms, and the difference in height would be equal to a certain constant distance, multiplied by the difference between the logarithms of the heights of the barometer at the two places. The principal disturbing element is temperature, which varies the density of the air by its changes. If we could obtain the temperature of the column of air between the two places, the proper correction could be obtained; but as we can only apply the thermometer to the air near the surface of the earth, where it is greatly affected by radiation, and have to assume, as Laplace has done, that the temperature of the column of air between the two stations is the mean of that near the ground at each station, we sometimes get very anomalous results. This has been proved by observing barometers at two stations, not very distant, though considerably differing in altitude, whose difference of height had been well determined by careful levelling. Having now the height and the barometer readings, we can substitute them in Laplace's formula, and work out the temperatures. An extensive series of such observations was made by Professor Plantamour, using for his stations, Geneva and the Hospice of St. Bernard. From the mean of the 8 a.m. observations, the correction to the observed mean temperature varied from $+4{\cdot}5^\circ$ in December to $-4{\cdot}3^\circ$ in July. The 4 p.m. observations gave $+2{\cdot}3^\circ$ in December, and $-6{\cdot}5^\circ$ in July, and the 10 p.m. observations had a range of from $+4{\cdot}7^\circ$ in December to $-0{\cdot}2^\circ$ in July. Similar observations in the United States, between Mount Washington in New Hampshire and Portland, Maine, gave the following ranges: 8 a.m., $+1{\cdot}7^\circ$ in August, and $-1{\cdot}9^\circ$ in November; 5 p.m., $-3{\cdot}2^\circ$ in December, and $-1{\cdot}1^\circ$ in September; and 11 p.m., $+3{\cdot}4^\circ$ in August, and $-2{\cdot}1^\circ$ in November. As the effect of an error of one degree in the mean temperature is about 2 feet in 1000, the greatest of the above corrections, the $-6{\cdot}5^\circ$ in July, would amount to 13 feet in 1000. Attempts have been made to determine the law of decrement of the temperature of the

atmosphere, the results are not very consistent, but it appears to be nearly in an arithmetical progression, Glaisher finding in his 20,000 feet balloon ascent, a decrease of 1° for each 300 feet of ascent. The mean of several observations in Europe and America, is 1° for every 308 feet.

Humidity is another disturbing element: aqueous vapour has only five-eighths of the density of dry air, and does not permanently retain the gaseous form; the hygrometer is, therefore, sometimes used in conjunction with the barometer and thermometer in hypsometry, but as the necessary correction is not well established, it is generally neglected.

The last important source of error is that of gradient. With the air in a state of static equilibrium, two stations at the same height would receive equal pressures; but as a matter of fact, we find that stations at the same level have at the same moment very different pressures, especially if they are distant from one another. Gradients are the result of such complicated conditions, that there is no way of eliminating their effects. We can only mitigate them by taking extensive series of observations, on the supposition, that the effects will thus balance one another in the mean result.

Of the many forms of mercurial barometers, I think the Gay Lussac syphon is best suited for mountain work. It is very compact, not liable to derangement, and eliminates the error of capillarity. The zero point is now usually placed in the middle, so that the sum of the upper and lower readings gives the height of the quicksilver. Of aneroids, the Watkin seems likely to become the favourite for professional work, owing to its very open scale, which, in a four inch instrument, has about seven inches of its outer divisions to denote a variation of one inch of mercury. Ordinary travellers, however, will generally avail themselves of the small instruments, of from about one and a half to two inches diameter, which can be easily carried in the waistcoat pocket, where they are generally much less liable to injury than the larger ones carried on a leather strap. It must be mentioned, however, that no system of barometric measuring will give results nearly approaching those obtained by levelling, or even by the measurement of the vertical angles, where the uncertainty of the refraction is a disturbing element.

From a work issued in 1882 by the Geological Survey Department of the United States, entitled "A New

Method of Measuring Heights by means of the Barometer," by G. K. Gilbert, the following table is given, from the investigation of actual measurements. The assumptions are that one station is 5000 feet higher than the other, that the two places are fifty miles apart, and that they are situated in the temperate zone, remote from the ocean. The observations are supposed to be made near the middle of a fine summer's day, with a light wind blowing :—

——	Probable error in feet.	Possible error in feet.
From annual gradient	6	20
,, Diurnal gradient	8	30
,, Non-periodic gradient	20	50
,, Temperature	100	300
,, Moisture	10	20
,, Imperfection of observation ..	10	Unlimited
Totals	103	420 +

It will be noted how largely the temperature error exceeds all the others; and from the second column it will be seen that, excluding the error of observation (which, owing to mistakes, may be unlimited) the total error may amount to 420 feet, or more than one-twelfth of the whole amount measured. The probable error of 10 feet assigned for imperfection of observation is meant for a mercurial barometer; for an aneroid it would be much larger, even when used with the greatest care, and frequently compared with the mercurial column for finding its errors. At our observatory, we have an apparatus for testing mountain and other aneroids. I append the results of some of the late comparisons :—No. 1 has an error of ·09 in a range of 26 to 30 inches. No. 2, ·30 in a range from 23 to 30 inches. No. 3, ·13, range 24 to 30; and ·18, range 23 to 30. No. 4, ·13, range 24 to 30; ·23, range 23 to 30. No. 5 (which is a French barometer metrically divided), ·40, range 25 to 30; and ·63, 24 to 30. In the last three instruments it will be remarked, how the error increases as the extremity of its scale is reached. I have on several occasions, when travelling on our railways, carried an aneroid with me, and recorded its readings, as well as the temperature of the air at stations where we have stopped, and have compared the heights thus deduced with the accurate ones of the railway levels. At first I treated the results as matters of curiosity only, and did not preserve

the records, but I give those I have been able to find. On March 21, 1883, I measured the heights of the following stations on the Sandhurst line, with the French barometer mentioned above. I left Melbourne at 6.45 a.m., the barometer reading 775 millimetres, and temperature of the air 20° centigrade. When I reached Kangaroo Flat at 10.46 a.m. the barometer read 748 millimetres, and the temperature of the air was 24·6° centigrade. The following are the corrections in feet to be applied to the aneriod heights to get the true heights: Sunbury + 26, Lancefield Junction + 105, Gisborne + 50, Macedon — 9, Woodend + 96, Malmsbury — 48, Taradale + 12, Castlemaine + 34, Kangaroo Flat — 34. On May 8 of the present year, I took No. 3 of the above-mentioned barometers along part of the same line. I started at 7 a.m., the barometer reading 30·30 in., and the temperature of the air being 58° Fahr. I reached Macedon at 8.45; the barometer reading 28·73, and the temperature of the air 66°. I left Macedon at 5.30 p.m.; barometer 28·65, air 66°, and arrived in Melbourne about 7 p.m.; barometer 30·28, air 62°. Most of my levelling this day was done off the railway, where I had no levels for comparison, but the known heights measured required the following corrections: Gisborne + 154, Macedon (from up readings) + 151, and from the return readings + 86. The above results are not given as specimens of the best method of using the aneroid, but the observations were made with the greatest care. When the mercurial barometer is used, and the stations are in the same vertical, where the error of gradient should be very little, the errors are generally greater than expected. One of the most extensive series of this description was carried out from July 22 to October 15, 1848, by the Royal Engineers employed in the trigonometrical survey of Great Britain. Four mercurial barometers were used, two of these were placed on the top of the dome of St. Paul's Cathedral in London, the other two rested on the floor under the centre of the dome; after 62 observations had been taken the barometers were transposed, and 89 additional observations were made. The mean of the first set made the height 356·99 feet, and the mean of the second set 353·57, whereas the actual height was 352·75; both determinations were therefore in excess of the real amount —the first to the extent of 4·24 feet, and the second to 0·82 feet. Most mountain aneroids are furnished with an altitude scale, either on the same dial as the inch divisions

or on a separate ring which can be set to zero at starting, and thus save the trouble of taking the differences. This latter plan, although more convenient, is not so accurate as the former; but in every case, if the best result is desired, the readings should be taken from the scale of inches or millimetres, as it is uncertain to what temperature the altitude scale is adapted. I have measured some of the English ones, and find the temperatures they represent to vary from 47° to 51°, but the French one mentioned before has its scale adapted to 70° Fahr. The small tables supplied by instrument makers, which have no temperature factor, are generally adapted to about 50°; while the larger tables, which contain the factors for temperature, latitude, and decrease of gravity, are usually given for 32°, the freezing point. The adoption of so low a temperature as 32° is very inconvenient for Australia, where the mean temperature is much higher, as it necessitates a very large correction, and as this correction is frequently neglected, the results must be very inaccurate. I have therefore thought it desirable to compute a new table, in which the mean temperature and middle latitude of this part of Australia should be used. Calling B the height of the barometer, and t the temperature of the air at the lower station, B′ and t′ the same quantities for the upper station, L the latitude, and A the difference of height in feet between the two stations. Laplace's formula, leaving out the factors depending on the decrease of gravity, may be written:

$$A = 60158{\cdot}6\ (\log.\ B - \log.\ B') \times \left(\frac{1 + t + t' - 64}{900}\right) 0{\cdot}00265 \cos 2\ L.$$

Taking now T and T′ equal to 60°, and L = 37°, and substituting them in the above equation, we get

$$A = 63948{\cdot}6\ (\log.\ B - \log.\ B').$$

The mean height of the barometer at the Melbourne observatory, 91 feet above the level of the sea, reduced to 32° Fahr., is 29·931 in.; increasing this by 0·07 to bring it up to 60° Fahr., nearly the mean temperature of Melbourne, and by 0·10 to reduce it to sea level, we get 30·10; with this value in the above equation we should find 63948·6 log. B = 94552·26. It would be more convenient, however, to have it represented by o, because the tabulated values corresponding to the height of the barometer will at once show the height above the level

of the sea in Melbourne in the normal state of the atmosphere. This arrangement will have the disadvantage of introducing negative numbers, which will represent depths below the level of the sea, and the quantities will diminish with an increase of the argument, but on the whole, I consider it better than the usual plan. Let now $F = 94552{\cdot}26 - 63948{\cdot}6\ B$, and $F' = 94552{\cdot}56 - 63948{\cdot}6\ B'$, and calling a the height between the two places at the mean adopted temperature, 60°, we have $a = F' - F$. The values of F or F′ are tabulated in the first of the present tables, with the height of the barometer for argument. If a mercurial barometer has been used, the above value of a should be corrected for the difference between the temperatures of the quicksilver at the two stations. If T and T′ represent these temperatures at the lower and upper stations respectively, the correction will be $2{\cdot}5\ (T' - T)$; as T′ is nearly always less than T, this correction will be generally negative.

It will now be necessary to correct a for the actual temperature of the air, calling this corrected value A, we have—

$$A = a + \frac{a}{956{\cdot}7}\ (t + t' - 120)$$

putting $n = 1 + \frac{t+t'-120}{956{\cdot}7}$ we have $A = na$; and the value of n is given in the second table with $t + t'$ as argument. Generally speaking, the value determined from the equation $A = n\ (F' - F)$ will be far within the limits of accuracy of the aneroid barometer; but if it should be thought desirable to apply the small corrections depending on latitude, and decrease of gravity on the vertical, small tables are given for the purpose.

TABLE I.

Argument—Height of Barometer in Inches.

B.	F.	Diff.	B.	F.	Diff.	B.	F.	Diff.
23·0	7471·7	120·5	26·0	4066·7	106·6	29·0	1034·0	95·6
·1	7351·2	120·0	·1	3960·1	106·2	·1	938·4	95·3
·2	7231·2	119·5	·2	3853·9	105·8	·2	843·1	95·0
·3	7111·7	118·9	·3	3748·1	105·4	·3	748·1	94·6
·4	6992·8	118·4	·4	3642·7	105·0	·4	653·5	94·3
·5	6874·4	117·9	·5	3537·7	104·6	·5	559·2	94·0
·6	6756·5	117·5	·6	3433·1	104·2	·6	465·2	93·7
·7	6639·0	116·9	·7	3328·9	103·8	·7	371·5	93·3
·8	6522·1	116·5	·8	3225·1	103·5	·8	278·2	93·1
·9	6405·6	115·9	·9	3121·6	103·0	·9	185·1	92·7
24·0	6289·7	115·5	27·0	3018·6	102·7	30·0	+ 92·4	92·4
·1	6174·2	115·0	·1	2915·9	102·3	·1	0·0	92·1
·2	6059·2	114·5	·2	2813·6	101·9	·2	− 92·1	91·8
·3	5944·7	114·1	·3	2711·7	101·6	·3	− 183·9	91·5
·4	5830·6	113·6	·4	2610·1	101·1	·4	− 275·4	91·2
·5	5717·0	113·1	·5	2509·0	100·8	·5	− 366·6	91·0
·6	5603·9	112·7	·6	2408·2	100·5	·6	− 457·6	90·6
·7	5491·2	112·2	·7	2307·7	100·1	·7	− 548·2	90·3
·8	5379·0	111·7	·8	2207·6	99·7	·8	− 638·5	90·0
·9	5267·3	111·3	·9	2107·9	99·4	·9	− 728·5	89·7
25·0	5156·0	110·9	28·0	2008·5	99·0	31·0	− 818·2	89·5
·1	5045·1	110·4	·1	1909·5	98·6	·1	− 907·7	89·1
·2	4934·7	110·0	·2	1810·9	98·3	·2	− 996·8	88·9
·3	4824·7	109·6	·3	1712·6	98·0	·3	− 1085·7	88·6
·4	4715·1	109·1	·4	1614·6	97·6	·4	− 1174·3	88·3
·5	4606·0	108·7	·5	1517·0	97·3	·5	− 1262·6	88·0
·6	4497·3	108·3	·6	1419·7	96·9	·6	− 1350·6	87·8
·7	4389·0	107·8	·7	1322·8	96·6	·7	− 1438·4	87·4
·8	4281·2	107·5	·8	1226·2	96·3	·8	− 1525·8	87·3
·9	4173·7	107·0	·9	1129·9	95·9	·9	− 1613·1	86·9
26·0	4066·7		29·0	1034·0		32·0	− 1700·0	

TABLE II.

Argument—Sum of Temperatures of Air at both Stations.

$t+t'$	n	$t+t'$	n	$t+t'$	n	$t+t'$	n	$t+t'$	n
50	0·9268	80	0·9582	110	0·9895	140	1·0209	170	1·0522
51	·9279	81	·9592	111	·9906	141	1·0220	171	1·0533
52	·9289	82	·9603	112	·9916	142	1·0230	172	1·0543
53	·9300	83	·9613	113	·9927	143	1·0240	173	1·0553
54	·9310	84	·9624	114	·9937	144	1·0251	174	1·0564
55	·9321	85	·9634	115	·9948	145	1·0261	175	1·0575
56	·9331	86	·9645	116	·9958	146	1·0272	176	1·0585
57	·9341	87	·9655	117	·9969	147	1·0282	177	1·0596
58	·9352	88	·9666	118	·9979	148	1·0293	178	1·0606
59	·9362	89	·9676	119	0·9990	149	1·0303	179	1·0617
60	·9373	90	·9686	120	1·0000	150	1·0314	180	1·0627
61	·9383	91	·9697	121	1·0010	151	1·0324	181	1·0638
62	·9394	92	·9707	122	1·0021	152	1·0334	182	1·0648
63	·9404	93	·9718	123	1·0031	153	1·0345	183	1·0659
64	·9415	94	·9728	124	1·0042	154	1·0355	184	1·0669
65	·9425	95	·9739	125	1·0052	155	1·0366	185	1·0679
66	·9436	96	·9749	126	1·0063	156	1·0376	186	1·0690
67	·9447	97	·9760	127	1·0073	157	1·0387	187	1·0700
68	·9457	98	·9770	128	1·0084	158	1·0397	188	1·0711
69	·9467	99	·9780	129	1 0094	159	1·0408	189	1·0721
70	·9477	100	9791	130	1·0105	160	1·0418	190	1·0732
71	·9488	101	·9801	131	1·0115	161	1·0429	191	1·0742
72	·9498	102	·9812	132	1·0125	162	1·0439	192	1·0753
73	·9509	103	·9822	133	1·0136	163	1·0449	193	1·0763
74	·9519	104	·9833	134	1·0146	164	1·0460	194	1·0773
75	·9530	105	·9843	135	1·0157	165	1·0470	195	1·0784
76	·9540	106	·9854	136	1·0167	166	1·0481	196	1·0794
77	·9551	107	·9864	137	1·0178	167	1·0491	197	1·0804
78	·9561	108	·9875	138	1·0188	168	1·0502	198	1·0815
79	·9571	109	·9885	139	1·0199	169	1·0512	199	1·0826
80	·9582	110	·9895	140	1·0209	170	1·0522	200	1·0836

Small Corrections, depending on Decrease of Gravity at the Upper Station, Height of the Barometer at the Lower Station, and the Latitude.

		A						
		1000	2000	3000	4000	5000	6000	7000
Decrease of Gravity ..		+ 2·5	5·2	7·4	10·8	13·7	16·7	19·9
	B.							
Height of Barometer at Lower Station ..	24°	+ 0·6	1·2	1·8	2·4	3·0	3·6	4·2
	25°	+ 0·5	1·0	1·5	2·0	2·8	2·9	3·4
	26°	+ 0·4	0·8	1·2	1·6	2·0	2·3	2·7
	27°	+ 0·3	0·6	0·9	1·2	1·4	1·7	2·0
	28°	+ 0·2	0·4	0·6	0·8	0·9	1·1	1·3
	L.							
Latitude ..	20°	+ 1·3	2·6	3·9	5·2	6·5	7·8	9·1
	25°	+ 1·0	1·9	2·9	3·9	4·9	5·8	6·8
	30°	+ 0·6	1·2	1·8	2·4	3·0	3·6	4·2
	35°	+ 0·2	0·3	0·5	0·7	0·9	1·1	1·2
	40°	− 0·3	− 0·5	− 0·8	− 1·1	− 1·3	− 1·6	− 1·9
	45°	− 0·7	− 1·5	− 2·2	− 2·9	− 3·6	− 4·4	− 5·1

$$A = n\,(F' - F) + \text{small corrections.}$$

Rule.—Take out the values of F corresponding to the heights of the barometer at the upper and lower stations; take their difference, which in case one of them is negative will be their numerical sum, multiply the difference by the value of n corresponding to the sum of the temperatures of the air at each station; the product A will be very nearly the height in feet of one station above the other. To this value, apply the small corrections for a final result. If the barometer be a mercurial one, a further correction of $2\frac{1}{2}$ feet will have to be subtracted for each degree of excess of the temperature of the mercury at the lower station over that of the upper.

Example.—On May 8, 1889, an aneroid barometer, at the meteorological station near the summit of Mount Macedon, indicated 27·03 in., the temperature of the air being 59°; the same barometer, a few hours after, read at the Melbourne Railway Station 30·23 in., the temperature of the air being 62°. Find the difference of height:—

27·03 in. F =	2987·8	
30·23 in. =	−119·6	
Diff.	3107·4	
	100·1	= n for 121°
	3107·4	
	3·1	
	3110·5	
Small corrections +	8·2	
Difference of height ..	3118·7	

ART. IX.—*Notes on the Barometric Measurement of Heights.*

By PROFESSOR KERNOT, M.A., C.E.

[Read June 13, 1889.]

I propose at the present time to submit to the Society a few remarks on the above subject, in connection with the very full and interesting paper given by the Vice-President last month. In that paper the author expressed considerable doubt as to the accuracy of certain statements that had from time to time been made with reference to the high degree of precision with which differences of level can be obtained by means of ordinary aneroids, in the hands of observers whose time is limited, and who are not provided with the costly appliances to be found at a great national observatory. In this view he is certainly not singular, as several of the most experienced and skilful surveyors of my acquaintance have repeatedly made in my hearing very disparaging statements as to these instruments and their performances. Thus, it will be seen that there has been considerable difference of opinion. Some experienced and reliable surveyors speaking of the instrument as being capable of giving differences of level in average cases within five feet, or even less, of the truth; while others regard an error of 100 feet as not only possible, but even probable, under ordinary circumstances. To determine which of these two views is correct, is a matter of great importance from an engineering point of view. If the relative levels of points ten or twenty miles distant can be determined with a probable error of not more than ten, or even twenty feet, the location of roads, railways, and schemes of water supply will be greatly facilitated, as a few hours' work of a solitary observer with the aneroid will often serve, instead of several days' labour of a fully-equipped survey party.

I do not, of course, propose to dispense with accurate levelling in the final or detailed survey of the adopted line. It is in the preliminary investigation and comparison of various possible alternative routes that extreme accuracy is

not needed, while the speed and small cost of aneroid work are so advantageous.

Having taken, on several occasions, the optimistic view in this matter, I felt it desirable to submit some results justifying this opinion. The instruments with which the results I propose to quote were obtained, are the following :—

1. A small compensated aneroid supplied by Kilpatrick and Co., about fifteen years ago. It is a good instrument of its kind, and when tested at the Observatory under the air pump, showed great sensitiveness, the hand responding promptly to the smallest change of pressure. At the same time, I do not suppose it is better than many others that have been exposed for sale by Melbourne opticians.

2. A large open-faced aneroid, not compensated, with a five-inch dial, supplied by the same firm about twenty years ago. This was an exceedingly cheap instrument, but happens to be unusually sensitive, responding to a variation of pressure represented by $\frac{1}{200}$th inch of mercury. This instrument I used many years ago in laying out contour lines on the Geelong waterworks, and found the lines so laid out, when subsequently tested by levelling, to be almost always within three feet of the right level. I should add that I was aided by accurate level marks about fifty feet lower down the slope.

3. A new Watkin aneroid, supplied to the University by Kilpatrick and Co., jewelled and compensated, and having a scale so open that a movement of the index corresponding to $\frac{1}{1000}$th inch of mercury is visible. This instrument is marked No. 161 on the dial.

4. An aneroid barograph marked Kilpatrick and Co., Melbourne, and purchased last year. This instrument keeps a constant record of the pressure of the atmosphere, and as far as I have tested it has worked satisfactorily.

The first experiment that I wish to describe was made about twelve years ago. Four readings were taken with instrument No. 1, on the crest of the dam of the Pipehead reservoir, Geelong Water Works. These readings were taken at intervals of three or four hours, and were compared with simultaneous readings on the mercurial barograph at the Government Observatory, corrections for temperature and for instrumental errors being applied. The true difference of level by levelling was 760 feet, and the distance about forty miles, the intervening country being nearly level and generally devoid of trees. The four

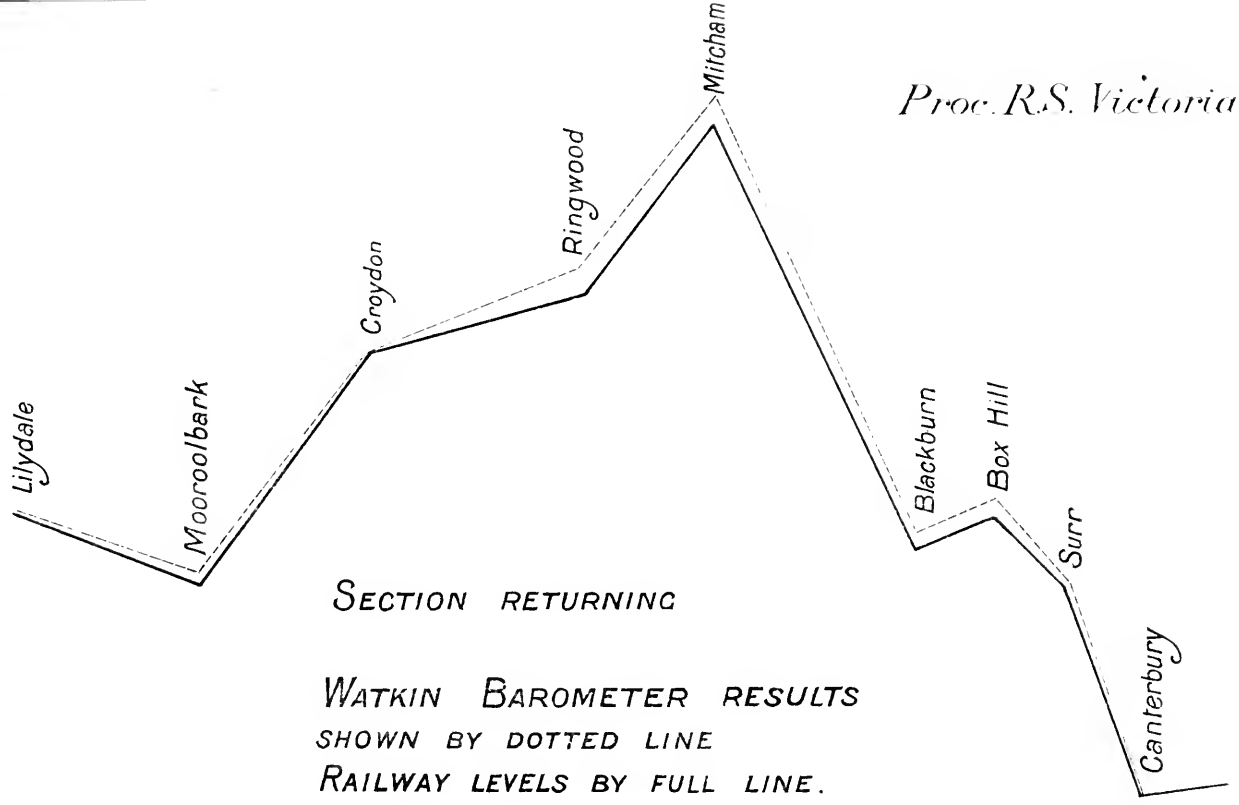
determinations by barometer were all too low, the best being four feet out, the worst eight feet, and the average six feet in error—Laplace's table being used in the calculation.

A second experiment at the same time, consisted in comparing three points within half a mile of the Pipehead dam, and within 100 feet of its level with the dam itself. The level of two of these points was given within two feet of the truth by a single observation, while the third which was not so well observed, owing to night coming on, was five feet in error.

A third experiment which has been frequently performed with the surveying class at the University, consists in taking the height of the gallery on the tower of Ormond College. This is 130 feet from the ground, and has been many times measured by instruments 1 and 2. The result has always been slightly below the truth, usually about 125 feet. I do not remember it ever having been below 120 or above 130.

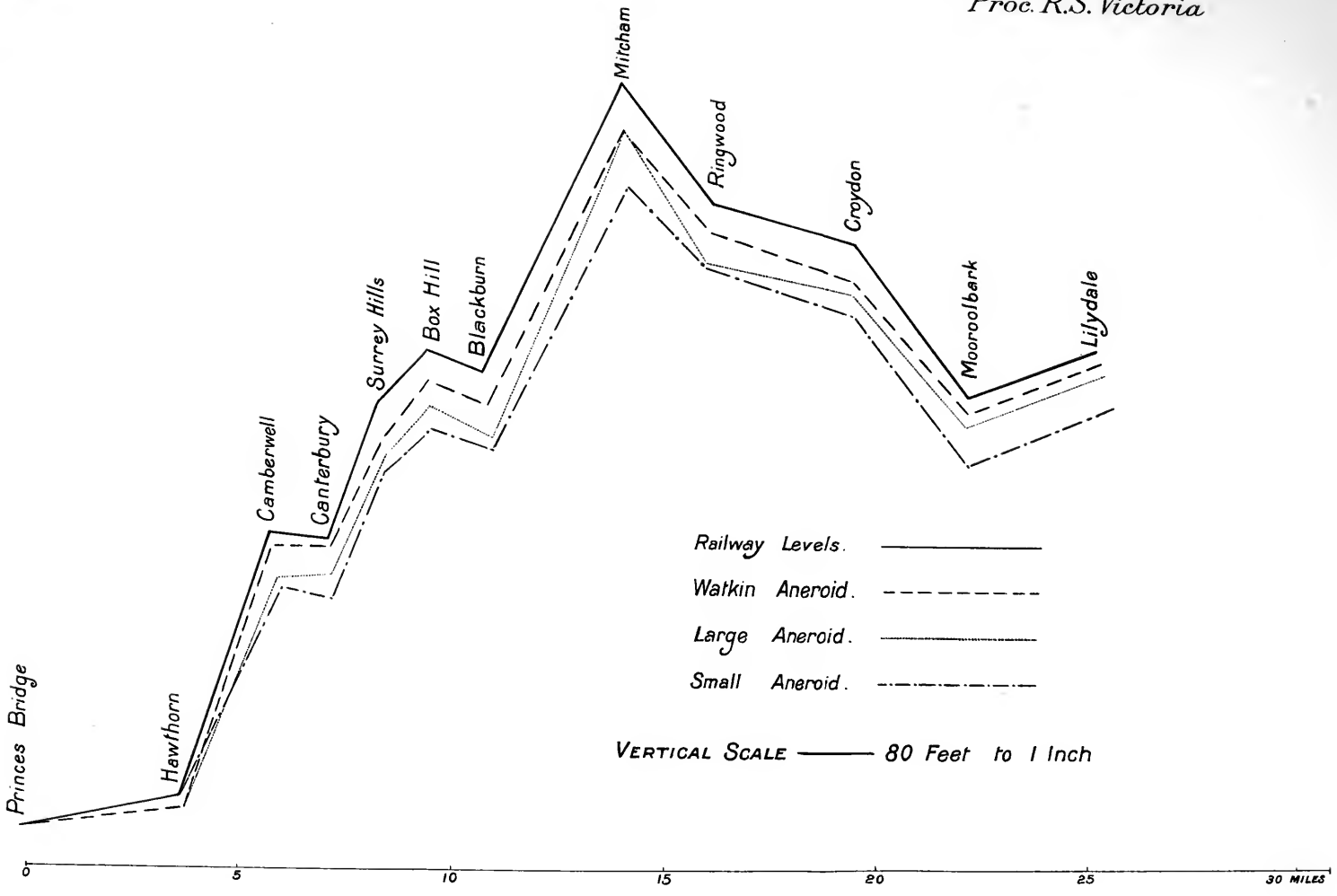
On the 1st inst., having Mr. White's remarks in view, and having for other purposes to pay a visit to a place called Riverview, near the Yarra Glen Railway Station, I determined to make a careful test of the three barometers, and compare the result when fully worked out and all proper corrections applied, with the known difference of level by actual levelling. I therefore set the barograph going at the University, and carefully reading the three instruments at the Princes Bridge Railway Station, took them to Riverview, and read them as other engagements permitted, eight times in forty-eight hours. Thus I obtained twenty-four readings, which, when compared with the Princes Bridge readings, corrected by reference to the barograph and worked out by Laplace's table with instrumental and temperature corrections, gave the following results:—

	Aneroid No. 1.	Aneroid No. 2.	Aneroid No. 3.
	228	222	233·7
	228	240·5	222·0
	238	259	256·1
	228	240·5	236·7
	238	231·2	230·8
	249	231·2	221·7
	228	212·8	213·1
	249	222	222·4
Mean	235·7	232·4	229·6



SECTION RETURNING

WATKIN BAROMETER RESULTS
SHOWN BY DOTTED LINE
RAILWAY LEVELS BY FULL LINE.


Princes Bridge
Hawthorn
Camberwell
Canterbury
Surrey Hills
Box Hill
Blackburn
Mitcham
Ringwood
Croydon
Mooroolbark
Lilydale
Railway Levels.
Watkin Aneroid.
Large Aneroid.
Small Aneroid.
VERTICAL SCALE —— 80 Feet to 1 Inch
0
5
10
15
20
25
30 MILES

The true difference of level is 237 feet,* and the distance in a strait line twenty-four miles, the intervening country being rangy and timbered. The worst result by instrument No. 1, is 12 feet in error, the best 1 foot, and the mean 1·3 feet; by No. 2, the worst is 24·2 in error, the best 3·5, and the mean 4·6; by No. 3, the worst is 19·1 in error, the best ·3, and the mean 7·4. The mean of the three means is 4·4 in error.

I also read the instruments at the various stations between Melbourne and Lilydale, and plotted the section of the line from the observations so made. The diagram submitted shows the result. I do not regard this as a fair test, as the readings were hurried, and the instruments had not time to settle. Still the result, especially with No. 3, the Watkin, is fairly consistent and good enough to be of very considerable practical utility.

I think the above experiments will serve as far as they go, to show that barometer work, carried out with fairly good instruments carefully used, and with all proper corrections applied, may be relied upon to give differences of level with greater accuracy than is often supposed, and with sufficient accuracy to be of very great service in preliminary investigations connected with engineering works of various descriptions.

Art. X.—*A New System of Photo-Lithography.*

By G. W. Perry, Esq.

[Read June 13, 1889.]

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* I have since been informed that this level is not quite accurate.

Art. XI.—*Liquid Kino.*

By J. H. Maiden, F.L.S., F.C.S.,

Curator of the Technological Museum, Sydney.

Communicated by Baron Ferdinand von Mueller, K.C.M.G., F.R.S., &c.

[Read Thursday, July 11, 1889.]

Angophora intermedia (D.C.), the narrow-leaved apple-tree is a tallish tree, which extends from Victoria to Queensland, and is the only species of the genus which is found in the southern colony. In the following respect, it is perhaps unique amongst Australian trees. Frequently, when an incision is made into the bark, and more particularly when the knobby excrescences sometimes found on this tree are cut, there exudes a watery liquid which occasionally is almost as clear and as colourless as water, and at other times of an orange-brown or reddish-brown colour, and of the consistency of a thin extract, or even as thick as treacle. This is doubtless the substance which was sent from New South Wales to the Paris Exhibition of 1867, labelled "apple-tree juice," with the statement that it is used as a varnish; but this is not correct, as the liquid is aqueous. It is used by fishermen for tanning their nets. Mr. Kinton informed Baron von Mueller that a single tree will yield as much as two gallons of liquid, which is generally called "liquid kino." This is a modest computation, for the tree which yielded the Bangley Creek sample *(infra)* yielded from eight to ten gallons. The quantity is, in any case, by no means small, and is dependent on a variety of circumstances.

Two samples of this "liquid kino" having recently been forwarded to the Technological Museum, the author has had an opportunity of examining it.

1. From Bangley Creek, Cambewarra, N.S.W., of a clear reddish-brown colour, and in order to give precision to the tint, it is very like raw linseed oil, Strasburg turpentine, or dark balsam of Copaiba, but redder than any of them.

It has a specific gravity of 1·008 at 60°F., and an acidulous smell (owing to the presence of acetic acid), accompanied by an odour not so pleasant, and reminding one somewhat of spent tan liquors. It deposits a quantity of sediment of a buff colour, consisting almost entirely of catechin. It contains tannic acid ·772 per cent., "non-tannin" ·508 per cent. (Löwenthal's process.) The water amounts to no less than 98·3 per cent. The catechin was not estimated in this sample.

2. This was obtained from Cambewarra, but from a different locality. It is darker in colour than the preceding sample, being of a rich ruby colour. Like No. 1, it deposits a small quantity of sediment (catechin). This liquid kino had a specific gravity of 1·022 at 60°F., when received in April 1888.

The following results were obtained in December to January 1889:—Tannic acid 3·048 per cent. (of the liquid kino, without evaporating), "non-tannin" 1·27 per cent. (a portion of liquid kino, kept in agitation so as to obtain a fair proportion of sediment, was added to water to make up the strength of one grain of liquid kino to the litre), water 96·7 per cent. (after filtration from deposited catechin). The catechin and a little phlobaphene filtered off, were found to be in the proportion of ·495 per cent. of the original liquid kino. Ether agitated with the filtrate took up ·15 per cent., of which one-third was estimated to be catechin, and the rest resin.

Mr. Kirton has recorded liquid kino from the Illawarra district of New South Wales, but since there appears to be no reason why it should be found in one colony more than another, it will doubtless also be obtainable in Victoria, most likely on application to fishermen.

Art. XII.—*The Calculimetre.*

By James J. Fenton, F.S.S.

[Read July 11, 1889.]

The Calculimetre is a circular measure of French make for performing approximate arithmetical and trigonometrical calculations. It consists of a flat disc of metal about the size of a watch, which can easily be attached to a chain and carried in a watch pocket. On one face, there are the two principal scales—one movable, the other fixed—for performing the ordinary rules of multiplication, division, and proportion; also a third scale for finding the squares and square roots of numbers. On the reverse face may be instantly found, by means of a movable arm, the logarithms of numbers, and the sines and tangents (the latter being under 45°) of angles.

This instrument is, of course, based on the principle of Gunter's line, *i.e.*, a scale divided logarithmetically, but marked with the natural numbers only, and has the advantage over the ordinary carpenter's and other similar slide-rules of convenience and portability, and a readier application to arithmetical calculations, besides having the additional scales for trigonometrical calculations. The arithmetical scales are about the same length as in the ordinary slide-rule, and, with good observation, results with the first three figures of a result can often be closely ascertained.

Some time ago, I brought before the notice of this Society, *Fuller's Calculating Slide-rule*,* which will readily give accurate results to the fourth and sometimes to the fifth figure. In that ingenious instrument, however, the scale is of great length, being no less than 41½ feet, it being drawn in a spiral form round a cylinder; whilst in the more portable calculimetre the scale is only 6¼ inches in length, and of course cannot give the more extended results which may be obtained with the invaluable rule of Professor Fuller. But in cases where rough approximations

* *Vide* paper read 10th September, 1885. Two of these instruments have been in constant use in the office of the Government Statist for a long time past, and have proved most invaluable for statistical computations.

are required by architects, engineers, surveyors, analytical chemists, actuaries and statisticians, mechanics, mathematicians, students and others, the circular rule now exhibited will doubtless prove of valuable assistance.

A considerable amount of time and labour is constantly being wasted in the present day, by making long calculations out of all proportion to the accuracy of the data involved. Take surveyors' calculations for example. A good ordinary —say a 6-inch—theodolite is divided to twenty minutes of a degree (20′), in which case the lines would be only about $\frac{1}{50}$th of an inch apart. It is quite within the bounds of possibility, therefore, that a rough observation might be liable to an error of 10′, which would be equivalent to an error in the sine, varying (in the case of angles under 70°) from ·001 to ·003, according to the magnitude of the angle. The error would be thus in the third place, and what can be the use of employing tables of sines calculated to six or seven places when the observation is, in the case supposed, not correct to even three. By means of the vernier, in like manner the same instrument may, by careful observation, be read to say within one minute of a degree (1′); then the error in the sine of the angle would vary from ·0001 to ·0003, which involves an error in the fourth place, and so on, according to the accuracy of the observation, and the precision of the particular instrument used.

I think it may be laid down as a general rule in arithmetical operations that a computer is justified in accepting as correct only as many figures (digits) in the product or the quotient, as there are reliable figures in either of the factors, or in either the divisor or dividend, by which such product or quotient respectively was obtained. For example, supposing it was required to find a death-rate at a particular age, *i.e.*, deaths divided by population, assuming the deaths to be fairly correct, and the population to be uncertain beyond (say) the third figure, any death-rate based on such figures would be incorrect beyond the third figure. It is the same in the case of products, the number of reliable figures in the result being solely dependent on the number of reliable figures in the most uncertain of its factors.

In using logarithms, likewise, a similar general rule might be applied, *i.e.*, to use logarithms to as many places only* as

* In special cases one place more might be used, so as to ensure of the last figure but one being as accurate as possible.

correspond to the number of correct digits in the numerical data involved. For example, it would be useless labour to use the log. sines of angles observed with an error of one minute of a degree to six or seven figures of decimals, when a table of four figure logarithms would answer equally well.

When these things are well understood and appreciated, the more extended tables of logarithms will be used less and less, and slide-rules will come into more general use.

For results to the second and third figure, the small circular slide-rule is best adapted; and for results to the fourth figure, the spiral slide rule is most invaluable; but for results beyond the fourth, we must still resort to mathematical tables or the arithmometre.

The great advantage of slide-rules over logarithmic tables are obvious. To find a product by logarithms, no less than seven operations* are necessary, and then there is the liability to error as well as loss of time in transcribing the logarithms, after finding the differences, and in adding them. With the slide-rule, only the natural numbers are dealt with, and it is merely necessary to bring the indices to the factors and the results may read off immediately by inspection.

I should mention, that I described in my paper on Fuller's Calculating Slide Rule, a circular rule somewhat similar to the calculimetre, called the *Cercle à calcul.*† The cercle à calcul more nearly resembles a watch, the calculations being performed by two hands—the one movable, and the other fixed. The cercle à calcul is in some respects the better instrument, but it is about three times the cost of the other, which is only about ten or twelve francs.

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* Multiplying $a \times b$; (1) find a in log. book; (2) then log. a and transcribe; (3) find b; (4) then log. b and transcribe; (5) find sum; (6) find same in log. book; and (7) find colog. $a\ b$.

† A similar instrument made in England is known by the name of "Boucher's Pocket Calculator."

Art. XIII.—*On Finding the Longitude from Lunar Distances.*

By E. J. White, F.R.A.S.

[Read Thursday, October 10, 1889.]

About a fortnight ago the newspapers contained an account of the sufferings of the crew of the ship Garston, which had been wrecked, owing it is stated to a fault of the chronometer. On reading this, I was led to reflect on the methods at present in use for finding the position of a ship at sea. The latitude is obtained in so simple and so direct a manner that no notice will be taken of this operation, beyond remarking that the principal desideratum is a night instrument, to allow of altitudes of the stars being observed at other times than twilight, at which time only can the ordinary sextant be relied on for this purpose. The longitude problem is more complex, it resolves itself into two questions—finding the local time, and that of the first meridian, which to English speaking people, and indeed to most others now, is that of Greenwich. The observation for finding the local time is as simple as that for latitude, but the calculation is a little more complex, and it is dependent on the latitude, less so, however, when the body observed is east or west than in any other position. The finding of the Greenwich time is a more serious matter; it exercised the minds of men for many centuries, and large rewards were offered by the British Parliament to stimulate investigation. As far as navigation is concerned, the methods have been reduced to two—timekeepers, and moon observations, generally known as chronometers, and lunar distances. The chronometer method is so simple that it has now nearly superseded the other (I was informed by a naval officer a little time ago that he had never seen a lunar distance taken for finding the place of the ship, but only for the instruction of the naval cadets); but in my opinion, it is criminal to rely upon it for long voyages when less than three chronometers are carried, for such delicate machines are always capricious, and even the slight rusting

of the balance spring would render it quite untrustworthy. The observation and reduction of lunar distances has been a favourite pastime with me for forty years, and from the experience thus obtained, I have formed such a high estimate of the method, that I have viewed with sorrow its gradual disuse. Many reasons have been given for this state of affairs—one is, that seamen have not time for the necessary calculations, but with Thomson's tables, which are quite accurate enough for navigation, the time required for a reduction is only ten minutes. Another, and this I consider the true reason, is that the results could not be trusted. In the consideration of this it may be stated that about thirty years ago the lunar tables were so inaccurate that an error of twenty-two miles of longitude would sometimes be due to the Nautical Almanac alone. In 1862, Hansen's tables were first used in this work; these gave the place of the moon very accurately for some years, but commenced to diverge a little time ago, to counteract which, the Nautical Almanac applies Newcomb's empirical correction to the places of the moon used in computing the lunar distances, and the outstanding error is now very small indeed. Besides the errors of the Nautical Almanac, there are those of the sextant, which owing to excessive competition and lowering of price, are larger than formerly. It is quite surprising how rarely one meets with a really good sextant nowadays. Those made by the celebrated Troughton at the beginning of this century are still unsurpassed. I took the following excerpt from the catalogue of a manufacturer who exhibited at our last exhibition:—"We guarantee any of our best sextants to have a small margin of error (under 3′, and generally under 1′ of arc)." As the index error is easily and always ascertained by the observer, I suppose the error referred to is independent of this, principally excentric and division error, which is so troublesome to measure that it is generally neglected by seamen; and how would these errors affect a longitude determined from a lunar distance? by about thirty times their amounts—90′ and 70′ of arc respectively. I once had brought under my notice a modern sextant, where the excentric error amounted to 9′. If such a one had been used in a lunar distance, the error of longitude would have been about four degrees and a half. In other cases, sextants originally very good, have been ruined by incompetent repairers, or bungling treatment by their

owners. Those who wish to test the lunar method should practise at a place whose longitude is well known. The index error should be carefully found at each observation. The same dark glass or glasses should be always used for the sun, the grading of the brightness being obtained by the up and down motion of the telescope, and the contacts should be alternately made on and off. The errors of the resulting longitudes can then be tabulated or graphically described, whence a table of corrections for the different parts of the arc can be made. Some observatories contain special apparatus for testing sextants, but an ordinary observer would have more confidence in the former method. To those who wish to study the general theory of the sextant, I would recommend "Simms on the Sextant and its Applications," published by Troughton and Simms, of London, as the best work on the subject in our language. It is not, however, an easy book to read, and the notation is cumbrous and uninviting. For an example of finding the errors of a sextant from astronomical observations, the best work is the "Treatise on Practical Astronomy, as applied to Geology and Navigation," by Professor Doolittle, of the Lehigh University. The work was carried out by Professor Boss, the present director of the Dudley Observatory, and the various steps of the process are given with the minutest detail. The greatest correction found was 38 seconds of arc, which shows that the instrument was a very good one, for Simms states in the work before referred to, that there are few sextants in which the error which varies with the reading does not amount at its maximum to 40 seconds of arc. In many it exceeds 1 minute, and instances are to be met with where it amounts to 5 minutes.

For reducing a lunar observation, or clearing the distance as it is technically called, many methods have been devised, indeed, no other astronomical problem has shown such a fecundity of results, but their principles may be broadly divided into two—one the absolute solution of the two astronomical triangles presented by the problem, the other the differential variations of the parts of these triangles. The former of these is now seldom used, owing to the amount of work and care necessary; it is, however, the only safe one to use when the observed distance is very small. The shape in which this computation is carried out, is generally some slight modification of Borda's formula, published near the end of the last century. The large tables of Mendoza Rios

are also adapted to this method. At sea, the reductions are generally made on the differential principle, mostly by the aid of Thomson's tables, which give in a convenient shape, the result of an immense amount of labour, as the author stated that he solved more than 80,000 lunar distances in their construction ; but for hydrographic and land observations, they are not sufficiently precise. In these cases, the rigid formula was, until lately, generally applied. About thirty years ago, however, Chauvenet, in his great work on Special and Practical Astronomy, gave a new investigation and tables for its application, by means of which the whole of the corrections can be taken into account, and the result obtained with nearly the accuracy of the laborious method of Bessel, who, as Chauvenet remarks, is the only one who has given a theoretically exact solution of the problem.

From the many hundreds of lunar observations I have taken in Australia, I select my observations of the last three years, as I wish to show the degree of dependence on them in the present state of the Nautical Almanac. They were all observed at my quarters, a little to the south-west of the Observatory. The instrument was a pillar sextant, Troughton No. 1139, it was made at the beginning of this century, and has been in my possession nearly forty years, during the whole of which time the index error, which is measured at each observation, has barely varied half a minute of arc, and the greatest excentric error is about twenty seconds. The objects observed, have been in every instance the sun and moon, which, from their slower relative motion, are theoretically less suitable than the moon and a star; but I find the results to be actually better, owing to the delicate contacts that can be made with two discs, and the advantage of daylight in noting the time and reading off the arc. Only one coloured glass has been used in all the observations, the equality of brightness of the two images having been obtained by altering the distance of the telescope from the plane of the instrument. No special selection of time has been made for observing, indeed from the fact that I keep my sextant at home, most of the observations have been made before 8 a.m. or after 5 p.m., when one of the objects is usually rather low, whereas on board ship the most favourable times could always be chosen. The barometer and thermometer have been read immediately after each observation for the proper correction of the refractions, and the reductions have been made by means of Chauvenet's

tables. The corrections for excentricity have not been applied; the results, therefore, are those given by a good sextant used in the ordinary way, with careful reduction. The local time has been taken from a chronometer watch, compared with the mean time clock of the Observatory. On a few occasions, it was taken from a clock beating seconds, whose error was determined in the same manner, and in only one instance is there a doubt about this element. The clock was used in the observation of October 14, 1888—it will be noted as the most discrepant but one of the series—it was reduced soon after it was observed and the discrepancy remarked, and on examining the clock, I found that in that part of the dial where the minutes were read, the zeros of the second and minute hands did not correspond, and I have reason to believe that a mistake of a minute was made in the local time; as I have, however, a great dislike to cooking observations, I have not changed the original entry of the observation. As the altitudes are in every case computed, a mistake in the mean time would affect them also.

Date.	Approximate observed Distance.	☾	Resulting Longitude.	Errors true obs.	Remarks.
1887.					
d. h.	° ′		h. m. s.	sec.	
Aug. 27, 5	107 52	E	9 40 49	— 55	Good.
Sept. 10, 21	85 55	W	39 43	+ 11	Cloudy.
Oct. 8, 19	105 3	W	39 24	+ 30	Very good.
Nov. 19, 23	62 43	E	40 29	— 35	Good.
Dec. 6, 19	105 40	W	40 8	— 14	Cloudy.
,, 8, 19	79 48	W	39 52	+ 2	Good.
,, 9, 19	66 28	W	40 9	— 15	Good.
,, 10, 19	53 5	W	39 48	+ 6	Good.
1888.					
Jan. 21, 7	91 22	E	39 23	+ 31	Cloudy.
,, 22, 3	101 19	E	39 58	— 4	Good.
,, 24, 6	124 17	E	40 19	— 25	Good.
Feb. 4, 20	88 9	W	39 45	+ 9	Good.
,, 15, 6	37 21	E	39 44	+ 10	Moon faint.
,, 17, 6	59 28	E	39 18	+ 36	Good.
,, 18, 4	69 59	E	38 58	— 4	Good.
,, 20, 6	92 29	E	39 55	— 1	Sun clouded.
,, 21, 6	103 34	E	40 28	— 34	Good.
June 2, 23	72 39	W	39 55	— 1	Cloudy.
Sept. 29, 20	71 52	W	39 12	+ 42	Good.
Oct. 14, 4	115 26	E	40 58	— 64	Good. Minute of local time doubtful.
Dec. 22, 19	130 5	W	39 16	+ 38	Good.
,, 24, 19	106 39	W	39 33	+ 21	Very good.
,, 27, 19	68 8	W	40 20	— 26	Good.

Date.	Approximate observed Distance.	☾	Resulting Longitude.	Errors true obs.	Remarks.
1889.					
Jan. 11, 6	115 15	E	40 45	— 51	Moon faint.
,, 21, 19	125 9	W	40 26	— 32	Very good.
,, 22, 19	112 28	W	39 55	— 1	Very good.
,, 25, 19	73 19	W	40 22	— 28	Cloudy. Moon faint.
,, 25, 22	72 19	W	40 16	— 22	Moon faint.
,, 26, 20	59 31	W	40 37	— 43	Good.
,, 27, 19	46 3	W	41 30	— 96	Cloudy. Very unsatisfactory.
Feb. 19, 21	129 38	W	39 49	+ 5	Hazy. Moon faint.
,, 20, 21	116 44	W	39 59	— 5	Good.
,, 22, 21	90 24	W	40 3	— 9	Very good.
Mar. 6, 5	51 50	E	38 46	+ 8	Moon faint.
,, 7, 6	63 6	E	39 40	+ 14	Sun clouded.
,, 10, 5	95 35	E	39 55	— 1	Very good.
,, 11, 5	106 43	E	40 32	— 38	Very good.
,, 12, 5	117 47	E	40 36	— 42	Good.
,, 13, 5	129 8	E	40 9	— 15	Good.
Aug. 3, 3	72 51	E	39 17	+ 37	Good.
,, 4, 1	84 28	E	39 58	— 4	Good.
Oct. 2, 5	92 49	E	39 17	+ 37	Very good.

The mean of the whole 42 observations is 9 h. 39 m. 59 s., which only exceeds the adopted longitude, as determined by telegraph, by 4·8 s. The mean of the 21 with the moon east is 9 h. 39 m. 59 s., of the remaining 21, with the moon west, is 9 h. 40 m. The probable error of a single observation is found from the residual errors to be ± 21 s., or a little more than 5 miles of longitude.

The result is, in my opinion, very satisfactory, for much larger errors than these have been found in the longitudes of places which have been determined with the large instruments of astronomical establishments. In one instance, that of the Lisbon Observatory, an error of nearly nine seconds of time was discovered a few years ago, when the longitude was measured by means of the electric telegraph. As observations can be taken at sea with nearly the same ease as on shore, except perhaps in the case of steamers, where the smoke and vibrations are very annoying, the results should be equally good, if the same care is taken in the reduction ; but where Thomson's and similar tables are used, the probable error would be rather larger.

In conclusion, I may express the hope that this paper may contribute towards rescuing this once favourite method of finding the longitude from the neglect into which it has

undeservedly fallen, and that it may lead to a stricter supervision of the instruments employed in nautical astronomy. I believe that all gun barrels have to be submitted to a Government test, but if one burst, little harm would be done, except to the user. In the case of sextants and chronometers no supervision is exercised in their manufacture, and the selection is left to individual caprice, yet a faulty one may cause the loss of much property and many lives.

Art. XIV.—*On the Pseudogastrula Stage in the Development of Calcareous Sponges.*

By Arthur Dendy, M. Sc., F.L.S.

Fellow of Queen's College, University of Melbourne.

(With Plate 1A.)

[Read November 14, 1889.]

Thanks to the researches principally of Metschnikoff, Schulze and Barrois, we are now in possession of a tolerably full and accurate account of the development of the Sycon type of calcareous sponges, as represented by the genus *Sycandra*. It is in the hope of contributing a small addition to our knowledge in this department of embryology that the present paper is written.

Before going on to describe my own observations, it will be advisable to give a brief account of the now generally accepted views concerning the history of the development of *Sycandra*—such, for example, as is to be found in Balfour's "Treatise on Comparative Embryology."

The ovum is a naked, amœboid, nucleated mass of protoplasm, which, after fertilization, undergoes the early stages of its development within the tissues of the mother sponge. The ovum first divides vertically into two and then into four segments. The next two divisions are also

vertical, and result in the formation of altogether eight pyramidal segments, arranged in a single layer, with a small cavity in the centre, the embryo at this stage being cushion-shaped. Each segment now divides horizontally, so that we have an embryo composed of two layers of eight cells each. Segmentation goes on until the embryo has the form of a hollow sphere—the *Blastosphere*—whose wall is composed of a single layer of cells, eight of which, situate at one pole of the sphere, are distinguished from the remainder by their granular appearance. These eight cells increase to about thirty-two in number, and become pushed in or invaginated, still, however, remaining as a single layer, so as almost to obliterate the cavity of the blastosphere (segmentation cavity). The remaining cells of the blastosphere become much elongated and ciliated. The embryo is still enclosed within the parental tissues. To this stage—characterized by the invagination of the granular cells—the name *Pseudogastrula* has been given; according to Balfour, no importance can be attached to it. The embryo now soon leaves the parent, and by the time this takes place the granular cells have increased in bulk and become completely everted again, still remaining as a single layer.

The free swimming embryo (or larva), known as an *Amphiblastula*, is oval or egg-shaped, and transversely divided into two halves—a front half, composed of a layer of very numerous, elongated, ciliated cells, and a hinder half composed of the layer of granular cells, now thirty-two in number. Some fifteen or sixteen of the granular cells, viz., those which touch the ciliated cells, form a special ring. Balfour states that "during the later periods of the amphiblastula stage a cavity appears in the granular cells dividing them into two layers." This statement appears to be based upon Metschnikoff's observations, to which I shall have to refer presently.

After swimming about for some time, the ciliated half of the larva becomes invaginated into the granular half, obliterating the segmentation cavity and giving rise to the *Gastrula* stage. "The two layers of the gastrula," says Balfour, "may now be spoken of as epiblast and hypoblast." The gastrula next becomes attached to some object by its mouth, the attachment being effected by the granular (epiblast) cells of the special ring already referred to. "Between the epiblast cells and the hypoblast cells which line the gastrula cavity there arises a hyaline structureless

layer, which is more closely attached to the epiblast than to the hypoblast, and is probably derived from the former. . . . There would seem according to Metschnikoff's observations to be a number of mesoblast cells interposed between the two primary layers, which he derives from the inner part of the mass of granular cells." *

The principal changes which take place in the development of the fixed larva into the young sponge are the development of spicules in the mesoblast, the perforation of the double wall of the gastrula by the osculum and pores, and the conversion of the hypoblast cells into the collared cells so characteristic of sponges.

Such, then, is the generally accepted history of the development of *Sycandra*, given as briefly as possible. Perhaps the most remarkable feature in its whole course is the *Pseudogastrula*. Although Balfour states that no importance can be attached to this phase of the life-history, it is obvious that a stage of such constant occurrence amongst the Sycons, and found also, according to Keller,† in the Leucons, cannot be entirely meaningless. Sollas, indeed, has made a speculative attempt to explain it on purely theoretical grounds. "We may conjecture," says he, "that the larva which becomes a sponge now, by invagination of the ciliated layer, is a descendent of a form which used to become a coral by the invagination of the other layer, that is, that a form on the way to become a cœlenterate, took the wrong turn for once, and so ended in a cul-de-sac, and became a sponge. Thus the abnormal kind of invagination in Sycandra may be an instance of what is termed 'reversion to an ancestral type;' on the other hand it may simply indicate the balancing play of forces on the young organism, so that it looks as if it could not make up its mind, and was undecided as to whether to turn the flagellated layer inside and become a sponge, or outside, and become a cœlenterate. Between these alternative possibilities, we cannot decide."‡ All this is mere hypothesis, and I venture to hope that the correct explanation of the *Pseudogastrula* stage may be found in the following observations.

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* Balfour, *loc. cit.*

† "Untersuch. über die Anat. und Entw. einiger Spongien des Mittelmeeres." Unfortunately, I am unable at present to obtain access to this work. I cite it upon the authority of Metschnikoff.

‡ "The Structure and Life-History of a Sponge." Proceedings of the Bristol Naturalists' Society., Vol. 3, 1880.

The sponge which formed the subject of my own investigations, is the remarkable form originally named by Carter *Teichonella labyrinthica*. I propose shortly to publish a full account in another place of the anatomy of this sponge; meanwhile it is necessary to state that it does not belong to the genus *Teichonella* at all, but is a true Sycon—a fact, indeed, which Mr. Carter himself recognises in one of his later papers,* wherein he suggests that its generic name might be changed from *Teichonella* to *Grantia*. The sponge consists of a stalked cup, with a thin and very much folded wall. The flagellated chambers penetrate the walls of the cup in a direction at right angles to the two surfaces and open on the inner surface into the widely expanded cavity, corresponding to the gastral cavity of a typical Sycon; the osculum being enormously large and bounded by the folded margin of the cup.

I do not wish here to discuss the generic nomenclature of this sponge, which question I reserve for consideration in my forthcoming paper; but as it certainly cannot be called *Teichonella*, the type species of which I find to be a typical Leucon, I will, provisionally at any rate, adopt Mr. Carter's suggestion and call it *Grantia labyrinthica*.

In a fine specimen of *Grantia labyrinthica*, dredged by Mr. J. Bracebridge Wilson at Easter 1888, whilst I was myself with him, I met with a very large number of embryos. These were found both in the maternal tissues and also lying free in the flagellated chambers. While still within the maternal tissues the embryo lies in a cavity, which is but little larger than itself and lined by a very distinct single layer of flattened endothelial cells (*vide* Fig. 1). This capsule always lies in the thin layer of mesoderm between the wall of a flagellated chamber and the layer of spicules which surrounds it. Hence the capsule is bounded on the outside by the soft and yielding wall of the flagellated chamber, and on the inside by a layer of rigid spicules. As the embryo increases in size the capsule in which it lies becomes correspondingly enlarged, and owing to the manner in which it is bounded this enlargement must take place towards the flagellated chamber. Thus the side of the capsule next to the layer of spicules becomes flattened, while the opposite side bulges out into the flagellated chamber and forms a kind of blister, over which the delicate wall

* "Annals and Magazine of Natural History," July 1886, p. 38.

of the chamber becomes tightly stretched. These relations are of great importance in considering the development of the embryo, and they appear to be perfectly constant. Judging from the figures of Schulze, Barrois, and Metschnikoff, the embryo of *Sycandra* appears to be very similarly situated.

The youngest embryos in *Grantia labyrinthica* are always found near the margin of the sponge-cup, not far from the last formed flagellated chamber. Figure 1 represents the earliest stage found. The embryo here represented may be considered as in a late blastosphere stage, closely resembling the similar stage in *Sycandra raphanus*. The layer of elongated columnar cells is strongly arched, so as to form almost a hemisphere and lift up the wall of the flagellated chamber in the form of a blister as above described (owing to the direction in which the section happened to be taken this is not very well shown in the figure). The ovoid granular cells still form a single layer, or very nearly so, but show signs of proliferation already. This layer is flattened, and it is easy to see from the figure that the flattening is caused by the presence of the layer of rigid spicules beneath them. In this and in all the numerous other embryos which I have examined in the maternal tissues the ovoid granular cells are turned towards the layer of spicules, and the columnar cells towards the flagellated chamber. According to Schulze,* prior to this stage in *Sycandra raphanus* the layer of granular cells is always turned towards the flagellated chamber, but after this stage he finds the embryo in very different positions in the capsule, "gewöhnlich sogar mit dem hellen convexen Zellenlager dem Radialtubus zugewandt," Judging from this change in position, Schulze considers that from now onwards the columnar cells are ciliated. In my sections, made from spirit material, I have naturally enough not observed any cilia.

Even in this early stage of development the segmentation cavity is no longer quite empty, but contains a quantity of very delicate, finely granular, gelatinous-looking tissue (Fig. 1 *mes.*), in which a number of small, deeply staining nuclei are very distinctly visible. This tissue appears to be of constant occurrence, and is probably the commencement of the mesoblast, or mesoderm of the adult. It is quite uncertain from which layer it is derived, but the similarity of the nuclei to those of the columnar cells, and the fact that

* "Zeitschrift für wissensch. Zoologie," Vol. xxv. (Supplement), pp. 271, 272.

some of the latter nuclei—as shown in Figures 1, 2 and 4—are found out of the row, and apparently approaching the segmentation cavity, seems to indicate that it may possibly be derived from the layer of columnar cells. On the other hand, the granular cells, as I have already said, are already showing signs of proliferation, and may possibly have given rise to the tissue in question.

As development goes on the granular cells proliferate rapidly, especially towards the middle of the layer, where they become smaller and more numerous than at the periphery. As they go on increasing they occupy more and more space, and hence, as they cannot project outwards, on account of the rigid layer of spicules beneath them, they become invaginated, and give rise to the *Pseudogastrula* (Figs. 2, 4). The Pseudogastrula, then, is due to a mechanical invagination of the layer of granular cells, caused by their active growth and the peculiar situation of the embryo. These cells do not now, however, form a single layer, as is usually supposed, but a layer several or many cells thick. Such is certainly the case in *Grantia labyrinthica*, and, judging from the observations of Metschnikoff, to which I shall refer more in detail later on, I think it will probably be found to be the case also in *Sycandra raphanus*. The advantage of thin serial sections in the determination of such a point is obvious, and probably this method of investigation will lead to similar results in the case of the latter species.

At about this period of its life history the embryo leaves the maternal tissues, and escapes into a flagellated chamber, by rupture of the outer wall of the capsule (Fig. 3). This rupture of the capsule takes place in a ring, around the base of the blister which the embryo causes on the wall of the flagellated chamber. It involves, of course, not only the wall of the capsule, but also the wall of the flagellated chamber, which by this time has become tightly stretched and the collared cells composing it apparently flattened out. The outer part of the endothelial lining of the capsule and the portion of the wall of the flagellated chamber immediately overlying it appear to come away with the embryo when the latter breaks loose, forming a more or less structureless membrane, closely adherent to the layer of columnar cells (Fig. 4 *s.m.*) After the escape of the embryo the remains of the capsule appear on the wall of the flagellated chamber as a shallow recess lined by flattened endothelial cells (Fig. 3 *e.c.*)

By this time the granular cells have increased so much in bulk, and became so far invaginated as to reduce the segmentation cavity to a mere slit, in which, however, the primitive mesoblastic tissue is still recognisable (Fig. 4.)

The next distinct stage is represented in Fig. 5. The embryo is now solid and almost spherical. The columnar cells have elongated and their inner ends reach nearly to the centre of the embryo. The segmentation cavity is perhaps represented by a dark area in the centre. The granular cells form a hemispherical mass, which is the posterior half of the embryo. This mass has become differentiated into two distinct parts—(1) an external single layer of clearer, more or less cubical, nucleated cells; and (2) an internal mass of highly granular, larger, nucleated cells, which are ovoid or more or less polygonal from mutual pressure.

In the latest stage which I have seen (still within a flagellated chamber), the embryo has become somewhat pointed at the anterior extremity, and the boundaries between the internal granular cells are no longer distinctly visible. Fig. 6 is a diagram of this stage, representing the free swimming embryo as it leaves the parent sponge on its way to seek a place of fixation. As already stated, I have not myself seen the cilia, but there cannot be the slightest doubt, after the observations of so many authors on the living organism, of their existence.

Certain observations of Metschnikoff on *Sycandra* form a strong confirmation of my views as to the development of the Sycon type of calcisponge. This author* states that in the older larvæ, the posterior part, devoid of cilia, does not remain so simple as in the earlier stages. A cavity is developed in it which divides it into two layers. Sometimes also he found and figures (*loc. cit.* Fig. 11) a larva which closely agrees with that represented in my Fig. 5, in which the posterior half consists of an outer layer of epithelial cells and an inner mass of rounded cells closely packed. This internal mass he derives from the inner of the two layers into which the granular cells are first of all divided. Exactly how the original division of the granular cells took place is not made clear. Metschnikoff appears to have observed the fact that there is a division only after the pseudogastrula stage has been passed through. I suspect that the true course of events is very much the same as I have described

* "Zeitschrift für wissensch. Zoologie," Vol. 32, p. 368 *et seq.*

for *Grantia labyrinthica*. Concerning the inner mass of granular cells, Metschnikoff continues, "Diesen Zellenhaufen kann man als Mesoderm deuten, wie es solche Larven beweisen, wo in demselben sich mehrere Nadeln vorfinden (Fig. 13). Ich will nicht behaupten, dass die von mir beschriebenen Stadien durchaus normale sind; ich glaube vielmehr, dass sie uns eine sehr verfrühte Bildung des Mesoderms, resp. der Nadeln repräsentiren, welcher Vorgang aber mit dem normalen qualitativ ganz ähnlich verläuft. Wenigstens habe ich auch an vollkommen regelmässig und normal ausgebildeten Stadien eine, wenn auch bei weitem nicht so stark ausgebildete Mesodermanlage wahrgenommen."

Metschnikoff, then, has certainly seen in *Sycandra* something closely resembling what I have found in *Grantia labyrinthica*, and it is highly probable that the development of the two forms is almost, if not quite, identical. Metschnikoff's interpretation of the appearance of the internal mass of granular cells as an unusually or abnormally early development of the mesoderm is probably due to the fact that in older larvæ he finds this mass to be no longer visible. This fact, however, is easily explained according to my view of the case, which is as follows:—

The embryo already at a very early stage lies within a cavity lined by a special layer of endothelial cells. As it develops it increases greatly in size, and obviously receives nutriment from the mother sponge, probably through the medium of the endothelial cells.* Balfour† has already expressed the opinion that the granular cells of the free swimming embryo are nutritive in function, and this I hold to be correct, though I do not suppose that they take in any food while the embryo is swimming about. I maintain that the granular cells absorb nutriment from the maternal tissues, increase in size, proliferate rapidly, become mechanically invaginated as before explained, and when they have done absorbing nutriment become arranged in a hemispherical mass of large ovoid cells, highly charged with food granules, and an investing epithelial layer (Fig. 5). The embryo is now ready to lead an independent existence, and the internal mass of granular cells is, I believe, a supply of food which enables it to wander for a long distance before becoming

* Compare my account of the embryos of Stelospongos flabelliformis.—*Quart. Jour. Micro. Sci.*, December 1888.

† "Morphology and Systematic Position of the Spongida."—*Quart. Jour. Micro. Sci.*, vol. xix., 1879; also, "Comparative Embryology," vol. i., p. 122.

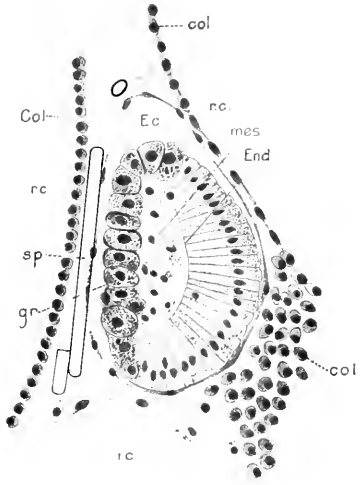
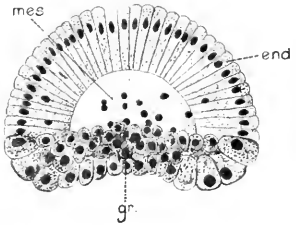


Fig 1.



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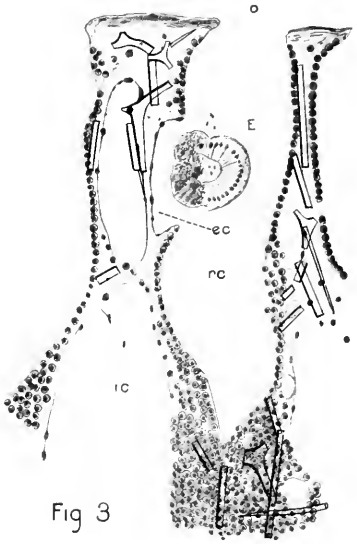

Fig 3

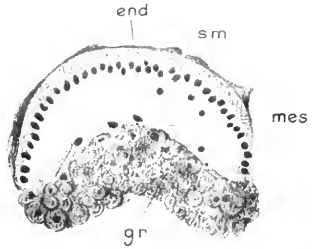

Fig. 4.

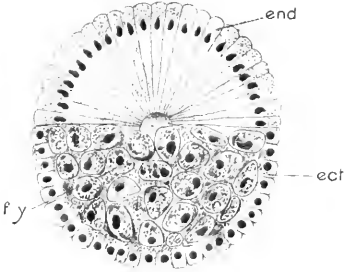

Fig. 5.

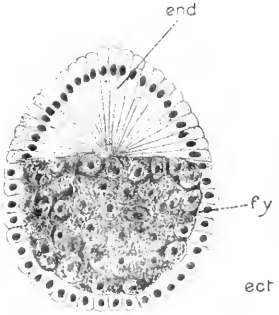

Fig. 6.

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Sycon Sponge Embryos

fixed. By degrees this food is absorbed and used up, then the invagination of the ciliated cells takes place, and the embryo becomes attached. Hence, in the gastrula stage, the internal granular mass of cells is no longer visible.

Thus I think that the internal granular mass of cells is to be looked upon as food-yolk, and that it has little or nothing to do with the formation of the mesoderm. The latter, as I have already shown, appears to be present before the mass of food-yolk is formed, and though hidden by it later on (Figs. 5 and 6), is doubtless still there, and from this tissue the spicules observed by Metschnikoff probably arose.

My investigations were carried on by means of serial sections of the mother sponge, stained with borax carmine and embedded in paraffin.

EXPLANATION OF PLATE 1A.

The following explanation of the lettering applies to all the figures:—

col.—Collared cells lining the flagellated chambers of the mother sponge.
e.—Embryo.
e.c.—Capsule containing the embryo and lined by flattened endothelial cells.
ect.—Ectoderm.
end.—Columnar cells of the embryo, which will form the endoderm of the adult.
f.y.—Mass of granular food-yolk-containing cells derived from the invagination and proliferation of the granular cells of younger stages.
gr.—Granular cells of embryo.
i.c.—Inhalant canal of mother sponge.
mes.—Commencement of mesoderm of embryo.
o.—Opening of a flagellated chamber into the gastral cavity of the mother sponge.
r.c.—Flagellated chamber of the mother sponge.
s.m.—Structureless membrane, formed of the outer part of the embryo capsule and the remains of the collared cells lining the flagellated chamber of the mother sponge.
sp.—Spicule of the mother sponge.

FIGURE 1.—Section of embryo in late blastosphere stage, lying within the embryo capsule in the maternal tissues, between a layer of spicules and a flagellated chamber.

FIGURE 2.—Section of embryo at the commencement of the pseudogastrula stage, represented apart from the maternal tissues by which it is surrounded.

FIGURE 3.—Portion of section of the mother sponge, showing an embryo breaking loose from the embryo-containing cavity into a flagellated chamber. (The spicules are represented in blue).

FIGURE 4.—Section of embryo in late pseudogastrula stage, with the structureless membrane which adheres to it on its escape from the maternal tissues.

FIGURE 5.—Section of a solid embryo found in a flagellated chamber of the mother sponge.

FIGURE 6.—Section of the free-swimming, ciliated embryo (diagrammatic).

Art. XV.—*The Pineal Eye of Mordacia mordax.*

With Woodcut.

By Professor W. Baldwin Spencer, M.A.

[Read June 13, 1889.]

In 1883,* Ahlborn published an account of the structure of the Pineal gland in the lamprey Petromyzon; the discovery and investigation of the structure of the Pineal eye in Lacertilia some three years later, led Beard† to investigate the nature of the Pineal gland in Cyclostomata, and his full results published in 1888 showed that, as in lizards, the distal part of the gland was, in certain Cyclostomata, transformed into an eye-like structure, though one not so highly developed as in the former group.

His work was done upon *Petromyzon* and the larval form *Ammocœtes*, and upon *Myxine*. In these three he found, though not constantly, that pigment was deposited around the cells forming the vesicle of the epiphysis.

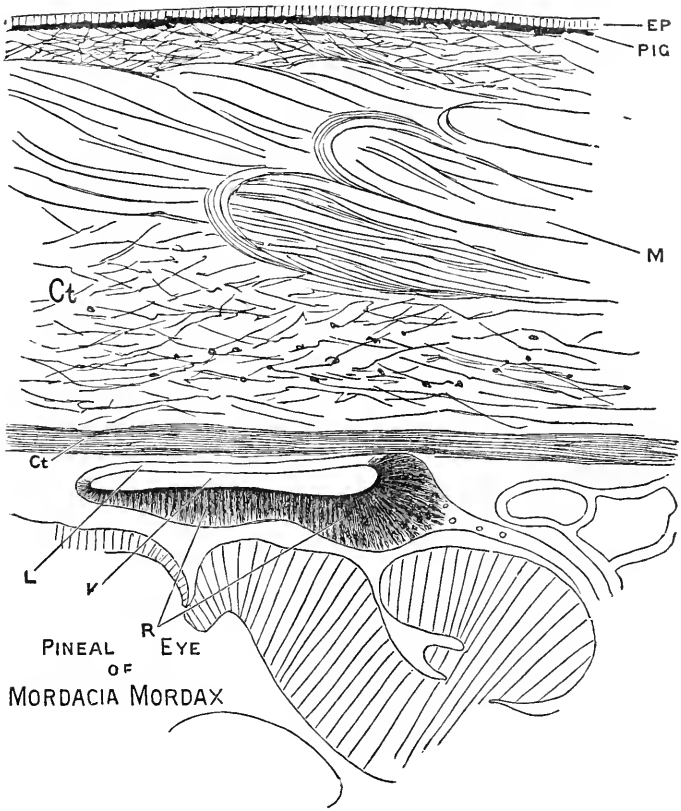
He was unable to secure a specimen of the Australian form *Mordacia*, and I am indebted to the kindness of Professor McCoy for placing at my disposal a specimen of the latter genus, upon an investigation of which this note is based. The specimen was obtained in Victoria, and Professor McCoy tells me that he has identified this with the Tasmanian form.

Ahlborn had already described in detail the relationship of the epiphysis to the brain and its union with the left ganglion habenulæ, and the division of its distal or vesicular portion into two parts—an upper larger, and a lower smaller vesicle. It was, in fact, simply Ahlborn's misfortune in not meeting with a specimen in which dark pigment was developed which prevented him from first discovering, by

* "Untersuchungen über das Gehirn von Petromyzonten."—*Zeitschr. für Wiss. Zool.*, Bd. xxxix., Heft. 2, 1883.

† "The Parietal Eye of the Cyclostome Fishes."—*Q.J.M.S.*, 1888; also *Nature*, July 14, 1887.

actual investigation, the true nature of the epiphysis, though both he and Rabl Rückhard had independently arrived at the conclusion that the Pineal eye was to be regarded as the rudiment of an unpaired eye.



DESCRIPTION OF WOOD CUT.

MEDIAN LONGITUDINAL VERTICAL SECTION THROUGH A PART OF THE HEAD OF MORDACIA MORDAX IN THE REGION OF THE PINEAL EYE.

Ct.—Connective tissue.
Ep.—Epidermis.
L.—Lens part of the eye.
M.—Muscles.
Pig.—Pigment immediately beneath epidermis.
R.—Retina.
V.—Vesicle of eye filled with fluid during life.

The brain of the specimen examined by myself was not, unfortunately, in a good state of preservation, not having been intended especially for histological work. Externally there was when preserved in spirit no indication of the presence of a Pineal eye. In a specimen of Petromyzon which has lain for some time in turpentine so as to render the tissues somewhat transparent, there is a strongly marked white spot indicating the epiphysis lying beneath, but in Mordacia no such indication was visible.

Longitudinal vertical sections, however, revealed the fact that the larger vesicle is attached by a stalk to the dorsal surface of the brain, and that in its walls an abundant deposit of pigment of a dark brown colour is developed.

The vesicle is of large size, and is flattened out against the roof of the brain case, and it may perhaps be due to the state of preservation of the brain in the particular specimen examined, but I could find no trace of the lower of the two vesicles normally present in Cyclostomata.

The eye stretches forward much compressed dorso-ventrally, and overlaps the cerebral hemispheres, its posterior end being continuous with the optic stalk, and being somewhat swollen out. Its walls are composed of long rod-like cells embedded in brown pigment, and facing into the cavity of the vesicle. These cells are longest at the posterior end, where the stalk joins the vesicle, resembling thus the eye in many Lacertilia, and the whole structure is very similar to that figured by Beard as present in *Petromyzon*.* The rod-cells appear to be in connection at their outer ends with nuclei, though these could not be detected with absolute certainty, owing to the incomplete histological state of the brain. My experience of other Pineal eyes makes me have little doubt, however, that they are present.

Of a true lens, that is of a cellular structure which could serve to focus rays of light entering the eye, it must be confessed, that neither here nor in the specimens figured by Beard, can one be said to be present. The vesicle wall is complete, and anteriorly consists simply of a comparatively thin layer, in which no pigment is deposited, and through which rays could easily pass to impinge upon the retina beneath. The layer appears to be of equal thickness all the way across, and there is no median swelling out, such as is

* Op. cit. Pl. VI., Fig. 1.

so constantly seen in the Lacertilia, nor in the specimen examined could the outlines of cells be in any way distinguished owing, again, doubtless, to the bad state of preservation.

The cavity of the vesicle, as in Ahlborn's and Beard's specimens, is apparently filled with fluid which coagulates when preserved in spirit.

In two points, with regard to the eye, *Mordacia* differs from *Petromyzon* as described by Beard:—

First, although the pigment is very well developed the eye is not placed in a deep depression of the skull, the latter passing quite evenly above the epiphysis. Beard points out the curious fact that in *Petromyzon*, when the pigment is well developed, the depression is deep; when absent, the depression is almost or entirely absent.

Secondly, the pigment in the skin (pig.) passes straight over the eye which would render it difficult and, when added to the layer of muscle and skeleton above the epiphysis, practically impossible for rays of light to reach the structure. In *Petromyzon*, Beard states that the pigment in the skin is absent above the eye.

There can be little doubt that here, as I believe, in all other animals in which it is now found, the Pineal eye must, as an organ for the perception of rays of light, be regarded as rudimentary and functionless.

ART. XVI.—*Description of New or Little Known Polyzoa.*

PART XIII.

By P. H. MACGILLIVRAY, M.A., M.R.C.S., F.L.S.

(With Plates IV and V.)

[Read November 14, 1889.]

NOTAMIA GRACILIS, McG.

Zoœcia very long and slender, aperture occupying almost the whole of the anterior surface, rounded or quadrate above, and with the superior margin projecting slightly forwards; a pedunculate, capitate avicularium on one or both sides, from the upper part of the posterior tube.

In a paper read before the Society in November 1885, I briefly described a species as *Calvellia gracilis*, from one or two very imperfect fragments, believing it to be a species indicated, but not described, by Mr. Maplestone. This identification is, however, somewhat doubtful, as I have on several occasions had specimens sent to me named *C. gracilis*, which proved to be merely rather slender forms of the well known *C. bicornis*. After my brief and necessarily imperfect description was published, I received from Mr. Whitelegge some fragments on an alga from Port Jackson, as well as specimens mounted in balsam. These have enabled me to make out its real structure, and to confirm Mr. Whitelegge's opinion, that it belongs to the genus Notamia.

Notamia gracilis is at once distinguished from the only other species, the European *N. bursaria*, by its much smaller size, the slenderness of the zoœcia, the rounded or somewhat quadrate form of the upper part of the aperture and its projection forwards, and the more slender attachment of the avicularia to the posterior tube, which also is not enlarged to the same extent above.

STIRPARIA EXILIS, n. sp., Pl. IV.

Zoarium very small, flabellate, branches dichotomously divided. Zoœcia alternate, elongated, upper edge straight,

with the outer angle turned forwards; aperture large; a single, long, hollow, articulated spine from the outer angle, and one or two from immediately behind the upper edge. The first cell of the zoarium with a large number (six or seven) of spines, and the succeeding two with three or four. No avicularia.

A very small species, about an eight of an inch high, growing on sponge. The stem consists of a few lengthened internodes, with intervening round ball-like joints.

The appropriate name was suggested by Mr. Wilson.

Port Phillip Heads, Mr. J. Bracebridge Wilson; Port Jackson (a young specimen), Mr. Whitelegge.

Biflustra sericea, n. sp., Pl. V, Fig. 1.

Zoarium encrusting. Zoœcia oval or elliptical, with raised finely crenulated borders, within which the aperture is entirely membranous. A single sessile avicularium, with a broad triangular mandible, situated on a space above each zoœcium or oœcium. Oœcia rounded, with a small, inversely clavate ridge.

Allied to *B. Lacroixii* and *Membranipora cyclops*, Busk, but I believe distinct from both.

Port Phillip Heads, a single specimen.

Biflustra uncinata, n. sp., Pl. V, Fig. 2.

Zoarium adnate, hemescharine or bilaminate. Zoœcia large, arranged alternately in linear series, separated by raised margins, aperture elliptical, partly filled in, especially below, by a narrow smooth extension of the raised margins, the edge being smooth or very faintly denticulate; on each side above is a short, stout, pointed, and somewhat uncinate process, from the thickened margin.

Allied to *B. delicatula* and *perfragilis*, from which it is distinguished by the stout uncinate processes.

Port Phillip Heads, Mr. J. Bracebridge Wilson.

Schizoporella impar, n. sp., Pl. V, Fig. 3.

Zoœcia elongated, irregularly arranged, separated by distinct raised lines, surface covered with small hollow granulations; mouth semicircular, or slightly contracted below; lower lip straight, with a distinct, rather wide, sinus; peristome above becoming thickened, projecting, and

bevelled internally. A transverse avicularium, with large rounded mandible, usually on a considerable mound-like elevation, immediately below and to one side of the mouth.

Western Port, Rev. Mr. Porter.

SCHIZOPORELLA SPECIOSA, n. sp., Pl. V, Fig. 4.

Zoarium encrusting. Zoœcia very irregular in shape and arrangement, indistinctly separated by very narrow raised lines; surface rough, with hollow granulations; mouth arched above, higher than broad, a distinct, widely open, shallow sinus in the lower lip. A transverse elliptical avicularium to one side of the oral sinus. Scattered large vicarious avicularia, with very large thin mandibles. Oœcia reniform, with thickened rim, and several white-bordered pores, or granulations, on the convex surface.

With age, the zoœcia become highly calcified, the oral apertures, however, remaining on the surface; the peristome at the sides is much thickened and produced; the rim of the oœcia is thickened, and the pores very marked; the surface of the zoœcia, also, has numerous pores, or areolations. The edges of the vicarious avicularia are thickened and calcareous, the mandibles remaining thin and membranous.

Allied to *Schizoporella Maplestonei*, a variety of which has been described by Mr. Hincks from Western Australia as *S. lucida*, from which it differs in the suboral sinus being wide and open above, as well as in the peculiar vicarious avicularia.

Port Phillip Heads, Mr. J. Bracebridge Wilson; Western Port, Rev. Mr. Porter.

SCHIZOPORELLA NODULIFERA, n. sp., Pl. V, Fig. 5.

Zoœcia somewhat quadrate, separated by narrow raised lines; surface (young) granular and perforated, when more fully developed with large shining calcareous nodosities; oral aperture large, nearly quadrate above; lower lip straight, with a wide rather deep sinus. A broadly elliptical avicularium, with large mandible, usually situated transversely below the mouth, on one side. Oœcia subimmersed, with a thickened border, flattened in front, and usually with several large white-bordered pores.

In this very striking species, the young zoœcia have the surface granular and nodular, with perforations between the nodules; the oral aperture is very large, with a wide sinus

in the lower lip. In older zoœcia, the peristome becomes raised, and very large porcellanous nodules become developed. Between the zoœcial nodules are numerous large pores. The oœcia are immersed, flattened in front, with two or three large white-bordered pores ; the border thickened, and with several large nodules. The suboral avicularium, which is present in the large majority of zoœcia, is also a marked feature. The space below the mouth, containing the avicularium, is usually destitute of nodules. The size and prominence of the nodules make the oval aperture seem very deep, and give the specimen a very peculiar appearance.

Western Port, Rev. Mr. Porter.

SCHIZOPORELLA PORTERI, n. sp., Pl. V, Fig. 6.

Zoœcia confused, indistinct ; surface smooth and polished ; oral aperture rounded above, with a well defined wide sinus in the straight lower lip. Below the sinus, a small avicularium with vertical rounded mandible, on the upper edge of an elevation of the cell. Numerous scattered avicularia between the zoœcia, with triangular mandibles, on mound-like elevations. Oœcia subimmersed, a nearly circular portion in front remaining membranous.

The scattered avicularia, and confused arrangement and size of the zoœcia, give a superficial resemblance to some specimens of *Rhynchopora bispinosa*, from which, however, the structure of the mouth is quite different. The incomplete calcification of the oœcia is very peculiar, and seems to be constant.

Western Port, Rev. Mr. Porter.

MUCRONELLA MENTALIS, n. sp., Pl. V, Fig. 7.

Zoœcia elongated, alternate, in regular lines, separated by deep grooves ; a row of deep rounded areolations or pores along the margins ; surface granular ; mouth arched above, lower lip projecting as a rounded process, bulging below the mouth ; six articulated spines on the upper margin. Oœcia rounded, granular, subimmersed in the cell above.

Port Phillip Heads.

LAGENIPORA SIMPLEX, n. sp., Pl. V, Fig. 8.

Zoœcia much enlarged below, contracted at the mouth, with the produced peristome either circular at the orifice

or bilabiate; surface smooth, glossy, with a few minute shining granulations.

Differs from *L. tuberculata* in the absence of pores or tubercles.

Western Port, a single specimen, Rev. Mr. Porter.

AMATHIA PLUMOSA, n. sp.

Zoarium large, tufted. Primary branches cylindrical, without zoœcia. Secondary branches given off oppositely in pairs, each secondary branch bifurcating, the branch before bifurcation occupied, except at the basal portion, with a cluster of about six pairs of cylindrical zoœcia, and each bifurcation having a similar or smaller group, each of these bifurcations terminating on a pair of confervoid filaments, which again divide at their extremities.

Port Phillip Heads, Mr. J. Bracebridge Wilson.

EXPLANATION OF FIGURES.

PLATE IV.

Fig. 1.—*Stirparia exilis*, natural size.
Fig. 1a.—Portion magnified.
Fig. 1b.—Stem and lower zoœcia of the same.

PLATE V.

Fig. 1.—Biflustra sericea.
Fig. 2.—Biflustra uncinata.
Fig. 3.—Schizoporella impar.
Fig. 4.—Schizoporella speciosa.
Fig. 4a.—Young zoœcium.
Fig. 5.—Schizoporella nodulifera.
Fig. 5a.—Mouth of zoœcia.
Fig. 6.—Schizoporella porteri.
Fig. 6a.—Young zoœcium.
Fig. 7.—Mucronella mentalis.
Fig. 8.—Lagenipora simplex.

ART. XVII.—*On the Illumination of Public Clocks.*

By SIDNEY W. GIBBONS, F.C.S.

[Read December 12, 1889.]

Proc. R. S. Victoria. *Plate* 4.

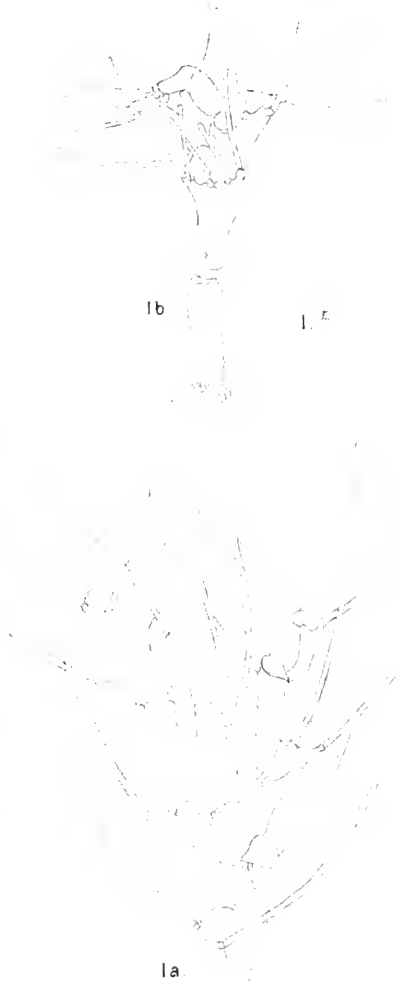


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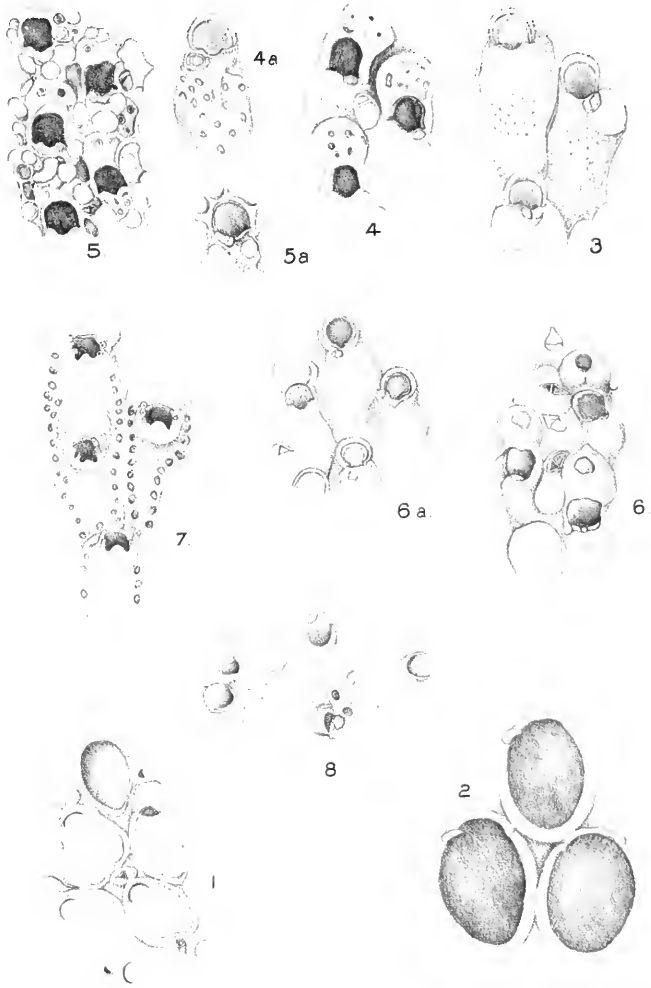
Plate 5.



Art. XVIII.—*Notes from the Biological Laboratory of the Melbourne University.*

(With Plate VI.)

[Read December 12, 1889.]

(1) *On the Occurrence of a Partially Double Chick Embryo.*

By A. H. S. Lucas, M.A., B.Sc.

Formerly, abnormal growths of plants and animals excited interest as being curious marvels, monstrosities, so-called *lusus naturæ*. Now-a-days, they are studied in the hope of discovering in them extraordinary, and perhaps therefore especially instructive, manifestations of ordinary laws of growth.

The younger such abnormal forms are, the more light are they likely to throw upon the difficult problems, latterly so much discussed, concerning the physical causes of heredity and variation.

The chick will probably, owing to the ease with which material for research can be procured and manipulated, always furnish the standard type of development amongst the higher vertebrates. It seems well then to record occurrences of healthy chick embryos which depart in a marked manner from the ordinary lines of growth, especially as such embryos appear to be somewhat rarely met with.

The particular embryo under consideration had been incubated about twenty-seven hours, and presents most of the features characteristic of this time. The blood-vessels are definitely forming in the vascular area. The vitelline folds are clearly indicated. The central nervous system, and the mesoblastic somites, have their usual appearance at this stage.

The embryo is, however, partially double. In front, it forks to form two very distinct heads, of which one is larger

than the other. Both are fully developed up to date; the unsegmented brain being carried over the front of the head fold producing the mitriform appearance. The (optical) right neural fold of the right head is continued back along the common trunk, and so the left neural fold of the left head. The adjacent neural folds can only be traced to the level of the point of divergence of the fork, and seem to meet as they thin out. They are quite wanting in the trunk.

There are eight rows of mesoblastic somites with definite outlines, and traces of others can be discerned. The outer row on each side is normal, and close to the corresponding neural fold. The two inner rows have fused to form compound median somites, which have double the width of the single outer ones. The hinder part of the primitive streak is double, the two divisions running outwards at right angles to the main axis of the embryo. The vascular area and the primitive heart seem to be quite simple. The specimen was mounted as a whole, and I am unable to distinguish the hypoblastic structures.

The double form may have been produced in two ways. The product of a single germinal vesicle may have undergone a certain amount of longitudinal dehiscence, or the products of two germinal vesicles may have partially fused in the growth side by side, on a yolk originally common to both, or formed by union of the two yolks. The process, whichever it has been, has affected all the three germinal layers at the two extremities, where the separation of the two embryos is complete. In the region of the somites, the somatopleure is distinctly divided into two equal longitudinal halves, which have remained in juxtaposition; the splanchnopleure does not show any signs of fission.

I do not think that there is any evidence upon which we can decide in which of the two ways the doubling has been brought about, but it is plain that the cause must have been deep-seated, and must be looked for in far earlier stages.

(2) *On the Formation of a Double Embryo in the Hen's-egg.*

By Professor W. Baldwin Spencer, M.A.

Whilst working in the Biological Laboratory of the Melbourne University, one, amongst a large number of hens' eggs incubated, was found to present the curious feature of having two clearly-formed embryos developed within the limits of the one blastoderm. As this is by no means of common occurrence, and as the embryos were quite distinct, and developed to a considerable extent, it has been thought worth while to figure them (Pl. VI, fig. 2). Wolff, Reichert, Thompson, and others have previously shown that this may take place, and a figure showing two chick embryos distinct from one another, is given by the latter investigator.* In this case two embryos, of a very early stage, each showing what is probably meant for the primitive groove, are seen lying side by side, with their anterior ends close together. They are not sufficiently developed to show traces as yet of mesoblastic somites or nervous system. The anterior ends of the two are closely approximated, whilst the posterior ends diverge from one another. In the embryos figured by myself, the blastodermic area is somewhat elongated in the direction corresponding to that of the short axis of the egg; the area pellucida and the area opaca are clearly distinguishable from each other and the latter is covered with a complete network of blood-vessels, limited externally by the sinus terminalis. The two embryos are so placed that their anterior ends lie side by side in the middle of the area pellucida, whilst their posterior ends are directed towards the two opposite ends of the area. The two embryos are precisely similar to one another. Each has reached the stage at which the nervous system has the form of a tube, the anterior end of which is becoming swollen out to form the vesicles of the brain, though these are not as yet clearly differentiated. At the posterior end of the body the neural canal is still widely open, and encloses the remnant of the primitive streak and groove. The head-fold has lifted the

* I am indebted to Professor Allen, M.D., of the Melbourne University, for the opportunity of seeing this. It is to be found in "Todd's Cyclopædia of Anatomy and Physiology," under the article "Teratology."

head up above the blastoderm, but the latter is not yet enclosed by the amnion. In the middle region of the body seven pairs of mesoblastic somites are present.*

The vessels passing across the area pellucida to the embryos are not yet clearly visible, and the sinus terminalis is perfectly complete, no such structures as the one or two large vessels being present, which in the normal embryo return the blood to the body from the sinus at the anterior end.

Apparently, every stage may be met with between an embryo which shows reduplication of one portion of the body and the condition in which, as described above, two perfect embryos are formed within the area of the same blastoderm. One of these stages is represented in the adjoining drawing (Fig. 1), by Mr. Lucas, of an abnormal embryo, showing a clearly double formation at the head end and an indication also of doubleness at the posterior extremity, where the primitive streak divides into two halves, running out right and left of the median line. Occasionally an embryo is met with showing only this double nature of the primitive streak posteriorly.

Regarding simply the case in which the two embryos are complete and separate from one another, there are perhaps three ways in which it might possibly be supposed that the result has been brought about. First, as in the case of *Lumbricus trapezoides* division of the, at first single and normal, embryo may have taken place after a certain stage of development has been reached. It is difficult to imagine how this could have been produced; had it been so, the yelk and the area pellucida and opaca would have shown some trace of division. Secondly, it might be supposed that the two embryos were due to the existence of two distinct nuclei, enclosed abnormally within the protoplasmic material constituting one ovum. In contrast to the usual method of formation of the germinal cells in Craniata out of a number of nucleated cells, which first become aggregated

* For teaching purposes, I have found it convenient to relinquish the old form of nomenclature according to which chick embryos were designated by the number of hours of incubation—a most unsatisfactory method, since different eggs incubated for the same length of time will often yield embryos of various stages of development. I have instead adopted the method followed by Balfour in dealing with elasmobranch embryos, and according to which the stages of development are indicated by the letters of the alphabet. An account of these stages, with illustrative figures, is now in course of publication. The embryos here referred to are at the commencement of the stage which will be designated G.

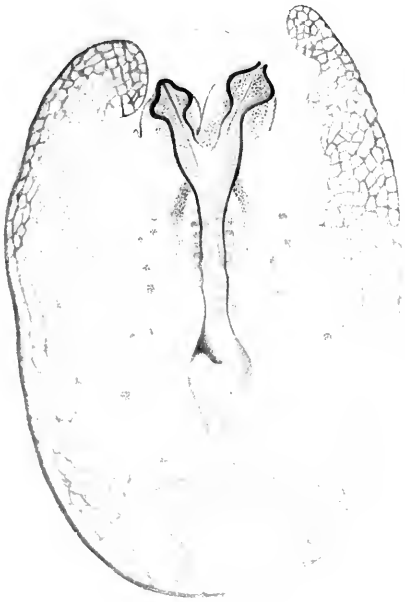
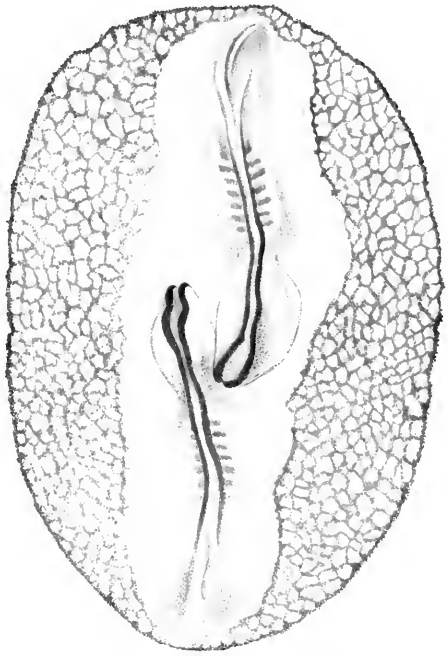


Fig.1.

Fig.2.



A.H.S. Lucas & W.B. Spencer, del

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into "nests" having the form of masses of protoplasm containing nuclei, the "nests" becoming subsequently constricted off into distinct cells, it might be supposed that two nuclei became enclosed in a common mass of protoplasm. In this case, even supposing that each nucleus became united with a spermatozoon, we should expect to find two distinct blastoderms formed, an occurrence which has not as yet been noted.

Thirdly, and most probably, it may be supposed that the very first division of the nucleus was abnormal. The nucleus may have become divided into two halves, which were qualitatively and quantitatively precisely similar, and not, as we may suppose to be the case in normal division, slightly different from each other. Probably, in the normal development of at all events the higher form of life, from the very first division of the nucleus and protoplasm, parts are produced which differ minutely from each other, and neither of which, if placed in suitable circumstances, could give rise to a perfect animal. Abnormally, we may suppose that division takes place in such a way that the two half nuclei are *exactly* similar to each other, when further development may, under suitable conditions (*e.g.*, a sufficient mass of nuclear material remaining in each half, and a sufficient supply of nutrient material), result in the formation of two similar and fully-formed embryos.

This suggestion will also serve to account for the cases of incomplete division of the embryo, as in the one figured by Mr. Lucas. In these cases, abnormal segmentation, resulting in the production of two halves precisely similar to each other, only takes place at a later stage, and so only affects certain cells (and their nuclei), which will give rise to certain organs of the body. Hence, we get a duplicature of such structures; or, if abnormal division again follow, a still further multiplication of them. The further back in segmentation, that is the earlier this abnormal division takes place, the larger is the part of the body affected, until, if the division affect the segmentation nucleus of the ovum, the result is two complete and separate embryos.

ART. XVIII.—*Address at the Inauguration of the Literature and Art Section of the Royal Society.*

By ARTHUR S. WAY, M.A.

President of the Section.

In his recently published "Letters on Literature," Mr. Andrew Lang, with a touch of that fine superciliousness, that fashionable air which your critic affects now, observes: —"Can anything speak more clearly of the decadence of the art of poetry than the birth of so many poetical 'societies?' . . . They all demonstrate that people have not the courage to study verse in solitude, and for their proper pleasure; men and women need confederates in this adventure." "Demonstrate," do they? Because, forsooth, it is inconceivable that they may be the outcome of real earnest interest and devoted study, which bears fruit in desire for communion with kindred minds, for the give and take of thought and criticism, that so the golden sands of the stream of song may yield up the more treasure. And does the birth of a microscopical society "demonstrate" that men will not investigate alone, or the birth of a musical society that they cannot sing and play in the privacy of home? Is it too flattering to human nature to imagine that people may wish to meet to interchange ideas upon what interests them deeply; that it is not mere hypocrisy which brings strangers together, to be thenceforth made friends by the strong bond of common intellectual pursuits and tastes? Is this feature of our time something strange and wholly new? Not so, but it is a genuine rational endeavour to supply that which our fathers enjoyed, but which altered social conditions have made unattainable, under the same form, in these days. The nights at the "Mermaid" are fled beyond recall; nor will men gather any more, as once they gathered, round "glorious John" enthroned at Will's; nor will such discourse of gods be again heard, as when the coffee houses knew Johnson and

Goldsmith and Burke. Yet we are not, therefore, behind our fathers in love of intellectual culture, and it is a pitiful cynicism which can see in literary societies only a sham enthusiasm, an attempt to galvanise into a semblance of life the taste and interest that have long been dead. Rather is it matter for surprise, that for years past there has been in Melbourne no society having for its object the study of literature and art. There have been Browning and Shelley societies; there is—to the astonishment and confusion of the critics who croaked at its birth—a Shakspeare Society, flourishing in vigour still; there are also divers associations of skilled votaries of music and art—these, however, are almost professional in their character; but for those who can pretend to no special gifts or training, there is no place and little interest in these. And meanwhile the world's inspired work goes on; its poets sing as seldom they have sung in times past; its romancers weave their wonder-webs; its musicians, now as in Shakspeare's day, "hale men's souls out of their bodies;" its painters kindle the light that never was on sea or land; and of all this each of us sees and hears and notes a little, in fragments, overlooking much, and missing the significance of more, forming half judgments, and receiving fast-fading impressions. In casual meeting with friends who are like-souled, he may compare thoughts, and find how much of the past and the present a solitary reader is in danger of missing, and may taste how good a thing it is to interchange ideas, and to tell and hear of pilgrimages into the fairyland of mind, and to discourse together of work that will endure, of names that will be enshrined, of ever-living presences that will be enthroned long after the sand-ripples of politics have been a myriad times washed out and re-moulded by the tides of time, and the babble of society gossip is become as the withered leaves that fluttered to the ground in forgotten autumns.

To substitute for such casual communication of thought some system of mutual help and guidance, to gather and focus the literary interest of a great city, to make something nobler than a coterie, something more unselfish than a clique, was the aim of those who proposed to quicken into life this literature and art section of the Royal Society of Victoria. There is something peculiarly British in the instinct for the old paths, which prompted them, not to burst upon the world with a new society of imposing title, but to awaken a

long dormant potentiality of the good old Royal Society. Few of the two score members who have attended—or of the ten score who have stayed away from—the meetings of this respectable body, have bethought them that beneath its ample wing there was room for any nestlings but such as chirped abstrusely of biology, chemistry, physics, and all that stern sisterhood of science, who are not to be wooed save with tireless toil of research, with concentration of knitted brows, and libations of midnight oil. At meeting after meeting we sat and listened while our betters threaded labyrinths of theory, and shot out waggon loads of facts, lightly gliding through mazy calculations, or glibly "chattering stony names." We hearkened diligently with much heed, if haply we might gather for ourselves a few crumbs from so plenteous, and so indigestible, a feast. And still we gazed, and still the wonder grew, as other Anakim rose, and discussed and criticised off-hand these miracles of abstruseness, put what seemed to be pertinent questions, and with Burleigh-nods received answers which, for us, "made the case darker, which was dark enough without." But not even the genial aspect of our president, as he sat wearing all that weight of learning lightly like a flower, could embolden us to rise and reveal our abysmal ignorance by question, much less by criticism. We were in our own sight as grasshoppers, and so we were in their sight. There was something depressing in being thus, as it were, mere cumberers of the ground, the one excuse for the impertinence of whose existence lay in the hope that our annual subscriptions helped to plume the wings of science for soaring far above our ken. Then some one spoke his open-sesame at a long-sealed door, and behold, we also had a mission!

And now that our vocation is revealed to us, we perceive that we can never be at a loss for lack of material whereon to work. For, passing by for the present music and art, as being as yet but doubtfully represented amongst us, the whole range of literature lies before us as our field of study. Homer is not too remote, nor Browning too near. Nor poetry only, but fiction, with—shall we say, including?—history and biography; the long result of time in scholarship and criticism; the thoughts that shake mankind in theology and philosophy. The mine is inexhaustible; how we shall work it, we see as yet but dimly. We may remark at the outset, that the main object of our co-operation must be to furnish incentives and aids to reading and reflection.

It may be accepted as an axiom, that no amount of criticism or discussion of a book, if it is worth reading, can serve as a substitute for reading it, and if it is not worth reading, it is not worth talking about. Unless, therefore, the papers that will be read at our meetings, and the discussions that will follow, stimulate us as individuals to extend our acquaintance with literature by personal study, the work of this section will be but a casting of seed by the wayside, for nothing is more evanescent than knowledge picked up from mere talk about a subject, nothing more fleeting than the interest so excited, if it be not followed up by earnest, fruitful research.

This outcome of our work must, of course, depend almost entirely upon members individually, but it is well that they should understand that one for whom our meetings constitute, not the salt, but the food of his literary life, is not only surrendering the substance for the shadow, but is thwarting the very object for which we co-operate. For it must be recognised, that the work of a literary society does not stand on the same footing as that of a scientific society. The latter is, to a considerable extent at least, concerned with original discovery; and every minutest observation, every lifting of a corner of nature's veil, may prove one more fresh addition to the mass of details, the accumulation of which by a host of patient investigators is providing the heritage of posterity, the hope and prophecy of science, the solution of the riddle of the earth. And in no country can the work of the biologist, for example, be more important than in Australia now, while yet so many ancient and unique types remain which are doomed to disappear before the advancing tide of settlement. The searcher into nature may be said to be working against time; every moment may be precious, as bringing an opportunity irretrievable if lost; every find may be pure gold, as he rescues vanishing links and gathers up failing clues, for lack of which the men of future days would grope in darkness and twist ropes of sand. He heaps up riches, and if he knows not who shall gather them, at least he knows that they surely will be gathered, and that the harvest will be many times the richer for every grain saved now.

But we of this section of the society are not so much wealth-heapers, as wealth-users. We look to rescue no waifs from antiquity; we shall not unearth treasures of archæology; the voices that call out of the past will scarcely reach us first, nor will it be ours to place new leaves on Clio's brow. It

may well be that our tribute to the world of scholarship and criticism will be insignificant, nor do we flatter ourselves that the thinkers of far-off lands will ever learn to wait till we have spoken. But we need not, therefore, underrate the importance of our actual work. If self-culture only were the end and aim of our association, there would be ample justification for this section's existence; for as no man liveth to himself, whatsoever be our gains in freshness and depth of thought, in wealth of widened culture, and clearness of intellectual vision, we win for others also. From the quickening of a man's mental powers, a magnetic influence thrills those with whom he mingles, nor does he, in rising, wholly leave his fellows behind. But this indirect and insensible influence is not the limit of our hopes; we trust, even in this our day of small beginnings, to render more direct service to the community, and to take a more active part in meeting the needs of our generation. It is no new observation, that to the life and thought of this Colony the poet's words are peculiarly applicable, "The world is too much with us, late and soon getting and spending we lay waste our powers." We claim no right to make this a reproach to our fellow citizens, nor to look upon them as from a pedestal of superiority. The rush of the tide of commerce, rising almost too fast for our financial argosies to ride its crest, the imperious stress of business, the merciless strain of competition, the bewildering swiftness with which vistas of opportunity open on every hand, the eager energy of a young community pressing in the first flush of its vigour ever on to new conquests, the thrilling consciousness that we are here laying the foundations of an empire, and doing a mighty work for ages unborn—all this makes it seem less strange or sad, that men should fancy that these interests claim all their thoughts and powers; that when art and literature are beckoning, they should think that they do well to reply, like the sternly earnest builder of old time, "I am doing a great work, so that I cannot come down. Why should the work cease whilst I leave it and come down to you?" It is not obvious to all, but only by experience do men learn that the pursuit of culture is no hindrance, but a secret help in the race for worldly success, that wealth of intellect makes material wealth more valuable when won, widening the range of its application, and creating taste and refinement in place of vulgar profusion and senseless display. We cannot too steadfastly believe, nor too earnestly proclaim,

that the pursuit of gain, the struggle for existence, must not be all-absorbing, lest, when the goal is attained, we find that the hard-won rest is a joyless old age, an aimless *ennui* of weary years. It is a physiological fact, that the bodily powers will be the sooner worn out by toil if the intellect meanwhile is rusting out, if its faculties are not stimulated and exalted by what is at the same time a rest and a refreshment, which "will keep a bower quiet for us, and a sleep full of sweet dreams and health and quiet breathing." We hope, therefore, to attract into our society some world-weary toilers, who, as they accompany us on our pilgrimages into regions of thought and imagination, may find a charm and peace as of green pastures and still waters.

Our primary object being to arouse and foster an intelligent and appreciative interest in the best literature of the present and the past, we have bound ourselves beforehand to no stereotyped method of procedure. A series of papers, each followed by such impromptu discussion as their subject-matter and treatment may provoke, is a very common feature of such meetings as ours; but if it becomes the rule, it has this disadvantage, that, as few will undertake the trouble of preparing such papers, in process of time the work falls into the hands of a small section of the society, the rest becoming mere listeners, who, for want of previous acquaintance with the subject-matter of a given essay, are generally unprepared even to take part in a discussion of it. Hence we must endeavour to contrive that sometimes papers shall grow out of previous common readings and discussions. It may be arranged, for instance, that on a given evening shall be introduced to the society the latest work of some great author. It is not too much to expect that the reading and conversation of that meeting will secure for the next a number of short papers on his style, on the growth of his genius, his place in literature, his influence, his "school," and so forth. Again, we might have an occasional meeting at which each member would be pledged to appear, armed with a short criticism, or notice, though it be but half-a-dozen lines, of a work recently read by him. We shall shall thus furnish each other with suggestions and guidance for reading, and be also cultivating a discriminating, critical spirit in our reading. Bacon's aphorism will ever be true, that "writing maketh an exact man," and if we from time to time practise formulating our impressions, and recording our judgments of our reading, we shall be cultivating that

clearness and precision of thought, that faculty of sifting the bran from the flour, without which a reader may degenerate into a mere skimmer of books, and may wholly forget our philosopher's counsel, "to weigh and consider." We shall not only endeavour to keep abreast of the world's literary work in older lands, but shall study with peculiar interest the beginnings of Australian literature; we shall endeavour to rescue from oblivion noteworthy work done in the past; and though we will not undertake the invidious office of sitting in judgment on the present, it is possible that, by kindly criticism and helpful counsel, we may be of some service to those beginners who would fain be of the brotherhood of the pen. There are more of these aspirants than is commonly supposed; they have written to individuals amongst us now and then. There is something pathetic in their hard surroundings, in the ignorance which comes of dearth of opportunities, in the depression which lack of appreciation engenders. Something pathetic, too, in the groundless complacence which is born of uncritical praise, or of that good-natured commendation, which is but cruel kindness. Remembering how fallible mortal judgments are, and how little promise early attempts have sometimes given of the great achievements which have built an everlasting name, one shrinks from the single-handed responsibility of, on the one hand, damping the nascent enthusiasm of the muse; or on the other, of encouraging a youth "to pen a stanza, when he should engross." Not as a tribunal but as a board of advice, the Royal Society may, as the years go by, render some little service to the literary fledglings of young Australia. It may happen that, as with the Melbourne Shakspeare Society, so with ourselves, some of our contributions will expand into lectures, and we may thus become the means of spreading over wider areas a knowledge of, and interest in, high-class literature. Doubtless, as we go on, other methods of work and other opportunities of usefulness will open out before us, but I have said enough to show that we have a goodly field to reap, a harvest the ingathering of which will enrich not ourselves alone.

We do not, as I have already said, propose to limit ourselves to the study of the literature of our own day, or of the English-speaking race. The centuries behind us like a fruitful land repose, and not in Britain only rise the shrines of the Muses. In proceeding, therefore, to a brief survey of the present aspect of English literature, I would not be

understood as pressing this upon your attention to the exclusion of all else, but as constrained by limitations of time and space to deal with but a little corner of a vast area, and as wishing to indicate, from the abundance of this, what measureless wealth lies beyond.

The first thing that strikes us in connection with what we may call the Victorian era of literature, is its marvellous activity, the multitude of workers, and the rapidity of production. We have often heard how England became, in the days of Elizabeth, a nest of singing birds; the same might be said, perhaps with even more truth, of our own Queen's reign. The revival which began with Cowper, and which received a Titanic impulse from Scott and Byron, from Wordsworth, Shelley, and Keats, is unexhausted yet. The oldest poets' songs still breathe and burn with the fire of youth, and a throng of others are yet in full voice. There is, however, one peculiar and ominous feature. Speaking generally, no work of any of these, produced during the last ten or twelve years, has been an advance on their previous work, and in some instances there has been a decided falling off. This is not only the case with those to whom fulness of years might be expected to bring some decay of strength, but with those who should now be in the full maturity of their powers. In these latter, we observe a tendency to work more and more artificial, where diction and expression and technical effect are more than ideas; a tendency to imitative work, reproductions of old styles, to the neglect of originality. The execution is certainly wonderfully perfect, not a slip or a false note anywhere; but the lines make you think of engine-turned jewellery. As you read one page, you know what to expect on the next. There are no surprises, and when you pause from reading two or three score pages of this machine-made poetry, and try to recall one thought that has lifted you out of yourself, one hint that has lured you into dreamland, one touch that has "oped the sacred source of sympathetic tears," and find only a certain tired wonderment, as of one who has sat through an evening of conjuring tricks, then it dawns upon you that the wonder is nowise wonderful, nor the perfection of work perfect work. The poet has but to take care of the sound; there is so little sense that it can easily take care of itself. Years ago the sculptor fashioned divine marble and deathless bronze; delicate cameos and dainty gems engross him now, and seldom has gem or cameo borne such fairy

tracery ; but alas for us, and alas for him, if bronze and marble shall know him no more. Is it the beginning of the end ? Are the voices but singing on, when the spontaneity, the heart-throbs, have gone out of the song, and the wings of genius have flagged ? or is it but a pause of midsummer twilight, the falling of shadow that shall quickly be scattered by a new dawn ? Who shall say ? Ever and anon a brief outburst reveals that this singer and that can still put forth the old soaring power, the old fire, and we wonder whether it is weakness or wilfulness which makes these nobler notes so short and so far between. This interval which we seem to have reached suggests this as a favourable time for a review of the present aspect of English poetry as represented by our chief living singers.

The roll of the leading poets of to-day is one throng of splendid memories, it means to us thirty years of unsurpassed achievement, years resonant with melody, and rich with romance, thrilling with high-wrought passion, and rapt in noble visions and deep heart-searchings ; years in which poets' dreams were as the dreams of seers, and their speech like the crying of prophets. Noble themes and earnestness of utterance were the key-notes of those years, and it is just because these characteristics can never seem to be lost beyond recall, but to be resumable at the choice of the poet who has yet the power to sing, that we hope on against hope, that each next volume may herald the flowing of the tide once more.

From the time when Tennyson stormed the hearts of men with "In Memoriam," and wrought the world to "sympathy with hopes and fears it heeded not," his muse has always trod the mountain heights, as though conscious of a great mission, of powers consecrated to the help of brother men. We have stood with him beside the tomb, and seen the angel of consolation reach a hand through time to catch the far off interest of tears ; we have watched with him the sun of a noble purpose set in a stormy sea, and have learnt that defeat is not failure, nor any striving against evil vain. With him we have found love in huts where poor men lie ; we have from him learnt sympathy with the egotism of man's passion, with the fever of woman's unrest, with the despair of unfaith, and the night of hopeless anguish ; little children that lie on beds of pain are nearer to our hearts through him ; and England is stronger to-day for the battle songs that remind us that we are of kin to heroes.

He has been pre-eminently the poet of his own country, and of his own time. A reader who came upon Browning, Morris, or even Swinburne for the first time in the garb of a foreign tongue, might be long at a loss to refer them to their country or even their period, but Tennyson breathes England all through. He accepts as fit themes for poetry the speculations of latter-day philosophies, the onward march of science, the turmoil of political questions, the pressure of social problems; at the touch of his magic wand they reveal their mystery and their beauty, their solemn import and their deep pathos, the entangling of human hearts and lives with them; the faith that grapples with them, a bold and tireless wrestler; the hope that broods over them, an angel meditating a pæan song; the charity that suffereth long and beareth all things. We feel that he has given us his best through the golden years of the past, and we know that he will give us his best to the end. Now that the snows of fourscore years crown him, it will not be strange if we miss some of the old fire, the old glow of fancy, and strong free sweep of execution; yet, because he is Tennyson, we look forward with glad expectation to the new poem, which they tell us will come from that old man eloquent to us with Christmas over the seas.

Browning, too, "keeps the great pace neck by neck," with him that is but three years his senior, for he also has another Argosy well-nigh ready for the launching. It is characteristic of Browning, that we cannot tell whether a great treat or a great disappointment awaits us. His power we do not doubt; it is not nine years since his "Dramatic Idyls" recalled the finest work of "Men and Women," and "Dramatic Lyrics." And if since then we have groaned in spirit over "Jocoseria," "Ferishtah's Fancies," and "Parleyings with People of Importance," it has been not because of any signs of weakness, but rather of wilful strength in their author. Here is a poet whose genius is a rich gold mine. Many a great ingot of the pure metal has he brought forth, and yet—is it indolence, is it impatience, or is it scorn of his readers that leads him continually to cast at their feet, or rather hurl at their heads, rough masses of the native quartz, starred and veined with brightness it is true, but hard and refractory even to despair, bidding them do their own crushing and separating if they care for gold?

The Romans of old gave the name of "the mules of Marius" to those loyal legionaries who patiently submitted

to the grim captain's iron discipline, and so have these days beheld the mules of Browning, for whom no load is too merciless, no path too rugged for their patient plodding. They receive with humble gratitude his periodical bounties, and stolidly proceed to put them through the mill of interpretation and analysis, more than rewarded if they can proclaim that they have found a meaning. The Browning societies are a very doubtful blessing to their poet, for their tendency is to disguise the fact that to the world generally he is to a large extent unreadable, and, if he regards them at all, to confirm him in a course which may sorely thin his wreath of immortality. If it be objected that each poet has a right to his own style, and is under no obligation to stoop to a popular level, it may be answered, first, that there is no "stooping" implied in returning to the style of what even his votaries acknowledge as his noblest work, and which has a depth and clearness like Shakspeare's; secondly, that a great poet, dowered with a gift whereby he may raise and purify and inspire men's souls, whose song may be strength to the weak, comfort to the sorrowing, companionship to the lonely, and a spur to high endeavour—such an one owes to his fellows a free and generous recognition of the principle that "none of us liveth to himself." There is no poet whose disregard of it could be a greater loss to the world, for since Browning's special gift lies in the analysis and presentment of character, and since he has an inborn affinity for what is noble and true and strong, and since he holds with an unfaltering grasp those vital truths which deeply concern all men, and since in a day when the sensuous, the revolting, the unmoral assert their claim to the thrones of Valhalla, he is ever a witness for what is pure and lovely and of good report, it is of the highest moment that every stroke should tell, that the trumpet should give no uncertain sound, that the prophet should not speak in riddles nor babble in an unknown tongue.

To attempt to arrange in order of merit, like so many boys at a school, the great writers of any period, would be both futile and misleading; for, on examining their work, we find that their genius is at bottom dissimilar. It has an affinity for different subjects, and even should these be based on identical events or phenomena, it at once cancels the apparent identity by taking a different point of view, by selecting different features as most important, by a different moral attitude to the subject, and by singing the song to

different music. No one author ever exhausts the possibilities of noble treatment of a theme. Browning may go to the heart of it if he will, but there is that in it which it is not for him to win, and which may through another become to us a precious possession for ever. From the same mine whence he has dug diamonds, Tennyson will bring forth sapphires, Swinburne rubies, and Morris emeralds. There is no classifying; each sings his mighty song, and for each there is a several multitude of listeners whose spirits are most attuned to his, who take his best and let his worst pass, knowing that it is not truly and essentially of him. If we think that a subject appeals to Tennyson through its connection with human sympathy, the hopes and fears and strivings of men; to Browning through the scope it gives for mental analysis and the search for fundamental truth, we might imagine that it appears to Swinburne not as plastic material at all, but as a living thing, that it touches him with an electric shock, flashing on him a sudden vision of mystery and terrible beauty, sweeping around him a tempest of passion, in which motives and their working may be vaguely defined, and the sequences of thought be blended and confused. While other poets enter into and possess their subject, he seems rather to be caught up and possessed by it. Hence he comes nearer to the old conception of the poet, who, as Plato puts it, "creates his work not by wisdom, but by a certain might of nature and frenzy of inspiration, like soothsayers and prophets." It can be no prosaic age which has born and fostered this Pindar of passion-song, this singer of the heart's storm and the spirit's rapture, those rare moods of exaltation when we are like unto them that dream, when we tread on ether and think by lightning gleams. It was fitting that in command of his instrument, the rhythmical resources of language, in mere word-music, he should be wholly without a rival. He has revealed capacities for melody in our tongue that were unsuspected before. Over his strings our stubborn English floats softly as Italian, and trips daintily as lyric French, and swells with an oceanic surge and thunder that we had despaired ever to win from Greek. Ever since, five-and-twenty years ago, he shook our pulses with the thrilling sweetness of that hunting chorus in "Atalanta in Calydon"—

> "When the hounds of Spring are on Winter's traces,
> And the mother of months in meadow or plain
> Fills the shadows and windy places
> With lisp of leaves and ripple of rain"—

his harp has never been hushed, has never given forth a tuneless note. In swift succession followed the lawless beauty of "Poems and Ballads," immature in thought, and nowise meet *virginibus puerisque*, but in execution perfect; the mingled trumpet-blast and organ-roll of "Songs before Sunrise," and the other poems inspired by the same theme. Scarcely a year has passed since then without fruit of his exhaustless fancy, his wonderful versatility. Powerful dramas, some of them of most portentous length, rhapsodies of the sea, romance of Arthurian legend, echoes from the lutes of old France, revivals of old Border ballad song, marvellous achievements in forms of verse once exotic, but now made English; the apotheosis of the baby, the Armada's triumph pæan—he has proved his strong pinions in all, and has shown that he has soaring imagination, vigour of expression, and staying power enough for the grandest theme. A little cloyed with sweetness, a little surfeited with melody, a little weary of high-pitched passion, a little impatient of endless roundels and ballades and invocations to his latest idol, the babe, we would fain see him rise from sporting amid flowers and toying with antiques to crown with a worthy wreath the head of that dear England whom he has often hailed with song since eighteen years ago he cried—

> "O thou, clothed round with raiment of white waves,
> Thy brave brows lightening through the grey wet air,
> Thou lulled with sea-sound of a thousand caves,
> And lit with sea-shine to thine inland lair,
> Whose freedom clothed the naked souls of slaves,
> And stripped the muffled souls of tyrants bare."

Surely there is inspiration enough in her heroic past, "the centuries of her glorious graves," in the Titan-tasks of her present; will her noble story not quicken, will the love of her not uplift, a great poet to do for her what Homer did for Hellas, what Virgil did for Rome?

When, twenty years ago, the tale of the "Earthly Paradise" followed on that strong sweet poem, the classic romance of "Jason," men became aware that the star of Chaucer was re-risen, that such a poet story-teller had come as England had not known for 500 years. William Morris took the old-time legends of Greece and Italy, of the Orient and the Northland, and married them to immortal verse—verse flowing clear and limpid as an unpolluted river, musical as a mountain stream. His strings were

never shaken by a wind of passion, nor his song perplexed with strange doubts and obstinate questionings—

> "Glad, but not flushed with gladness,
> Since joys go by;
> Sad, but not bent with sadness,
> Since sorrows die."

His muse, with far-away eyes, and heart unheedful of the life of to-day, seemed like a fairy godmother crooning by a prince's cradle the songs of Elfland, with effortless even flow of murmuring melody—

> "Like of a hidden brook
> In the leafy month of June
> That to the sleeping woods at night
> Singeth a quiet tune."

But "that strain we heard was of a higher mood," when, with a fresh keen wind from the Northland, with blast of war-horns and clash of sword and shield, "The Story of Sigurd" came as a revelation of strength and earnestness, of vigour and fire, of which he had given but half-tokens before. The swinging gallop of its sonorous lines, the unbroken maintenance of the "grand style" throughout, the heroic cast of thought, the wealth of incident, the energy of its magnificent battle-scenes, marked it as the most Homeric poem in the range of English literature. It was its author's high-water mark; he has since then been more and more spreading his powers over many interests, and his latest work of this year, "The House of the Wolfings," is rather like an ancient saga than a poem. In stately rhythmical prose, broken at intervals by speeches in the "Sigurd" metre, it tells the tale of the gallant stand made by our forefathers beyond the Rhine against the legions of the empire. Morris may yet give us much beautiful work, fascinating and perfect in its kind, but he has not taught us to credit him with the manifold possibilities of Tennyson, Browning, and Swinburne.

A very noteworthy characteristic of the poetry of the hour is profusion. The days are gone by when bards climbed Parnassus with slow and cautious step, giving good heed to their foothold, when Goldsmith thought ten years not too much for the production of the few poems and dramas which the world cannot forget, when Gray bought his eternity with the reading of one little hour. Now they go up the Aonian Mount by leaps and bounds, and reap the laurels with a bill-hook. There must be natural richness in the soil which (to change a familiar

metaphor) every time it is hurriedly tickled with a pen, laughs into such stintless harvests. Poppies and tares among the wheat, of course. No matter for that; posterity, which has plenty of time, may sort them out. And no one shivers with a premonition of doom, doubting what manner of sorting that will be when men gather the bundles for the burning. If Browning is profuse through crowded abundance of ideas, Swinburne through affluence of fancy and lordship over language, and Morris through wealth of material and facility of utterance, we might say that Robert Buchanan is so because he is in earnest about everything but writing good poetry; Edwin Arnold because he thinks that the "Light of Asia" has cast a glamour over men's eyes that will last his time, "and look a rosy warmth from marge to marge" of his exotic gardens; and Lewis Morris because he thinks—or shall we dare to say because he doesn't think?

Buchanan as a singing voice has been silent for some seven years, but between his twentieth and his fortieth year he poured forth verse enough to float—or swamp—three reputations. With no reserve or self-restraint, opening his heart to all the world, troubled by no misgivings as to his capacity to adorn any class of subject, he has roamed from classical studies to Scottish idyls, from "Phil Blood's Leap" to mystic transcendentalism. In "Idyls of Inverburn" and "North Coast" he struck his richest vein, full of perfect pastoral beauty and tender human sympathy, the pathos and the dignity of poverty and suffering. In "White Rose and Red," he essayed an Indian idyl, and in "Saint Abe" a Mormon romance of the Bret Harte type, with a success the spuriousness of which it takes an American eye to detect. But what Mephistopheles at his elbow prompted him to poetise Scotch metaphysics in "The Book of Orm," or to out-Shelley Shelley in "Napoleon Fallen"? There is no poet to whom the paradox is more applicable, "If he had written less, he would have written more." Akin to him in sincerity of conviction and in early promise was Jean Ingelow, whose voice rose like the song of a lark from daisied meadows, just as the nightingale notes of Mrs. Browning were for ever hushed. Her lyrical idyls were full of the music of sunny brooks and vocal English hedgerows. Among the cottage homes of England, her voice rang very sweet and true. There was surely variety and human interest enough in these for a life's work. She has not enhanced her fame by recent more ambitious efforts.

"The Light of Asia" was a great success, as it deserved to be. The richness and sublimity of Oriental poetry, without its vagueness and diffuseness, were there embodied in verse that was perfect of its kind, that was to Tennyson's as the floating grace of Aphrodité to the imperial tread of Pallas. It was, in the words of an almost forgotten poet, "a poem round and perfect as a star." There were even people to whom it came as a new gospel, and Buddhism became the cult of some Bostonian enthusiasts.

But the "Song of Songs" and "Pearls of the Faith" are far below it. They are fragmentary, without sustained interest, they are cabinets of "specimens," or albums of "beauties," they bristle with unpronounceable names, and recondite allusions; they do not read as if the thought of a far-off age and country had been passed through the crucible of a poetic mind aglow with inspiration. The fascination of their forerunner drew you on and on, till, when you reached the end, you wished the poem longer; you must be a proselyte indeed if these charm in like manner. It would seem that Sir Edwin must keep touch with Eastern fancy and imagery, or he is lost; for never did a poet who had once achieved a name, blunder into a more melancholy waste of commonplace, a flatter Batavian landscape of prosy rhyme, than he, in the volume with which last year he attempted to vindicate his claim to a place among singers of English song. If, as some have conjectured, it was a bid for the reversion of the laureateship, it must have been based on the theory that the office would be disposed of by Dutch auction. There is a fortunate resumption of the Oriental sumptuousness of fancy, now blended with the pathos of sorrowing love, in the just-published "In My Lady's Praise," an acrostic poem which takes up successively the precious stones whose initial letters spell the name of his dead wife.

It has been the misfortune of more than one of our prominent poets to be betrayed by success in one field into failure in another. Tennyson's mastery in development of character and human sympathy led him to tempt the gods in writing acting dramas. Edwin Arnold's success in piloting splendid argosies from the East, a rich storehouse of romance and mystery, entrapped him into producing original poetry out of his own head, which no one had suspected of being so forlornly bare. Lewis Morris achieved popularity, even to the 23rd edition—as he is at pains to inform us—by the art

of re-telling old-time stories with picturesque fancy and in easy-flowing verse, an echo of Tennyson's; but the stroke of Nemesis fell heavily upon his head—albeit somewhat callous—when the great vision of life, the mystery of its passion and its pain, stirred him to soar into the clouds in a grandiloquent "Ode of Life," only to find, when at his highest, Tupper still a little above him. The public ear had become attuned to Tennysonian melodies and Tennysonian meditativeness when the "Songs of Two Worlds" and the "Epic of Hades" appeared, and (in advertisement phrase) "supplied a felt want." For here were poems, tender and graceful, to comprehend which entailed no intellectual strain, and which could be read without a mental effort—and the public likes to do its reading without thinking; poems not too deep and nowise dry, where wealth of sunny fancy disguised poverty of high imagination, and plenty of whip consoled Pegasus for being stinted of the divine fire. Had Morris maintained this level he would at least have been a charming poet, pleasant to read, in whose pages strictly moderate expectations would not be disappointed; but he fell below himself into mere book-making, and became often weak and washy, in "Songs of Britain," "Gwen," and above—or rather below—all, "The Ode of Life."

The grove of the muses is full of singing birds, and ringing with sweet, pure notes on every side, but they are mostly imitative, echoes, or variations upon the strains of our mightier singers. The only distinctive class as yet unnoticed, is that of what we may call the "drawingroom poets"—the writers of society verse. These are of the lineage of Suckling, Lovelace, and Waller; they have caught up the lyre that fell from the hands of Praed. Their work, in its perfection, is marked by elegance of finish, by lightness of touch, and by rapier play of wit; an art concealing art most cunningly. Seriousness, of course, is alien from their whole atmosphere. They seem, as it were, born out of due time, and to belong of right to the days when patrician beaux fluttered and flaunted with diamond snuff-box and priceless ruffles through the glittering *salons* of Queen Anne. They have captured and haled at their chariot-wheels the forms of old French Court verse, marvels of daintiness and difficulty, the ballade, the villanelle, the roundel, the triolet, and all their fairy company. Of these graceful triflers, who are so numerous as to constitute a salient feature of what is, perhaps, our transition period, Austin Dobson, Edmund Gosse, and Andrew Lang, are

foremost. "Proverbs in Porcelain," "Ballades in Blue China," and "Rhymes à la Mode," are titles which aptly indicate the nature of their contents. It may be doubted, however, whether there is not something suicidal in collecting such trifles in book form. To come upon occasionally and unexpectedly, and amongst graver reading, they are charming; but marshalled side by side, like linnets ravished from their native copses, and crowded in a cage, they quickly pall upon you. It is a banquet wholly of syllabubs, and you soon feel very hungry, and there comes to you, like a wicked whisper, that epigram of the old satirist, which seems to have a cruel applicability to the author—

> "As skilful divers to the bottom fall
> Faster than those who cannot swim at all;
> So in this way of writing without thinking,
> Thou hast a strange alacrity in sinking."

Andrew Lang, in the work already quoted, says, "Now we dwell in an age of democracy, and poetry wins but a feigned respect, more out of courtesy and for old friendship's sake than for liking. Though so many write verse, as in Juvenal's time, I doubt if many read it. 'None but minstrels list of sonneting.'" Just so; the public is quickly sated with rhyming for rhyming's sake. But when what is both good poetry and good reading appears, it counts its readers by thousands; but while poets write to please themselves, to practise their hand in quaint measures, to catch far-off echoes from old lyres, to reproduce the outward shell of a past century's thought, while they give us the barren blossom of an airy fancy, the devices of a fine-strung ear, but do not dig deep into their own hearts, nor speak as those who are stirred with strong emotion, or lifted by mighty inspiration to utter things irrepressible, they need not wonder, they should not complain, if the world cares as little for their trifling as they for the world's needs.

I have thus briefly touched upon one department of the literature of our day, and that only in connection with living poets, of whom we may expect more, and for whom there is yet hope. I had intended to glance at fiction, biography, history, the drama, and so on; but these must needs wait a more convenient season, and, perchance, a more experienced critic. I do not flatter myself that my audience will accept all my conclusions without demur. In poetry, which is pre-eminently a matter of taste, each reader will find his own affinities, and will know what best appeals to him.

> "'Tis with our judgments as our watches, none
> Go just alike, yet each believes his own."

ART. XX.—*Report of the Port Phillip Biological Survey Committee*, 1889.

Members of Committee :—W. M. Bale, F.R.M.S. ; Rev. A. W. Cresswell, M.A.; A. Dendy, M.Sc., F.L.S.; P. H. MacGillivray, M.R.C.S.; Professor W. Baldwin Spencer, M.A.; C. A. Topp, M.A., F.L.S. ; J. Bracebridge Wilson, M.A.; A. H. S. Lucas, M.A., B.Sc., Hon. Secretary and Treasurer.

Your Committee has continued its operations during the year. The grant of twenty-five pounds was devoted to the purchase of spirit and jars, which were sent to Mr. Wilson to assist him in his work near the Heads.

At the close of the season, Mr. Wilson forwarded his collections, which are very valuable, to the Biological Laboratory of the University for distribution to the specialists.

Certain of the specimens thus obtained, as also others collected previously, have been sent to the specialists for determination and report. Others are packed and ready to be sent, and your Committee would ask for a further grant of ten pounds to defray the expenses of transmission.

Reports have been received from Professor W. Hatchett Jackson, of Oxford, on the Pycnogonida; from Dr. S. J. Hickson, on the Alcyonaria and Zoantharia; and from Mr. Lucas on the Fishes. These will be ready to appear in the ordinary course of publication. In all these groups, new species have been determined and described.

Mr. Dendy has devoted much time and care to the study of our sponges, and we may expect from him a very full and valuable account of the taxonomy and anatomy of this difficult group.

Mr. Wilson has established a small Biological Laboratory and Aquarium at Sorrento, and opportunity will thus be afforded of studying some of the marine forms more satisfactory in the living state.

A. H. S. LUCAS,

Hon. Sec. and Treas.

December 1889.

(1) *Preliminary Report on the Crinoids obtained in the Port Phillip Biological Survey.*

By P. H. Carpenter, D.Sc., F.R.S.

In the Summer Season of 1887–8, a number of Crinoids were dredged in the outer stations of Port Phillip, and from outside the Heads, all of them by Mr. J. Bracebridge Wilson.

Twenty-nine specimens were forwarded to Dr. P. H. Carpenter, F.R.S., who has obligingly sent us early information, notwithstanding his pre-occupation with other work.

Dr. Carpenter considers that five species of Comatulæ are represented, viz :—

Antedon pumila, Bell. 14 specimens.

A. wilsoni, Bell. 4 specimens.

A. macronema, Müll. sp. 2 specimens.

A. sp. nov. (prob.) 5 specimens.

Actinometra trichoptera (Vall.) Müll. sp. 4 specimens.

A. pumila was described by Prof. F. Jeffrey Bell, in the *Alert* Report, from Port Jackson. By some confusion, when he received, later on, Port Phillip specimens from Mr. Wilson, similar to those sent to Dr. Carpenter, he described them as new, under the title of *A. incommoda*. In a recent letter to Mr. Wilson, Prof. Bell writes :—"I am sorry to say that *Antedon incommoda* is a synonym of *A. pumila* from Port Jackson. There will be a note on the subject in the next Annals." (A.M.N.H., March 1889).

Dr. Carpenter adds, that the originals, both of *A. pumila* and *A. wilsoni*, and also of *Actinometra trichoptera*, were sent to Prof. Bell by Mr. Wilson. They were not known from Port Phillip before Mr. Wilson's dredgings.

The novelties of our consignment to Dr. Carpenter are, the first record of *Antedon macronema* from Port Phillip, and the occurrence of a form, which "I believe to be a new species ; but it may turn out to be only a strongly marked variety of *A. pumila*."

Dr. Carpenter adds, "I have a large number of undescribed species in hand from various localities and collections ; and as soon as I have finished the Report on the *Blake* Comatulæ for Agassiz, I shall tackle them for the Linnæan Society ; and I shall take the opportunity then of properly figuring your *A. wilsoni*, and also *A. pumila*.

"I wish very much that you could get me some larvæ of *A. macronema.* I want very much to study the development of the calyx, which is very Jurassic in its general characters."

The communication with Dr. Carpenter was made by Mr. Dendy, on behalf of the Committee.

(2) *Preliminary Report on a Collection of Alcyonaria and Zoantharia from Port Phillip.*

By S. J. Hickson, M.A., D.Sc.

In preparing this report of a small collection of Alcyonarians, sent to me by Professor Spencer, of Melbourne, on behalf of the Port Phillip Biological Survey Committee of the Royal Society of Victoria, I have met with greater difficulty than I expected. The numerous genera and species of Stoloniferous Alcyonaria, which have been named, are so imperfectly described and figured that it is almost impossible to identify specimens without seeing the type specimens. The greatest possible confusion exists as to the characters which separate the different genera and species, and consequently it is frequently found that similar specimens, probably belonging to one and the same species, are described by different authorities under different specific and generic names.

In the course of the last few months, I have carefully gone through the literature of the subject, and I propose shortly to communicate to the Zoological Society a paper dealing with the classification of the group.

Very few specimens of the genera Alcyonium and Ammothea have as yet been received in this country from Australian waters, and it might have been thought desirable to consider the two specimens (20 and 21) sent to me to be new species. I hope to be able to justify the course I have taken, in referring them to the species mentioned in the report.

The same difficulty is met with in considering the position of the Zoantharian genera, Palythoa and Epizoanthus, as mentioned above in the case of the Stoloniferous Alcyonaria. I believe there is not sufficient ground for the maintenance of many of the species which have recently been described.

(1)* *Virgularia lowenii* (Kölliker). "Anat. System. beschreibung der Alcyonaria," p. 182 *et seq.*

This specimen closely corresponds with the description of the species given by Kölliker.

* The numbers refer to those on the specimens sent to Dr. Hickson.

(2) *Telesto smithi* (Gray). "Annals and Mag. of Natural History" (4) iii, p. 21.
There are considerable quantities of this species in the national collection at South Kensington.
Specimens collected by H.M.S. *Alert*, Arafura Sea, 32-36 fthms; Port Holle, Queensland, 12-20 fthms.

(3) *Clavularia australiensis* (sp. nov.)
Specimen growing on the test of an aseidian.
Stolon thin; membranous plate-like, dividing into separate ribbon-like pieces at the edges.
Polypes 2mm. long, 1mm. diameter in average size; separated from one another by very slight intervals.
Colour, brownish-yellow, due in large part to a considerable deposit of fine yellow sand.
Spicules very few, or absent.
Vide general remarks at the beginning of the report.

(4) *Virgularia lowenii* (?)
I believe this specimen to be a young form of *V. lowenii*, see (1).

(5) *Mopsea dichotoma* (Lamx.) "Hist. polyp. flexibles," p. 467; *Isis dichotoma*, "Linn. Syst. Nat.," Ed. x, p. 799, *vide Challenger* Reports lxiv, p. 41.
The specimen agrees with the specimens obtained by H.M.S. *Challenger* at Port Jackson, 35 fthms.

(6) *Telesto smithi*, *vide* (2).

(7) *Clavularia ramosa* (sp. nov.)
Specimen growing on a much ramified Alga.
Stolon composed of a number of branched tubular strands, upon which stand at intervals of about 3mm. the polypes.
Polypes partially retracted (the calyx being withdrawn into the body of the polype); funnel-shaped (narrow at the base, broad at the extremity); in the retracted condition 3mm. long by $1\frac{1}{2}$ diameter at the extremity.
Spicules numerous both in polyp walls and stolon, ·1 to ·15mm. long, double clubs and spindles bearing numerous prominent wart-like projections.
Colour, pale, dirty yellow.

(8) *Epizoanthus parasiticus* (Verrill). "Memoirs Boston Soc.," Vol. i, p. 34.
Vide Challenger Report vi, p. 116, by Hertwig; and Supplement to Report on Actiniaria, by Hertwig and Erdman, published in 1888.
Vide remarks on the species of Zoantharia at the beginning of the report.

(9) *Primnoella australasiæ* (Gray). "Ann. Mag. Nat. Hist." (2), Vol. v, p. 510; Wright, *Challenger* Reports lxiv, p. 88.
Specimens collected by the *Challenger* at Port Jackson, 30 to 35 fthms; Twofold Bay, 150 fthms.
Specimens collected by H.M.S. *Alert*, now in British Museum, in Magellan Straits, sandy bottom, 30 fthms, apparently belong to this species.

(10) *Epizoanthus parasiticus*, see (8).

(11) *Clavularia australiensis* (sp. nov.)
Specimen growing on a sponge.
Stolon, thin, membranous, plate-like, becoming divided at the edges into narrow ribbons.
Polypes crowded together in the central regions of the colony, scattered and separated by considerable intervals at the edge; partially retracted. The average length is 3mm., and the average breadth 15mm., but they vary very considerably in size.
Spicules numerous in the polypes, few and scattered in the peripheral portions of the stolon; ·2 to ·3mm. long; spindles with very prominent wart-like projections.
Colour, brownish-white.

(12) *Epizoanthus parasiticus*, see (8).

(13) *Mopsea dichotoma* (?)
A small fragment only of a Mopsea which apparently belongs to this species.

(14) *Telesto smithi*.
I can form no grounds for separating this specimen from *T. smithi*. It should be noted that some authors use, and with justice it appears to me, the stolon or root of the *Telestos* as one character useful for classification. None of the specimens submitted to me have this.

(15) *Gerardia* (sp.)
As a volume of the *Challenger* Reports, dealing with the large and interesting collection of the Antipatharia obtained by the expedition, is shortly expected, I have postponed the identification of this valuable specimen. It does not appear to differ very markedly, however, from *G. lamarcki*.

(16) *Sympodium verrilli* (Percival Wright and Studer). *Challenger* Reports lxiv, p. 271.
The specimen sent me is growing on a piece of Alga, and agrees fairly closely with the description of the species mentioned above.
The *polypes* are all completely retracted, a wart-like prominence, marked by an eight-rayed star, indicating their position.

These prominences are from 1 to 2mm. in diameter, rather smaller than those of the *Challenger* specimens, which are 2 to 4mm. in diameter.

The *spicules*, which are very varied in shape and size, are in general appearance similar to those figured by Studer (l.c. Pl. xlii, fig. 12).

The locality of the *Challenger* specimens is given as Station 320, lat. 37° 14′ S., long. 53° 52′ W.; 600 fthms.

(17) *Clavularia australiensis* (sp. nov. v. supra.) This specimen is growing on a piece of sponge.

Stolon thin and membranous, in some places forming sympodial plates, in others narrow ribbons. Numerous spicules in the older part of the stolon.

Polypes averaging ¼mm. in diameter; all of them considerably retracted, leaving projections on the stolon 1 to 1·5mm. in height. They stand on an average 2mm. apart from one another.

Spicules as in (11), only more numerous.

Colour, brownish-white.

(18) *Clavularia australiensis.* A very small specimen, apparently belonging to this species.

(19) *Palythoa anguicoma* (?) A very small specimen apparently belonging to this species.

(20) *Ammothea thyrsoides.* Klunzinger "Die Korallthiere des Rothen Meeres," p. 30, Part I.

This specimen agrees fairly well with the description given by Klunzinger.

(21) *Alcyonium tuberculosum.* Milne Edwards and Haime, Quoy and Gaimard, Voyage de l'Astrolabe Zooph., Pl. 23, fig. 4.

(22) *Clavularia australiensis.* Specimen growing on a Lamellibranch shell.

(23) *Palythoa anguicoma.*

(24) *Clavularia australiensis* (sp. nov.) Specimen growing on a broken piece of Mytilus (?) shell.

Stolon formed of thin membranous strands, in some places uniting together to form plates.

Polypes all completely expanded, 4 to 5mm. long.

Colour, white.

Spicules—I can find no spicules in this specimen.

(25) Missing.

(26) *Palythoa anguicoma.*

(27) *Sarcophyllum australe* (Kölliker). "Anat. System. beschreibung der Alcyonaria," p. 121.

The specimen sent me agrees in many of its anatomical details closely with Kölliker's species. The details in which it differs from it are such as might be expected in a young specimen. Kolliker's specimens varied from 196 to 262mm.; this specimen is only 115mm. in length. Kölliker's specimens possessed 32 to 47 leaves on each side; this specimen has only 28. The leaves of Kölliker's specimens bear four or five rows of polypes; the leaves of this specimen bear only two. In Kölliker's specimens there were numerous small calcareous needles in the leaves, and a few small needles in the stalk; in this specimen, I cannot find any spicules at all.

From the consideration of all these and other facts, I thought it better to refer this specimen to the species mentioned, than to consider it a new species, and give it a new name. It is very desirable to obtain more specimens of this pennatulid from the same locality. The only specimens hitherto obtained come from New Holland and Australia (*sic.*)

(28) *Clavularia flava* (sp. nov.)

Colony parasitic on old bivalve shell.

Stolon thin and ribbon-like, much branched, bearing a few polypes at intervals of 4mm. and upwards.

Polypes partially retracted; the calyx and tentacles are withdrawn into the lower part of the tubular body. Length in the retracted condition, 4 to 6mm.; diameter 1 to 1½mm.

Colour, bright orange.

Spicules orange-coloured, very numerous in both stolon and polypes; spindles club and double club-shaped, covered with numerous wart-like processes ·1 to ·15mm. long.

(29) *Primnoella flagellum* (?) (Studer). "Monatsbericht d. k. preuss Akad d. wiss., Berlin, 1878," p. 644; Wright, *Challenger* Reports, p. 85, Pl. xvii, 1.1a.

The very small specimen I received apparently belongs to this species, but it was too small and imperfect to identify with any degree of certainty.

MEETINGS OF THE ROYAL SOCIETY.

1889.

[N.B.—The remarks and speeches in the discussions are taken down verbatim by a shorthand writer, and afterwards written out at length with a typewriter, for reference and reproduction, if required; and therefore, more is seldom given herein than an indication of their general drift. If any person should wish to refer to the verbatim report, he can apply to the Secretary to the Society, who will give him an opportunity of perusing and copying it, or if he resides at a distance, so much as he requires will, upon payment of the cost of reproducing it, be forwarded to his address.]

ANNUAL MEETING.

Thursday, March 14th.

The President (Professor KERNOT) in the chair.

The PRESIDENT referred to the decease of Sir William Stawell, who, he said, was one of the original founders of the Society, under the name of the Philosophical Institute. It was instituted in or about the year 1857, and a list of members followed the rules, which were dated January 1857. The first name on the list was that of Sir Henry Barkly, who was then Governor of Victoria, and who took a great interest in all scientific matters. The next name was that of Sir William A'Beckett. Then there were the names of the late Sir Redmond Barry and others. Sir William Stawell was for a long time prior to his death a Trustee of the property of the Royal Society. He was also connected with many other bodies. He was a visitor to the Observatory from a very early period, and took an active interest in all scientific matters. Of late years he had not been able to attend the meetings of the Society. A debt of gratitude

was due to Sir William Stawell for being one of the founders of the Society. He would also be remembered at the University, where for some time he filled the position of Chancellor, and where the Stawell Scholarship was founded by him. He had passed away in the fulness of his years, and he would be missed in the scientific as well as in the political and judicial world.

Annual Report.

The Council of the Royal Society herewith presents to the Members of the Society the usual Annual Report for the year 1888. The following were the papers read during the Session :—

On the 8th of March, 1888, Dr. H. C. Wigg read the first "On the Proposed Introduction of New Diseases into Australia."

On the 12th of April, Mr. Robert Abbott's paper on "The Maintenance of Energy," was read by one of the Honorary Secretaries; and Mr. Newton E. Jennings' paper on "Irrigation and Water Supply in the Australian Colonies," was read by the President.

On the 10th of May, Mr. Thomas Wakelin's paper, entitled "An Experiment to show how the Earth is made to Gravitate Towards the Sun," was read by one of the Hon. Secretaries. Mr. A. Dendy read one "On the Anatomy of an Arenaceous Polyzoon;" and Professor Spencer read some "Notes on the Presence of a Fluke in the Egg of the Common Fowl."

On the 14th of June, Professor Spencer read a paper "On the Presence of a Pentastomum parasitic in the Lung of Hoplocephalus superbus." Mr. A. Dendy contributed "A List of all the Species of Sponges described by Mr. T. J. Carter, F.R.S., together with the latter's more important references to the Species described by other Authors;" and Professor Spencer read another "On the Presence of a Rare Cestode Amphiptyches in Callorynchus antarcticus."

On the 12th of July, Mr. T. S. Hall's paper "On Two New Fossil Sponges from Sandhurst," was presented by Mr. Dendy, and read by one of the Hon. Secretaries. Mr. Dendy gave "A Preliminary Account of the Anatomy and Development of Stelospongus flabelliformis." The President next described the Hawkesbury Railway Bridge, then in course of construction in New South Wales.

On the 13th of September (the August Meeting having been suffered to lapse on account of the Members being engrossed by preparations for the approaching Inaugural Meeting in Sydney of the Australasian Association for the Advancement of Science), Professor Masson read a paper by himself and Mr. J. B. Kirkland, "On Polyhaloid Salts of Organic Bases." Mr. Ellery, F.R.S., described a New Watkin's Aneroid Barometer.

On the 11th of October, the President gave a brief account of "The Rise and Progress of Steam Navigation," and exhibited William Symington's Original Model Steamboat, which had been furnished for the occasion by the Rev. Duncan Fraser. Mr. F. A. Campbell read a paper "On the Active Volcano on Tana, New Hebrides."

On the 15th of November, Mr. A. Dendy read a note "On some Actinian Larvæ parasitic on a Medusa from Port Phillip;" and the Rev. D. Macdonald's third paper "On the Oceanic Languages Semitic," was read by one of the Hon. Secretaries.

On the 13th of December, Professor Masson read a paper by himself and Mr. Kirkland, on "The Preparation of Alkyl-sulphine and Alkyl-phosphonium Salts;" and Mr. James Stirling, F.G.S., read one on "The Physiography of the Western Portion of the County of Croajingolong."

Your Council has to record the remarkably successful initial meeting in Sydney of the Australasian Association for the Advancement of Science in August last, and to remind the Members of this Society that the next meeting is to be held in Melbourne towards the end of the year, and it is hoped that no efforts will be spared to make the second gathering at least equal to the first.

Your Council has also to congratulate the Society on the change made in the form of the publications of the Society, a new Series of Transactions having been commenced with Professor Spencer's paper on "Megascolides australis" as the first number. This paper has been issued on the pattern of the Transactions of the Royal Society of London, and expense has not been spared to make it worthy of its prototype. The other papers will be published in the same form as preceding issues, but with the title of Proceedings, the term of Transactions being reserved for those demanding more elaborate treatment and style of illustration. It is

anticipated that ample materials will be furnished by the Port Phillip Biological Survey Committee, which is prosecuting its labours in a manner that promises to justify the expectation. A second grant of £50 has been made in aid of the Committee.

Your Committee regrets that, in view of the increased expenditure involved in this change, an application which was made to the Government for an increase to the yearly grant in aid, was too late in the year to be of any avail, and it ventures to urge upon the Society and the next Council the necessity of renewing the appeal to the Government immediately, as the cost of continuing such publications is quite beyond the present means of the Society.

Your Council considered it both due and advantageous to the Society to recommend the appointment of several distinguished scientific men in different countries as Honorary Members of the Society, and on the 15th of November, six gentlemen were duly elected by the Ordinary Meeting.

Your Council strongly recommends its successor to institute an early revision of the list of societies with which this Society exchanges publications.

Appended will be found the names of nineteen new Members and Associates, which have been added to the list during the year:—Ordinary Members—Mr. Richard Bastow, Mr. S. C. Candler, Mr. J. M. Coane, Mr. E. J. F. Love, M.A., Dr. Alex. Morrison, and Mr. W. H. Nimmo. Country Members—Mr. A. W. Dixie, Mr. James Ivey, Mr. Newton E. Jennings, C.E.; and Mr. Henry Shaw. Associates—Mr. Wm. Swan and Mr. James Wilson. Honorary Members—The Hon. J. W. Agnew, M.D., M.E.C., Hobart; Dr. Bancroft, Brisbane, Queensland; the Hon. John Forrest, C.M.G., West Australia; Sir James Hector, K.C.M.G., F.R.S., Wellington, New Zealand; the Hon. W. McLeay, M.L.C., F.R.S., Sydney; Mr. H. C. Russell, F.R.S., F.R.A.S., Sydney.

Jonkeer Daniel Ploos van Amstel (having gone to Europe), Mr. F. H. Baker, Mr. F. R. Godfrey, have resigned their membership of the Society, and one Associate (Mr. C. G. V. Williams) has done the same. The following Members have been lost to the Society by death, viz., Professor H. M. Andrew, M.A., and Mr. Germain Nicholson, J.P.

Your Council, in revising the Members' list, has found cause for omitting the names of some persons who were defaulters

of long standing. The list now shows eighteen Life Members one hundred and seventeen Ordinary or Town Members, thirty-eight Country Members, seven Corresponding Members, twelve Honorary Members, and sixty-nine Associates. Total, two hundred and sixty-one.

Mr. A. H. S. Lucas resigned his seat on the Council in May last, on account of the pressure of other engagements, and his place was filled by the election of Mr. C. A. Topp, M.A., LL.B., F.L.S., on the 14th of June.

Mr. Barnard also resigned the office of Hon. Secretary, and was succeeded by Professor W. Baldwin Spencer, M.A., who was elected Hon. Secretary at the Ordinary Meeting in November.

Dr. J. J. Wild's period of engagement as Assistant Secretary having expired, it was considered advisable to appoint a person less engaged in other directions, and Mr. Loton Cattlin, the present Clerk and Sub-Librarian, was accordingly engaged, and by his exertions the Library has at last been made effectively accessible to Members, the catalogue having been completed by him so far as to show where, on the shelves, any volume is to be found. He will next undertake the compilation of an alphabetical index, under proper heads of subjects, and names of Societies. The Sub-Librarian, by present arrangement, attends on Mondays, Tuesdays, Wednesdays, Thursdays, and Fridays, from 4 to 6 o'clock p.m., and is prepared to give information and assistance to Members desiring to consult the Library.

The Hon. Librarian reports that the following additions to the Library have been received during the year, the increase in number being apparently due to the greater regularity in acknowledging the receipt of publications:—From England 188 parts, Scotland 23, Ireland 11, Germany 109, Austria 16, Switzerland 2, France 7, Spain and Portugal 14, Italy 56, Holland and Belgium 35, Denmark, Sweden and Norway 10, Russia and Roumania 12, India and Mauritius 12, China and Japan 8, Canada 5, United States 87, Mexico 44, Argentine Republic 4, Australasia, Victoria 147, New South Wales 27, South Australia 2, Tasmania 3, Queensland 13, New Zealand 8. Total publications received, 843.

In connection with the Treasurer's Balance Sheet and Statement of Accounts which are appended, the Hon. Treasurer desires to impress upon the Members of the

Society that the financial position of the Society has only been maintained by the exercise of rigid economy, rendered imperative by the extra expenditure which has been undertaken, but as yet scarcely been actually commenced, in the Biological Survey of Port Phillip, and the proposed publication of the results in a more costly form. Not only have no bookbinding or repairs been executed, though much required, but the urgent want of increased shelving in the Library remains unsatisfied, and some considerable accounts remain unpaid, as appears in the statement of liabilities. On the other hand, the amount of subscriptions received has been abnormally augmented for the year by the collection of arrears. Although, therefore, the present balance to the credit of the Society compares favourably with the last, the future contemplated expenditure will be much greater, and to carry it into effect successfully, an increased income must be provided.

Dr. *The Hon. Treasurer in Account with the Royal Society of Victoria.* Cr.

To Balance on 1st March, 1888					£179	19	10	By Printing and Stationery	£272	1	5
,, Government Grant—								,, Expenses of Port Phillip Biological Survey ..	28	13	9
Balance of Vote for 1887-88	£50	0	0					,, Rates	5	10	0
,, ,, 1888-89	50	0	0					,, Gas and Fuel	8	1	11
				100	0	0		,, Salary of Assistant Secretary	76	13	4
,, Entrance Fees				23	2	0		,, Shorthand Writer's Records	6	6	0
,, Subscriptions—								,, Hall-keeper's Allowance	8	14	0
Life Memberships	52	10	0					,, Collector's Commission	38	5	2
Ordinary Subscriptions, 1888	253	11	6					,, Insurance	3	10	0
,, ,, 1889	10	10	0					,, Secretary's Postages	79	12	7
Arrears	61	19	0					,, Repairs	10	1	6
				378	10	6		,, Treasurer's Postages and Petty Cash	1	9	6
,, Rent of Rooms				25	11	0		,, Balance in Bank, 1st March, 1889	192	14	10
,, Sale of Transactions				0	12	6					
,, Interest				23	18	2					
				£731	14	0			£731	14	0

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Compared with the Vouchers and Bank Pass-book and Cash-book, and found correct,

J. JAMIESON,
Hon. Treasurer.

7th March, 1889.

(Signed) R. E. JOSEPH, H. MOORS, } Auditors.

PUBLISHING AND RESEARCH FUND.

Dr.		Cr.	
To Fixed Deposit in Bank	£300 0 0	By Fixed Deposit in Bank	£300 0 0
,, Interest	15 0 0	,, Interest transferred to General Account ..	15 0 0
	£315 0 0		£315 0 0

STATEMENT OF LIABILITES AND ASSETS.

Dr.				Cr.		
To Two Debentures		£10 0 0		By Outstanding Subscriptions (say)	£50 0 0	
,, ,, ,, Interest unclaimed		8 8 0		,, Rents due	25 0 0	
,, Estimated Outstanding Debts—				,, Hall, Library, and Furniture	5000 0 0	
Printing Account	£65 0 0			,, Balance of Grant, 1888-9 ..	£150 0 0	
Shorthand Writer's do. ..	12 0 0			,, Moiety ,, 1889-90 ..	100 0 0	
Other small do.	3 0 0					250 0 0
		80 0 0		,, Publishing Fund	300 0 0	
,, Grant to Librarian		10 0 0		,, General Account Balance ..	192 14 10	
,, ,, P.P.B.S. Commitee		21 6 3				492 14 10
,, London Illustration Account		20 0 0				
,, Balance		5668 0 7				
		£5817 14 10				£5817 14 10

On the motion of Mr. ELLERY, seconded by Mr. BLACKETT, it was resolved that the Report and Balance Sheet be taken as read, and be adopted.

ELECTIONS.

The retiring Office-bearers and Members of Council were re-elected.

AMENDMENT OF RULES.

Mr. RUSDEN said it would be remembered that in December he gave notice of motion regarding certain amendments necessary in the laws, which were about to be re-printed.

The amendments proposed by Mr. Rusden were then considered, and adopted with one or two verbal alterations (see Rules pp. 171).

Mr. MACDONALD moved that the Rules as amended that evening be printed and adopted as the Rules of the Society.

Mr. ELLERY seconded this motion, which was carried.

On the motion of Mr. ELLERY, the Meeting resolved itself into an Ordinary Meeting.

ORDINARY MEETING.

The reading of the minutes was deferred till the next meeting.

Mr. WHITE moved the suspension of the standing orders, to enable the election of Mr. Cameron, of Orbost, to be proceeded with.

Mr. Cameron was then elected as a Member.

Mr. J. M. Coane signed the Register, and was introduced to the Meeting.

The following short addresses were then read:—

(1) "On Recent Progress in Astronomy," by Mr. R. L. J. Ellery, F.R.S., C.M.G.

(2) "On Recent Progress in Geology," by Mr. G. S. Griffiths, F.G.S.

(3) "On Hygiene," by Dr. Jamieson.

The Meeting then adjourned to Thursday, March 21.

Thursday, March 21st.

The President (Professor KERNOT) in the chair.

Short addresses were read :—

(1) "On Recent Progress in Mechanical Science," by Professor Kernot, M.A., C.E.

(2) "On Recent Progress in Literature and Fine Arts," by Dr. J. E. Neild.

(3) "On Recent Progress in Biology," by Mr. A. H. S. Lucas, M.A., B.Sc.

Thursday, April 11th.

The President (Professor KERNOT) in the chair.

The minutes of the Annual and last Ordinary Meeting and adjournment thereof, were read and confirmed.

The PRESIDENT announced that the Hon. Dr. Agnew, of Hobart, who was recently elected an Honorary Member of the Society was present that evening. He trusted that Dr. Agnew might frequently be able to attend the meetings of the Society, and expressed the hope that other scientific gentlemen from the adjoining colonies, would honour them occasionally with their presence.

Mr. Edward Davies was nominated as an Associate.

Dr. NEILD, the Hon. Librarian, announced that fifty-five publications had been received since last Meeting.

The Hon. Dr. J. W. Agnew, of Hobart (Honorary Member), and the Rev. A. W. Cresswell and Mr. Gabriel (Associates), were introduced, and signed the Book.

The following papers were read :—

(1) "On a New Species of Bicellaria," by J. Bracebridge Wilson, M.A.

(2) "On some New Species of Marine Mollusca," by J. Bracebridge Wilson, M.A.

(3) "The Crinoids obtained in the Port Phillip Biological Survey," by one of the Hon. Secretaries.

(4) "Systematic Census of Indigenous Fish, hitherto described, from Victorian Waters," by A. H. S. Lucas, M.A., B.Sc.

(5) "Additions to the Fish Fauna of Victoria," by A. H. S. Lucas, M.A., B.Sc.

(6) "On the Occurrence of Krausia lamarckiana at Williamstown," by A. H. S. Lucas, M.A., B.Sc.

(7) "The Old Red Sandstone Rocks and Fossils of the Mansfield District," by Mr. George Sweet.

Mr. STIRLING hoped that Mr. Sweet would carry on his researches to the eastward. To the south of the area described by Mr. Sweet, there was an outcrop of bluish or greyish lava, which was probably Upper Silurian.

Mr. G. S. GRIFFITHS said that, up to the present time, the Devonian Rocks which occupied the region about sixty miles southward of the locality of Mr. Sweet's discoveries, and also the region eastward, were considered to belong to the Upper Devonian, but no fossils with the exception of a few vegetable remains had been discovered there.

Mr. SWEET said he had not examined the rocks to the eastward, except some fifteen miles in that direction. The same plants that were found in the Iguana Creek beds were also found on the top of Hat Hill. The rocks he examined were in an almost continuous line with the coal beds in Gippsland. If Carboniferous rocks were to be found outside of the Gippsland District, the two localities mentioned in his paper would be the proper places to look for them.

Mr. GRIFFITHS said that the locality examined by Mr. Sweet was considered by Mr. Howitt as having at one time been part of an old sea loch. Nearer to the sea were to be found the remains of ancient volcanoes of vast dimensions. When those volcanoes were in their prime, the country stood at a greater elevation than now. It then sank, until the sea overspread portions of it. The volcanoes then sank and died out, and the mountain glens were transformed into sea lochs. The conglomerates filled up these lochs. There was then a re-elevation of the land, and tremendous denudation, and another period of subsidence. On the top of the conglomerates, beds of marl and limestone were formed, and it was those beds that had been examined by Mr. Sweet.

Mr. LUCAS said that since the discovery of the Muddy Creek beds, no series of fossils such as had been brought to light by Mr. Sweet, had been obtained in the colony. It would be desirable to know if, in Tasmania, fossil fish had

been obtained in the Carboniferous limestone. To his knowledge, no such fossils had been found in Tasmania.

Mr. SWEET said one point which might be considered of interest in that direction, was the presence of Lepidodendron plants in the upper beds. The land plants first found in the beds were very small, not larger than the thumb. The larger plants seemed to indicate that they had not travelled a great distance by water. Professor McCoy had not yet had time to examine the fish thoroughly, but his first impression appeared to be that they were marine forms.

Thursday, May 9th.

The President (Professor KERNOT) in the chair.

The minutes of the last Meeting were read and confirmed.

Mr. Guilfoyle was nominated as a Member, and Mr. Hubbart as an Associate.

Mr. R. Barton and Mr. Edward Davies were elected Members.

Dr. NEILD announced that forty-nine new publications had been added to the Library during the past month. It was in contemplation to have additional shelves placed in the Library.

The Vice-President (Mr. E. J. WHITE, F.R.A.S.) read a paper "On Barometric Measurement of Heights," in which he presented some new tables for the barometric measurement of heights, which was followed by a long discussion in which the President and Messrs. J. M. Coane and Field took part.

Thursday, June 13th.

The President (Professor KERNOT) in the chair.

The minutes of the previous Meeting were read and confirmed.

Mr. E. Davies was introduced by the President as an Associate of the Society.

Mr. Guilfoyle, Director of the Botanical Gardens was elected a Member, and Mr. J. R. Hubbart an Associate.

Mr. M'Alpine was nominated as a Member of the Society.

NEW SECTION.

The PRESIDENT said:—I wish to draw the attention of the Meeting to a circular signed by Mr. H. K. Rusden, one of the Hon. Secretaries of the Society, which has been

issued in pursuance of the generally approved proposal in Dr. Neild's address on "Literature and art." That proposal was, that early steps should be taken under the 53rd Law of the Society to form Section G, for the Promotion of Literature and Art, including Architecture. I would commend this movement to the attention of Members of this Society. Our labours hitherto have almost been entirely in the direction of Science, but a wider scope is open to the Society. We are not restricted to Science as the only direction in which our discussions and investigations can take. Under Law 53, we are empowered to take up Literature and Art. I hope this Section will be developed vigorously. The only difficulty in this workaday world is to find time. I hope that those who have not come forward strongly in the Science direction will take up Literature and Art.

ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The CHAIRMAN said:—I have also to draw attention to a circular from the Australasian Association for the Advancement of Science, whose next meeting is to be held in Melbourne, on the 7th January, 1890. I hope that the meeting in Melbourne will be as successful as the last one held in Sydney. I trust that Members will not forget this event, and that they will take part in the discussions and supply papers.

The LIBRARIAN read a list of books and periodicals, eighty-seven in all, which had been received since last Meeting from different parts of the world. He said:—I take the liberty of announcing that since last Meeting the Council have accepted a tender for putting up more book shelves in the Library, a work which I think is highly necessary. I hope that the shelves will be in position before next Meeting. I would like to say that our Library, although a miscellaneous one, is a very valuable one; and it has been decided by the Council, and I think properly, that the books comprising the Library shall not go out of the building in the future. A great many of them, I am sorry to say, have been lost owing to the practice of letting them out. I do not think the Members will regard it as a hardship, that in future they will have to consult the books in the building. I will not say there is an absolute immorality amongst the community, but books have been taken away and withheld, not perhaps for any dishonest

purpose, but they stay away all the same. This is a great pity, because we wish to keep our Library as complete as possible.

Mr. J. Bracebridge Wilson, of Geelong, exhibited several marine specimens secured by the S.S. *Lady Loch* on her recent trawling expedition. Mr. Wilson said:—"By the kind permission of the head of the Ports and Harbours Department, a few tins and collecting jars containing spirit were placed on board the *Lady Loch*, when about to proceed on a trawling expedition to the east of Cape Schanck. Captain Livingstone most readily and courteously undertook to secure the preservation of any objects likely to be of interest to naturalists. The tins were forwarded to me on June 12th, and a rapid examination of their contents has been made. A few fish, chiefly allied to the sharks and rays, have been handed to Mr. A. H. S. Lucas for examination and report. Three or four species of crabs were taken, none of which differ from those obtained in dredging near the Heads; one *Antedon* (not yet determined); *Goniocidaris tubaria; Strongylocentrotus*, the common form with purple spines; a fine group of *Boltenia australiensis*, and an interesting compound ascidian; a fairly good specimen of the fine flabellate orange-coloured *Gorgonia;* some few sponges, chiefly of the coarse chalinoid form; one, apparently a *Suberites*, will require examination. A few of the commoner Hydroids occur in the collection, and about thirty species of Polyzoa, as given in the appended list."

Rhabdozoum wilsoni. A small fragment on a shell.
Catenicella lorica.
C. ventricosa.
C. urnula.
C. intermedia.
C. cribraria.
C. perforata.
C. dawsoni.
C. crystallina.
C. utriculus.
Caldwellia bicornis.
Scrupocellaria cyclostoma.
S. obtecta.
Canda arachnoides.
Caberea rudis.
C. grandis.
Menipea crystallina.
Cellaria rigida.
C. hirsuta.
C. divaricata.
Tubucellaria hirsuta.
Bicellaria tuba.
Flustra denticulata.
Carbasea pisciformis.
Craspedozoum roboratum.
Biflustra perfragilis.
Adeona cellulosa.
Schizoporella schizostoma.
Porina gracilis.
Bracebridgia pyriformis.
Retepora monilifera.
Crisia edwardsiana.
Hornera foliacea.
Amathia bicornis.

The chair having been vacated by the President in favour of the Vice-President, Mr. White.

Professor KERNOT read a paper on the "Barometric Measurement of Heights," giving the results of measurements taken on a recent trip.

Mr. ELLERY said that the subject of the Barometric Measurement of Height, was one in which all engineers and surveyors must be interested. So far as his experience went, a well made aneroid barometer was an extremely useful instrument. Those who claim for the aneroid barometer more perhaps than it deserves, must recollect that they have not an easy thing to measure in weighing the atmosphere. If people would only look at the weather chart sent out from the Observatory every day, they would come to the conclusion that this was true. Thus, in taking a line with the mercurial barometer from the Observatory to Gabo Island, it is found that in certain spots incorrect readings are obtained. There are certain spots where there is a depression in the atmosphere. Professor Kernot had told them that he took readings from his barometer while the train waited a few seconds at the different wayside stations. Such readings were invariably incorrect. It takes some time before the aneroid gets right after the motion of the train. It must be read, to get correct readings, some minutes after the train has stopped. Another thing, in the small barometers, ten feet were represented by a hundredth part of an inch, and as such, were not an easy thing to read. The greatest defect in these aneroids lay in the want of knowledge of the conditions of the atmosphere at the points of observation. But even at best, the results to be gained were merely approximate.

Mr. ALLEN said that so far as his experience went, the aneroid barometer was perfectly useless, except when the weather was favourable. He had recently made experiments with one of Watkin's best instruments, one of Mason's No. 1, and another of Watkin's No. 2. He tried to take the height of a mantelpiece from the floor. The first result was, that Mason's gave 13 feet; Watkin's No. 1, 7 feet; and Watkin's No. 2, 3 feet. He next raised the instrument, with the result that in Mason's there was no difference; Watkin's No. 1, no difference; Watkin's No. 2, 2 feet.

A long discussion ensued, in which Messrs. Coane, Allen, Campbell, White, Yates, and the President took part.

Professor SPENCER read a paper "On the Pineal Eye of *Mordacia mordax*."

Professor KERNOT remarked that the pineal eye was one of the most curious things ever discovered by anatomists. The subject was an intensely interesting one. It would be interesting to know how human beings came to lose the pineal eye.

Mr. ELLERY read a paper written by Mr. G. W. Perry "On a New System of Photo-Lithography."

In reply to Mr. Ellery, Mr. PERRY said he could not speak just now as to the cost, but there was no doubt as to the rapidity of the process. A transfer could be taken in the morning, and prints secured in three or four hours. The stone had to mature for three or four hours.

Thursday, July 11th.

The President (Professor KERNOT) in the chair.

The minutes of the last Meeting were read and confirmed.

Mr. Vickery, Mr. Barton, and Mr. Love signed the Roll, and were introduced to the Meeting.

Mr. Ingamells and Miss Helen H. Neild were nominated as Members.

Regarding the nomination of Miss Helen H. Neild, the PRESIDENT said that the proposal of a lady as a Member of the Society, marked an era in its history. After careful search through the Laws, the Council could find nothing to prevent a lady becoming a Member of the Society. He believed the Society was formed on the supposition that ladies as well as gentlemen would become Members of it. The ladies had not hitherto come forward to claim their right, but it was not improbable that many others would follow the example set by Miss Helen H. Neild. The particular circumstance that led to the nomination under notice, was the establishment of Section G—Literature and Art. In that Section, ladies would probably take a particular interest.

Mr. D. M'Alpine was elected a Member of the Society.

Mr. ELLERY proposed, and Dr. NEILD seconded, the nomination of Mr. Howitt to fill the vacancy on the Council, caused by the resignation of Mr. Bage.

The motion was put, and carried unanimously.

SECTION G.

The PRESIDENT brought under the notice of Members a statement as to the formation of Section G—Literature and Art, including Architecture. A circular was issued on the 5th of last month, requesting gentlemen interested in the matter to attend a preliminary meeting. That meeting was held in the Lower Hall on the 20th of last month, and the Section was duly formed. Although the formation of Section G was a new departure in the history of the Society, yet it was one that had been contemplated by the founders of the Society, and provided for under the Laws. Until Dr. Neild in his excellent address at the beginning of the year had called attention to the matter, no one had taken it up. He hoped that the formation of the Section would add to the success of the Society. The Inaugural Meeting would take place on the 23rd of August.

Dr. NEILD thanked the Members for the cordial way in which they had received the report of the Meeting. Nothing could be more cordial, nor more friendly, than the manner in which the proposition had been received by the Council. Outside the Society, the starting of Section G had occasioned a great deal of satisfaction. Mr. Way, who was elected Chairman of the Section, and who was very proud of the honour allotted to him, had asked him to express his regret at not being able to attend that evening, and to express his thanks for the honour done him.

Dr. NEILD, the Hon. Librarian, reported that since last meeting sixty-six new publications had been added to the Library. Thanks were due to Mr. Cattlin, who had worked hard to get it in order.

Mr. DENDY read a paper on "The Australian Species of Peripatus."

After some remarks from Professor SPENCER, the latter read a paper on "The Anatomy of Amphiptyches urna."

Mr. LUCAS said that as the fish, *Callorhynchus antarcticus* in which the parasite lived, was carnivorous, it seemed not

unlikely that the parasite would take a different form in one of the herrings on which the fish lived.

Dr. RALPH said that in the bladder of a frog would at times be found a very beautiful Distome. It was twenty years ago since he first saw it. It was above a quarter of an inch in length, and beautifully transparent. The ova could be seen through the integuments, and also the embryos struggling in the body of the parasite.

Mr. DENDY said that in the University laboratory they had found very few specimens of the Distome in the frog. It was remarkable that in the Australian frog, the worm had only two suckers, while the English one had five.

Mr. FENTON read a paper on "The Calculimetre."

A long discussion ensued, in which the President and Messrs. White, Love, and Marks took part.

Thursday, August 8th.

The President (Professor KERNOT) in the chair.

The minutes of the preceding Meeting were read and confirmed.

Mr. Frank Cole was nominated as a Member; Rev. Lorimer Fison, Rev. Dr. Bevan, Mr. Maloney, and Mr. W. W. Harris as Associates.

The PRESIDENT stated that the first business meeting of Section G would take place on Friday, the 23rd instant.

Dr. NEILD then read the Library report, which showed that sixty-two publications had been added to the Library during the past month.

The PRESIDENT called the attention of Members to a paper which had reached them that evening, from the Hon. Dr. Agnew. The paper had been read before the Australasian Association in Sydney last year. The subject was "The last of the Tasmanians." The last of the Tasmanians was an old lady, Truganini. Her husband who, he thought, had departed this life before her, was known as King Billy. Accompanying the paper was a large photograph of the latter. He thought the information contained in the paper was of great value and interest, as bearing upon the last survivors of the race.

The PRESIDENT then read a letter which had been received from the Secretary of the Victorian Engineers' Association, on the proposed amalgamation of scientific societies. He said that this matter had been considered by the Council of the Society. Of course this Society was in a different position to many other scientific bodies. They had an excellent building of their own, and did not feel the necessity for a local habitation as some of the other societies did; but at the same time, the Council had not entirely refused to look into the matter, and a committee had been appointed to meet with the gentlemen interested, to hear what they had to say. A question that had been agitated from time to time was, whether the meeting house of the Society was a suitable one as to position, or whether a better one could be found. As the property was valuable, it might be made to provide funds to enable them to have apartments or accommodation in some more central position. However, the matter at present was merely a suggestion, and he was not in a position to express any opinion. A number of societies besides those mentioned in the letter had been discussing the matter for some time past. He thought it right to give the members of the Society this information, but he thought the Royal Society would be about the last of the societies to feel a strong pressure in the direction of joining in the movement. Still, it might be to their interest to join it, for the purpose of securing quarters in a more central position. He believed that, were the place of their meetings within three minutes' walk of Flinders Street station, they would be more largely attended. If anything further were done in the matter, the Members would be notified.

Mr. DENDY read a paper "On the Anatomy and Histology of an Australian Land Planarium," which he illustrated by means of charts and sketches on the blackboard.

A discussion ensued, in which the President, Professor Spencer, Mr. Lloyd Marks, and Mr. Griffiths took part.

Mr. RUSDEN read a paper communicated by Mr. J. H. Maiden, F.L.S., F.C.S., Curator of the Technological Museum, Sydney, on "Liquid Kino."

Dr. NEILD said that Kino had been employed many years ago very largely for many purposes where astringents were required, but of late years it had not been used. He would suggest that a quantity of Kino should be subjected to some test, and that some should be tried in the hospitals.

In the ensuing discussion, the President, Mr. Lloyd Marks, and Mr. Howitt took part.

Thursday, September 12th.

The President (Professor KERNOT) in the chair.

The minutes of the preceding Meeting were read and confirmed.

Mr. D. M'Alpine signed the book, and was introduced to the Meeting.

Mr. A. G. Melville, Rev. E. H. Sugden, Rev. W. Allen, Mr. Fred. Tate, B.A.; Mr. T. A. Sisley, Rev. John Reid, Professor Morris, and Mr. Vidler were proposed as Members.

Mr. F. N. Ingamells, Mr. F. H. Cole, M.B.; Rev. Dr. Bevan, Miss Helen H. Neild, Dr. W. Maloney, Rev. L. Fison, and Mr. W. W. Harris were elected Members of the Society.

Dr. NEILD, the Hon. Librarian, reported that eighty volumes had been added to the Library since last Meeting, and that the improvements for the accommodation for additional books were being completed.

Mr. H. K. RUSDEN read a report by Mr. A. S. Way, President of Section G, of the progress of that Section.

The PRESIDENT congratulated the Members on the success of the Section, which bade fair to become the most popular of all.

The PRESIDENT exhibited and explained the action of a set of Kinematic Models, belonging to the Engineering Class of the University.

BARON VON MUELLER read a paper on "Records of Observations on Sir William MacGregor's Highland Plants from New Guinea," and exhibited the plants which had been forwarded to him from New Guinea by Sir Wm. MacGregor. He said that Sir Wm. Macgregor, to his infinite credit, in addition to performing his official duties, had, as a man of Science, worked hard in New Guinea. It was not necessary to enter into details of His Excellency's exploits, inasmuch as the Queensland papers had noticed them rather fully, and an excellent *resumé* of his work had been published. The tour of discovery undertaken by His Excellency, had been one in which extraordinary difficulties had to be encountered. Great efforts had to be made, and ingenuity

exercised, in obtaining the specimens from the abrupt crest in which the Owen Stanley Range terminated. As that Range rose to the height of 13,000 feet, there was at its summit a thousand feet of Alpine country. Still higher mountains covered perpetually with snow, had come into view. There was in New Guinea what was called a highland vegetation—Sir Wm. MacGregor termed it a Sub-Alpine vegetation. It was at the commencement of a new line of research, which he hoped Australia would carry out. A series of years would have to be occupied before the whole of the ranges, which were Alpine, could be exhaustively explored. This was owing partly to the difficulty of approaching them in their present state. The presence of the natives and the extraordinary abruptness of the ranges were the difficulties. It would require a man of great energy and strength to overcome those difficulties, and His Excellency the Governor of British New Guinea had done good work in that direction. A number of the plants obtained were to be found not only in the Snowy Mountains in Victoria, but down to the Auckland Islands. The same held good in regard to the Himalayas. There was therefore an intermixture of the forms peculiar to the Himalayas and the far South. Sir William MacGregor had discovered that some of the plants found on a mountain in North Borneo, also 13,000 feet high, were to be found also in New Guinea.

A discussion ensued, in which the President, Mr. Stirling, Dr. Wigg, Mr. G. S. Griffiths, and Baron von Mueller took part.

Thursday, October 10th.

The President (Professor KERNOT) in the chair.

The minutes of the last Meeting were read and confirmed.

Miss H. H. Neild signed the book, and was introduced to the Meeting.

Dr. NEILD said:—Mr. President and Gentlemen, I thank you for having elected my daughter as an Associate of this Society. She is the first lady Member, and her election marks an era in the existence of the Society, which has now been established for thirty-six years. I have heard some expressions of misgiving as to the propriety or expediency of

introducing the female element into this Society. There is a fear that it might destroy its severely scientific character. I do not think the principal Members share those misgivings. In the present day, women are coming to the front in every direction, and I do not see why they should not, so long as they do not go to the extreme lengths recommended by the Women's Rights Association. So far as the intellectual position of women is concerned, I do not see why she should not take her position with us. I think we should welcome the advent of ladies into the Society, and I do not think any misfortune is likely to happen as the result, as we all know the particular reason of this influx is on account of the development of Section G—Literature and Art. I believe most of the ladies who intend to become Associates are attracted by that Section. As Mr. Way will inform you, we have had in our Shakespeare Society some most gratifying evidence of the advantage of including women among our members. We have had several ladies who have read very good papers, and they have from time to time taken part in the discussions. I am sure the effect of their presence at our meetings has been of a beneficial kind. I thank you very much for the honour you have done my daughter.

The PRESIDENT said the Council, at any rate, felt no misgivings as to the propriety of admitting ladies to the Society. This was evidenced by the fact that they all signed Miss Neild's nomination paper. It was hardly large enough to contain the names of the members of the Council. I certainly agree with Dr. Neild that there is not the slightest reason why ladies should not be most useful members of the Society, not only of the literary, but of the scientific sections.

The PRESIDENT submitted a long list of names of ladies and gentlemen nominated for membership.

Dr. NEILD, the Hon. Librarian, reported that fifty-four new volumes had been added to the Library since the last meeting.

Mr. WAY said :—I am not prepared with a written report showing the progress of Section G. That is in the hands of the Secretary. But I can report in a general way that our second meeting was even more successful than the first. At our first meeting we had about fifty members present, but at our second meeting we had seventy. I am told that a large number came to the door, and seeing the crowded state of the room, went away in despair. The meeting, as far as I could judge from the expressions of those who were present,

seems to have been very successful, in the sense of being interesting and instructive, as well as inspiring. The subjects taken up had evidently in many persons created quite a new interest. While our first meeting was confined rather to the consideration of Literature, the second meeting was confined almost entirely to Art. This is gratifying evidence of how rapidly we are taking up the subjects which we intend Section G should embrace. Owing to Dr. Wigg being disappointed by a friend who should have provided him with certain materials, he preferred to hold over his paper, and an address was delivered by Mr. Archer, who spoke from a very full mind on Ruskin and Turner. It was a very interesting discourse, and evidently awakened new interest and enthusiasm in the minds of those present. The address was illustrated by a large number of Turner's drawings and sketches, and the interest was so well kept up that the meeting did not break up till half-past ten or thereabouts. I think we have every reason to congratulate ourselves on the progress made. We have no dearth of papers, as we have three or four standing over from last meeting, so I think the Society may look forward to a career of considerable prosperity and usefulness in this, its youngest Section.

Mr. E. F. J. Love read a paper "On a Proposed Gravity Survey of Australia."

The President said that we certainly seemed to be in a favourable position for making such observations, and if the work could be done in a satisfactory manner for anything like the sum of money named by Mr. Love, there would not be much difficulty in providing it. If the work were done in the way proposed, a substantial and valuable addition to our knowledge on this subject would be gained. Certainly, if it could be done at anything like the cost suggested by Mr. Love, then nothing should be allowed to hinder its being done.

Mr. Ellery said there was no doubt that the matter was of great scientific importance. Pendulums had been swung in Melbourne and some other places, but he thought the best work was done by Professor Neumeyer, who reported to this Society some years ago. He had recently heard from him as to the final results, which were for a long time in considerable doubt. The use of the pendulum leaves a considerable margin of doubt, and if an undertaking of this kind were to be made now, he would suggest that a very careful investigation

should be made into the results of pendulums now in existence. At the last transit of Venus, a party of scientific observers under Professor Harkness, brought out with them their pendulums. They were swung here, and had been swung before in several places along the Pacific line, but he had never seen any results published of those observations. He did not think it would be necessary in many places, at all events, to take any trouble about the geographical position or actual time. Nearly all the points could be got at the established Observatories, so that it would be hardly necessary for the observer to burden himself with transit instruments or anything of that kind. He thought one or two pendulums could be obtained from Kew on loan. We could get the pendulum that Professor Neumeyer used from the Hamburg Observatory. It follows, therefore, that the expense of the undertaking would not exceed the actual expense of the observer and his assistants. If once an observer has become *au fait* in his observations, they can be done very rapidly. The work done by Professor Neumeyer occupied only two hours. American observers did it in two hours. The supports of the pendulum are made so nicely now, that they have only to be set to be swung.

Mr. WHITE thought this a matter of great importance. Strange to say, attention was drawn to this matter in the early days of the colony. The first arrangement of pendulums was made here by the Spaniards, then in Port Jackson by the French Expedition in 1819. The results were not very successful. It was done in Parramatta again in 1827, more satisfactorily. The only measurements in Melbourne that he knew of were those of Professor Neumeyer and Captain Harkness. He had seen Captain Harkness four or five years ago, and he mentioned that the results were not such as to please him, and he had not published them. He thought the personal expense would be much larger than Mr. Love anticipated, although the apparatus could be obtained; and he had no doubt the resources of the Observatory would be at his disposal, and that if the matter were brought before the different Governments, Victoria at all events would lend assistance. He would like to have more observations made upon the main land of Australia, than at the coast.

Professor LYLE said that this was a subject that had interested all scientific men, from Newton's time downward. They had worked at the probability of the shape of the earth.

He thought it would be a very proper thing for the Society to try and get some kind of expedition formed to make observations, and see if they would correspond with the results obtained by Newton. Mr. Love suggested the possibility of the earth not being spheroid, but ellipsoid. He doubted very much if the gravity determination would tell us that. About practical details, he thought the expense should not exceed £300, and that sum should not interfere with the carrying out of the project.

Mr. ELLERY said that, having had some considerable experience in former times in obtaining the sympathy of our neighbouring colonists in matters of this kind, he thought we should now set to work to make some little enquiry into the matter. When it was desired to carry out the telegraphic determination of longitude, we adopted a similar course. The neighbouring colonies contributed their quota, and there was no trouble so long as the Government were satisfied that it was scientific work endorsed by scientific people. If the Society made up its mind upon the matter, we could communicate with the Home authorities as to the possibility of getting reliable pendulums. So soon as we considered the thing practical and desirable, we could apply to the Premier of the colony for the necessary assistance, and also ask the neighbouring colonies to join in the expense.

The PRESIDENT said:—As to the expense, he could corroborate what Mr. Ellery has said. He thought that there would be no real difficulty in getting the comparatively small sum of money required for such a survey, provided we could show that it was a real scientific work; and secondly, that what we propose, to do was not likely to end in a fiasco. Of course no Premier or Treasurer liked to give some hundreds of pounds and then afterwards find nothing done, but provided there were reasonable prospects of observations being made, with proper instruments and a sufficient amount of skill to ensure that the results would be reasonably accurate and comparable with results elsewhere, they would not be against such a proposal.

Mr. ELLERY undertook to write to England to learn what pendulums could be obtained.

The PRESIDENT said that he regretted to have to make the announcement to the Members of the death, since the

last meeting, of two gentlemen who had been prominent figures in times past in connection with Science in Australia. The Rev. Tenison Woods was well known for his Geological investigations. He was a corresponding Member of this Society, and his name was known in all scientific circles throughout Australia. The other name he would mention was that of Mr. R. Brough Smyth, who was Secretary to the Philosophical Society of Victoria. His name appeared as Secretary in the earliest volume. It would therefore appear that he was one of its founders. After a few years, that Society changed its name to that of the Philosophical Institute, and then became merged into the Royal Society of Victoria. Mr. Smyth published a large number of Geological maps, and also a very large and complete book on the Aborigines of Victoria, of which we had a copy in this Library. Mr. Smyth recently occupied the position of Director of the School of Mines at Sandhurst. He died at the comparatively early age of 59.

Mr. E. J. White F.R.A.S., read a paper "On Results of Longitude from Lunar Observations."

Mr. ELLERY said that, if lunar observations were more frequently made, the loss of ships would not be so great. There had not been so great an advance in the manufacture of sextants as of chronometers, but the sextant was the most valuable stand by.

The PRESIDENT said it was matter for regret that the Society could not do something to remedy the state of affairs on ships described by Mr. Ellery. If a lunar observation required even so much as ten hours solid work, it would certainly, in view of the life and property that was risked, be advisable to have it done on shipboard.

Mr. WHITE said that ten minutes' time was all that was necessary for the purpose of taking the observation. There was no power granted to any one to condemn a bad chronometer, and Mr. Ellery could not do such a thing were he asked to test one at the Observatory. He had no power to compel the ship captain to get a new one ; in fact, the captain could go to sea without a sextant or chronometer.

The Rev. J. J. HALLEY suggested that the Government might be approached on the matter, so that provision might be made to compel captains to have proper instruments on going to sea.

Mr. ELLERY said that the only manner in which attention could be called to the matter in the right quarter, would be by addressing the Marine Board here, and the Board of Trade in Great Britain. He did not think that at present it was desirable to take any step in the matter. The difficulty experienced in compelling ship owners to carry life saving appliances on ships, showed how hard it was to bring pressure to bear.

Thursday, November 14th.

The President (Professor Kernot) in the chair.

The minutes of the Meeting of October 10 were read and confirmed.

Mr. Ingamells as an Associate, and Mr. Wooster as a Country Member, were introduced to the Meeting by the President, and signed the roll.

Mrs. Riddell, Mr. J. Steele Robertson, Mr. J. Ross, Mr. L. Slade, and Mr. T. Fink, were nominated for election.

A large number of ladies and gentlemen were elected as Members or Associates, the President remarking that he did not remember having seen so long a list of names proposed for election. Most of those just elected were coming forward in connection with the new section—Literature and Fine Arts.

The Librarian's report showed the addition of eighty parts or numbers to the Library in the preceding month.

RE-ELECTION OF COMMITTEES.

The Members of the Port Phillip Biological Survey Committee were re-elected on the motion of Mr. Lucas, with power to add to their numbers.

The Members of the House Committee, on the motion of Mr. White, were re-elected.

The Members of the Royal Society on the Antarctic Committee, on the motion of Mr. White, were re-elected to act on that Committee.

The PRESIDENT said that the House Committee had very little to report. Improvements in the way of new bookcases

had been made to the building, and it would be necessary to re-appoint the Members of the Committee, so that if any small matter connected with the building required attention, it could be dealt with.

Mr. H. K. RUSDEN said that he was sorry to say that no great activity had been necessary on the part of the Antarctic Committee. A communication had been received from Norway, in reference to the proposal by Mr. Gunderson to send two ships to this side of the world. Information was required as to the particular kind of whale that inhabited the Southern Ocean. The authorities were not very precise on the point. When Ross went South in 1841–2, he saw a great number of whales, but very few of the people on board the ship knew anything of the different kinds. They observed a difference of some kind. A few years ago Mr. Musgrave, of Cape Otway, gave some information, but on the whole not enough of it was obtained to warrant a communication being sent to Mr. Gunderson. When a reply was received from the Marine Department in New Zealand, he would be communicated with.

The PRESIDENT read the report of the progress of Section G.

Mr. LUCAS, in the absence of Dr. McGillivray, gave a summary of the contents of Dr. McGillivray's paper "On Description of New or Little-known Polyzoa, Part XIII." He said that eleven new species had been discovered, and the paper was accompanied by two plates illustrating nine of them. As usual, Mr. Bracebridge Wilson's name appeared as the actual discoverer of the new species.

Mr. DENDY read a paper "On the Pseudo-Gastrula stage in the Development of Calcareous Sponges."

A discussion ensued, in which the President and Messrs. Wilson and Lucas took part.

Mr. MCALPINE read a paper "On the Transverse Section of Petioles of Eucalypts as Aids in the Determination of Species," by himself and Mr. Joseph Remfry.

Mr. LUCAS said that specialists had been enabled to judge of the species very largely by the anatomy of the plant. In many cases, the sections of the leaves were relied on. In the future, we should not have our floras described by the external forms only, but by the anatomy as well.

Thursday, December 12th.

The President (Professor KERNOT) in the chair.

The minutes of the last meeting were read and confirmed.

The Rev. Lorimer Fison and Mr. Thomas Currie (Associate) were introduced by the President to the Meeting, and signed the Roll.

The PRESIDENT announced that nominations should be made before the 1st of March next for the offices of President, Vice-President, Treasurer, Librarian, Honorary Secretaries, and six Members of Council.

The following were elected as Associates :—Mrs. Riddell, Mr. John Steele Robertson, Dr. Joseph Ross, Mr. Leonard Slade ; as Member, Mr. Theodore Fink.

Dr. NEILD, the Honorary Librarian, announced that ninety-two publications had been received during the past month.

The PRESIDENT stated that the Government had most generously increased to a very substantial extent the annual endowment to the Society, and in consequence, the Transactions would in future be prepared in an elaborate and better style than in the past. The new volume would be considerably larger than any published hitherto, and it would be issued during the ensuing month of January.

Mr. A. W. HOWITT, F.G.S., read a paper on "The Organisation of Australian Tribes."

The Rev. L. FISON said that Mr. Howitt's paper was specially important, because it showed that the aborigines of Australia—the lowest order of savages—were not only organised, but had a code of morals which was strictly observed, breaches of it rendering the person committing them liable to severe punishment. The system of group relationship, which Mr. Howitt had explained, had been found to exist not only amongst the aboriginals of Australia, but amongst the Iroquois Indians, and afterwards amongst the tribes of India. He had himself discovered its existence amongst the natives of the South Sea Islands. There were certain occasions, however, notably in Fiji, when epidemics were rife, on which certain tribes recurred to promiscuity as a means of propitiating the gods.

Mr. HOWITT, in reply to Mr. Dendy, said that promiscuity in the cases of certain Australian tribes did not appear to have

a deteriorating effect. In those tribes, he had seen men six feet high, as fine as any men he had seen in any other tribe, but the women were inferior.

Mr. Sydney Gibbons, F.C.S., read a paper on "The Illumination of Public Clocks."

This was followed by a long discussion, in which Messrs. Ellery, M'Lean, White, Coane, and Marks took part.

On the motion of Mr. Archer, it was resolved that the two biological papers on the notice paper be taken as read, viz.:

(*a*) "On the Occurrence of a Partially Double Chick Embryo," by Mr. A. H. S. Lucas.

(*b*) "On the Formation of Twins in the Hen's Egg," by Professor W. Baldwin Spencer.

LAWS.

Amended and ordered to be Reprinted 14th March, 1889.

I. The Society shall be called "The Royal Society of Victoria." Name

II. The Royal Society of Victoria is founded for the advancement of science, literature and art, with especial reference to the development of the resources of the country. Objects.

III. The Society shall consist of Ordinary Members residing within ten miles of Melbourne; Country Members residing beyond that distance; Life Members (Law XXV), Honorary Members (Law XXIV), Corresponding Members (Law LIX), and Associates (Laws XXV, XXVI, and LX), all of whom shall be elected by ballot. Members and Associates.

IV. His Excellency the Governor of Victoria, for the time being, shall be invited to accept the office of Patron of the Society. Patron.

V. There shall be a President, and two Vice-Presidents, who, with twelve other Members, and the following Honorary Officers, viz., Treasurer, Librarian, and two Secretaries of the Society, shall constitute the Council. Officers.

VI. The Council shall have the management of the affairs of the Society. Management.

VII. The Ordinary Meetings of the Society shall be held once in every month during the Session, from March to December inclusive, on days fixed and subject to alteration by the Council with due notice. Ordinary Meetings.

VIII. In the second week in March, there shall be an Annual General Meeting, to receive the report of the Council, and elect the Officers of the Society for the ensuing year. Annual General Meetings.

IX. All Office-bearers and Members of Council except the six junior or last elected Members, shall retire from office at the Annual General Meeting in Retirement of Officers.

March. Should a senior Member's seat become vacant in the course of the year, it shall be held by his successor (under Law XIII) as a senior Member, who shall retire at the next Annual General Meeting. The names of such Retiring Officers are to be announced at the Ordinary Meeting in December. The Officers and Members of Council so retiring shall be eligible for the same or any other office then vacant.

Election of Officers.

X. The President, Vice-Presidents, Treasurer, Secretaries, and Librarian shall be separately elected by ballot (should such be demanded), in the above-named order, and the six vacancies in the Council shall then be filled up together by ballot at the General Meeting in March. Those members only shall be eligible for any office who have been proposed and seconded at the Ordinary Meeting in December, or by letter addressed to one of the Secretaries, and received by him before the 1st March, to be laid before the Council Meeting next before the Annual Meeting in March. The nomination to any one office shall be held a nomination to any office, the election to which is to be subsequently held. No ballot shall take place at any meeting unless ten members be present.

Votes required.

Members in Arrear.

XI. No Member, whose subscription is in arrear, shall take part in the election of Officers or other business of the meeting.

Address by the President.

XII. An address shall be delivered by the President of the Society at either a Dinner, Conversazione, or extra meeting of the Society, as the Council may determine in each year.

Vacancies.

XIII. If any vacancy occur among the Officers, notice thereof shall be inserted in the summons for the next meeting of the Society, and the vacancy shall be then filled up by ballot.

Duties of President.

XIV. The President shall take the chair at all meetings of the Society and of the Council, and shall regulate and keep order in all their proceedings; he shall state questions and propositions to the meeting, and report the result of ballots, and carry into effect the regulations of the Society. In the absence of the President, the chair shall be taken by one of the Vice-Presidents, Treasurer, or Ordinary Member of Council, in order of seniority.

XV. The Treasurer may, immediately after his election, appoint a Collector (to act during pleasure), subject to the approval of the Council at its next meeting. The duty of the Collector shall be to issue the Treasurer's notices, and collect subscriptions. The Treasurer shall receive all moneys paid to the Society, and shall deposit the same before the end of each month in the bank approved by the Council, to the credit of an account opened in the name of the Royal Society of Victoria. The Treasurer shall make all payments ordered by the Council on receiving a written authority from the chairman of the meeting. All cheques shall be signed by himself, and countersigned by one of the Secretaries. No payments shall be made except by cheque, and on the authority of the Council. He shall keep a detailed account of all receipts and expenditure, present a report of the same at each Council meeting, and prepare a balance-sheet to be laid before the Council, and included in its Annual Report. He shall also produce his books whenever called upon to do so by the Council. Duties of Treasurer.

XVI. The Secretaries shall share their duties as they may find most convenient. One or other of them shall conduct the correspondence of the Society and of the Council, attend all meetings of the Society and of the Council, take minutes of their proceedings, and enter them in the proper books. He shall inscribe the names and addresses of all Members and Associates in a book to be kept for that purpose, from which no name shall be erased except by order of the Council. He shall issue notices of all meetings of the Society and of the Council, and shall have the custody of all papers of the Society, and, under the direction of the Council, superintend the printing of the Transactions of the Society. Duties of Secretaries.

XVII. The Council shall meet on any day within one week before every Ordinary Meeting of the Society. Notice of such meeting shall be sent to every Member at least two days previously. No business shall be transacted at any meeting of the Council unless five Members be present. Any Member of Council absenting himself from three consecutive meetings of Council, without satisfactory explanation in writing, shall be Meetings of Council. Quorum

considered to have vacated his office, and the election of a Member to fill his place shall be proceeded with at the next Ordinary Meeting of Members, in accordance with Law XIII.

Special Meetings of Council.

XVIII. One of the Secretaries shall call a Special Meeting of Council on the authority of the President or of three members of the Council. The notice of such meeting shall specify the object for which it is called, and no other business shall be entertained.

Special General Meetings.

XIX. The Council shall call a Special Meeting of the Society, on receiving a requisition in writing signed by twenty-four 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 ten days before the meeting.

Annual Report.

Auditors.

XX. The Council shall annually prepare a Report of the Proceedings of the Society during the past year, embodying the Balance-sheet, duly audited by two Auditors, to be appointed for the year at the Ordinary Meeting in December, exhibiting a statement of the present position of the Society. This Report shall be laid before the Society at the Annual Meeting in March. No paper shall be read at that meeting.

Expulsion of Members.

XXI. If it shall come to the knowledge of the Council that the conduct of an Officer, a Member, or an Associate is injurious to the interest of the Society, and if two-thirds of the Council present shall be satisfied, after opportunity of defence has been afforded to him, that such is the case, it may call upon him to resign, and shall have the power to expel him from the Society, or remove him from any office therein at its discretion. In every case, all proceedings shall be entered upon the minutes.

Election of Members and Associates.

XXII. Every candidate for election as Member or as Associate shall be proposed and seconded by Members of the Society. The name, the address, and the occupation of every candidate, with the names of his proposer and of his seconder, shall be communicated in writing to one of the Secretaries, 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. The assent of at least five-sixths of the number voting shall be requisite for the admission of a candidate. Votes required to exclude.

XXIII. Every new Member or Associate shall receive due notice of his election, and be supplied with a copy of the obligation*, together with a copy of the Laws of the Society. He shall not be entitled to enjoy any privilege of the Society, nor shall his name be printed in the List of Members until he shall have paid his admission fee and first annual subscription, and have returned to the Secretaries the obligation signed by himself. He shall, at the first meeting of the Society at which he is present, sign a duplicate of the obligation in the Book of the Laws of the Society, after which he shall be introduced to the Society by the Chairman. No Member or Associate shall be at liberty to withdraw from the Society without previously giving notice in writing to one of the Secretaries of his intention to withdraw, and returning all books or other property of the Society in his possession. Members and Associates will be considered liable for the payment of all subscriptions due from them up to the date at which they give written notice of their intention to withdraw from the Society. Members shall sign laws. Conditions of Resignation.

XXIV. Gentlemen not resident in Victoria, who are distinguished for their attainments in science, literature, or art, may be proposed for election as Honorary Members, on the recommendation of an absolute majority of the Council. The election shall be conducted in the same manner as that of Ordinary Members, but nine-tenths of the votes must be in favour of the candidate. Honorary Members.

XXV. Ordinary Members of the Society shall pay two guineas annually, Country Members and Associates shall pay one guinea annually. Those elected after the Subscriptions.

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* The obligation referred to is as follows:—

ROYAL SOCIETY OF VICTORIA.

I, the undersigned, do hereby engage that I will endeavour to promote the interests and welfare of the Royal Society of Victoria, and to observe its laws, as long as I shall remain a Member or Associate thereof.

(Signed)

Address

Date

Life Membership.

first of July shall pay only half of the subscription for the current year. Ordinary Members may compound for all annual subscriptions of the current and future years by paying £21; and Country Members may compound in like manner by paying £10 10s. Any Country Member having compounded for his subscription, and coming to reside within ten miles of Melbourne, must pay either the balance £10 10s. of the Ordinary Member's composition, or one guinea annually while he resides within ten miles of Melbourne. The subscriptions shall be due on the 1st of January in every year. At the commencement of each year there shall be hung up in the Hall of the Society a list of all Members and Associates, upon which the payment of their subscription as made shall be entered. During July, notice shall be sent to all Members and Associates still in arrears. At the end of each year, a list of those who have not paid their subscriptions shall be prepared, to be considered and dealt with by the Council.

Entrance fees, &c.

XXVI. Newly-elected Ordinary and Country Members shall pay an entrance fee of two guineas, in addition to the subscription for the current year. Honorary Members, Corresponding Members and Associates shall not be required to pay any entrance fee. If the entrance fee and subscription be not paid within one month of the notification of election, a second notice shall be sent, and if payment be not made within one month from the second notice, the election shall be void. Associates, on seeking election as Ordinary or Country Members, shall comply with all the forms prescribed for the election of Members, and shall pay the entrance fee prescribed above of Ordinary or Country Members respectively.

Duration of Meetings.

XXVII. At the Ordinary Meetings of the Society the chair shall be taken punctually at eight o'clock, and no new business shall be taken after ten o'clock.

Order and mode of conducting the business.

XXVIII. At the Ordinary Meetings business shall be transacted in the following order, unless it be specially decided otherwise by the Chairman :—

Minutes of the preceding meeting to be read, amended if incorrect, and confirmed.

New Members and Associates to enroll their names, and be introduced.

Ballot for the election of new Members or Associates.

Vacancies among officers, if any, to be filled up.

Business arising out of the minutes.

Communications from the Council.

Presents to be laid on the table, and acknowledged.

Motions, of which notice has been given, to be considered.

Notice of motion for the next meeting to be given in and read by one of the Secretaries.

Papers to be read.

Strangers.

XXIX. No stranger shall speak at a meeting of the Society unless specially invited to do so by the Chairman.

Papers to be first laid before Council.

XXX. Every paper before being read at any meeting must be submitted to the Council.

Additional Meetings.

XXXI. The Council may call additional meetings whenever it may deem it necessary to do so.

Visitors.

XXXII. Every Member may introduce two visitors to the meetings of the Society by orders signed by himself.

Members may read papers.

XXXIII. Members and Associates shall have the privilege of reading before the Society accounts of experiments, observations, and researches conducted by themselves, or original papers, on subjects within the scope of the Society, or descriptions of recent discoveries, or inventions of general scientific interest. No vote of thanks to any Member or Associate for his paper shall be proposed.

Or depute other Members.

XXXIV. If a Member or Associate be unable to attend for the purpose of reading his paper, he may delegate to any Member of the Society the reading thereof, and his right of reply.

Members must give notice of their papers.

XXXV. Any Member or Associate desirous of reading a paper, shall give in writing to one of the Secretaries, ten days before the meeting at which he desires it to be read, its title and the time its reading will occupy.

Papers by Strangers.

XXXVI. The Council may for any special reason permit a paper such as is described in Law XXXIII, not written by a member of the Society, to be read by one of the Secretaries or other Members.

Papers belong to the Society.

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

Papers must be original.

XXXVIII. No paper shall be read before the Society or published in the Transactions unless approved by the Council, and unless it consist mainly of original matter as regards the facts or the theories enunciated.

Council may refer papers to Members.

XXXIX. The Council may refer any paper to any Member or Members of the Society, to report upon the desirability of printing it.

Rejected papers to be returned.

XL. Should the Council decide not to publish a paper, it shall be at once returned to the author.

Members may have copies of their papers.

XLI. The author of any paper which the Council has decided to publish in the Transactions may have fifty copies of his paper on giving notice of his wish in writing to one of the Secretaries, and any further number on paying the extra cost thereof.

Members and Associates to have Transactions.

XLII. Every Member and Associate whose subscription is not in arrear, and every Honorary and Corresponding Member is entitled to receive one copy of the Transactions of the Society as published. Newly-elected Members shall, on payment of their entrance-fee and subscription, receive a copy of the volume of the Transactions last published.

Property.

XLIII. Every book, pamphlet, model, plan, drawing, specimen, preparation, or collection presented to or purchased by the Society, shall be kept in the house of the Society.

Library.

XLIV. The Library shall be open to Members and Associates of the Society, and the public, at such times and under such regulations as the Council may deem fit.

Legal ownership of Property.

XLV. The legal ownership of the property of the Society is vested in the President, the Vice-Presidents, and the Treasurer for the time being, in trust for the use of the Society ; but the Council shall have full control

over the expenditure of the funds and management of the property of the Society.

XLVI. Every Committee appointed by the Society shall at its first meeting elect a Chairman, who shall subsequently convene the Committee and bring up its report. He shall also obtain from the Treasurer such grants as may have been voted for the purposes of the Committee. Committees elect Chairman.

XLVII. All Committees and individuals to whom any work has been assigned by the Society shall present to the Council, not later than the 1st of November in each year, a report of the progress which has been made; and, in cases where grants of money for scientific purposes have been entrusted to them, a statement of the sums which have been expended, and the balance of each grant which remains unexpended. Every Committee shall cease to exist at the November meeting, unless then re-appointed. Report before November 1st.

XLVIII. Grants of pecuniary aid for scientific purposes from the funds of the Society shall expire on the 1st of March next following, unless it shall appear by a report that the recommendations on which they were granted have been acted on, or a continuation of them be ordered by the Council. Grants expire.

XLIX. In grants of money to Committees and individuals, the Society shall not pay any personal expenses which may be incurred by the Members. Personal expenses not to be paid.

L. No new law, or alteration or repeal of an existing law, shall be made except at the Annual General Meeting in March, or at a Special General Meeting summoned for the purpose, as provided in Law XIX, and in pursuance of notice given at the preceding Ordinary Meeting of the Society. Alteration of Laws.

LI. Should any circumstance arise not provided for in these Laws, the Council is empowered to act as may seem to be best for the interests of the Society. Cases not provided for.

LII. In order that the Members and Associates of the Society prosecuting particular departments of science may have opportunities of meeting and working together with fewer formal restraints than are necessary at the Ordinary Meetings of the Society, Sections may be established. Sections.

Names and Numbers of Sections.

LIII. Sections may be established for the following departments, viz :—

Section A.—Physical, Astronomical, and Mechanical Science, including Engineering.

Section B.—Chemistry, Mineralogy, and Metallurgy.

Section C.—Natural History and Geology.

Section D.—The Microscope and its applications.

Section E.—Geography and Ethnology.

Section F.—Social Science and Statistics.

Section G.—Literature and the Fine Arts, including Architecture.

Section H.—Medical Science, including Physiology and Pathology.

Meetings of Sections.

LIV. The meetings of the Sections shall be for scientific objects only.

Members of Sections.

LV. There shall be no membership of the Sections as distinguished from the membership of the Society.

Officers of Sections.

LVI. There shall be for each Section a Chairman to preside at the meetings, and Secretary to keep minutes of the proceedings, who shall jointly prepare and forward to one of the Secretaries of the Society, prior to the 1st of November in each year, a report of the Proceedings of the Section during that year, and such report shall be submitted to the Council.

Mode of appointment of Officers of Sections.

LVII. The Chairman and the Secretary of each Section shall be appointed at the first meeting of the Council after its election in March, in the first instance from Members of the Society who shall have signified to one of the Secretaries of the Society their willingness to undertake these offices, and subsequently, from such as are recommended by the Section as fit and willing.

Times of Meetings of Sections.

LVIII. The first meeting of each Section in the year shall be fixed by the Council; subsequently, the Section shall arrange its own days and hours of meeting, provided these be at fixed intervals.

Corresponding Members.

LIX. The Council shall have power to propose gentlemen not resident in Victoria, for election in the same manner as Ordinary Members, as Corresponding

Members of the Society. The Corresponding Members shall contribute to the Society papers which may be received as those of Ordinary Members, and shall in return be entitled to receive copies of the Society's publications.

LX. Associates shall have the privileges of Members in respect to the Society's publications, in joining the Sections, and at the Ordinary Meetings, with the exception, that they shall not have the power of voting; they shall also not be eligible as Officers of the Society. Privileges of Associates.

MEMBERS

OF

The Royal Society of Victoria.

Patron.

Hopetoun, His Excellency The Right Hon. John Adrian Louis Hope, G.C.M.G., Seventh Earl of.

Life Members.

Bage, Edward, jun., Esq., Redan-street, East St. Kilda.
Barkly, His Excellency Sir Henry, G.C.M.G., K.C.B., Carlton Club, London.
Bosisto, Joseph, Esq., C.M.G., Richmond.
Butters, J. S., Esq., Collins-street West.

Eaton, H. F., Esq., Treasury, Melbourne.
Elliott, T. S., Esq., Railway Department, Spencer-Street.
Elliott, Sizar, Esq., Were Street, Brighton Beach.

Gibbons, Sidney W., Esq., F.C.S., care of Mr. Lewis, Chemist, Bourke-Street East.
Gilbert, J. E., Esq., Money Order Office, G.P.O. Melbourne.

Higinbotham, His Honour Chief Justice, Supreme Court.
Howitt, Edward, Esq., Rathmines-road, Auburn.

Love, E. F. J., Esq., M.A., Queen's College, University.

Mueller, Baron F. Von, K.C.M.G., M.D., Ph.D., F.R.S., Arnold-street, South Yarra.

Nicholas, William, Esq., F.G.S., Melbourne University.

Reed, Joseph, Esq., 9 Elizabeth-street South.
Rusden, H. K., Esq., F.R.G.S., Ockley, Marlton Crescent, St. Kilda.

White, E. J., Esq., F.R.A.S., Melbourne Observatory.
Wilson, Sir Samuel, Knt., Oakleigh Hall, East St. Kilda.

Ordinary Members.

Allan, Alexander C., Esq., Fitzroy-street, St. Kilda.
Allan, M. J., Esq., 268 Smith Street Collingwood.

Allen, W. W., Esq., Wellington-street, Kew.
Archer, W. H., Esq., F.L.S., F.I.A., J.P., Alverno, Grace Park, Hawthorn.

Bage, William, Esq., M.I.C.E., 45 Collins-street West.
Ball, W., Esq., 61 Bourke-street East.
Barnard, F., Esq., Kew.
Barnes, Benjamin, Esq., Queen's Terrace, South Melbourne.
Barton, Robert, Esq., Royal Mint, Melbourne.
Beaney, Hon. J. G , M.D., M.R.I.A., F.R.C.S. Ed., Collins-street East.
Bevan, Rev. L. D., LL.D., D.D., Congregational Hall, Collins-street.
Bear, J. P., Esq., 83½ Collins street West.
Beckx, Gustave, Esq., Queen's Place, St. Kilda Road.
Bennetts, W. R., Esq., 180 Brunswick-Street, Fitzroy.
Blackett, C. R., Esq., F.C.S., Charlesfort, Tennyson-street, South St. Kilda.
Bowen, W. W., Esq., Collins-street West.
Bradley, R. S., Esq., Queen's College, Barkley-street, St Kilda.
Bride, T. F., Esq., LL.D., Public Library, Melbourne.

Campbell, F. A., Esq., C.E., Working Men's College, Latrobe-street.
Candler, Samuel Curtis, Esq., Melbourne Club.
Chapman, Jas., Esq., Beemery Park, Caulfield.
Clendinnen, Dr. F., Malvern-road, Hawksburn.
Cohen, Joseph B., Esq., A.R.I.B.A., Public Works Department, Melbourne.
Cohen, J., Esq., M.R.C.V.S., Tattersall's Bazaar, Exhibition-street.
Cole, Frank Hobile, Esq., M.B., Ch. B., Rathdowne-street, Carlton, Melbourne.
Cornell, Henry, Esq., Barkly-square, East Richmond, 36 Collins-street West.
Corr, J. R., Esq., M.A., Holstein House, Murphy-street, South Yarra.
Culcheth, W. W., Esq., F.R Met. Soc., 31 Temple Court, 86 Collins-street West.
Coane, J. M., Esq., care of Coane and Grant, Modern Chambers, 12 Collins-street West.

Daley, W. J., Esq., St. Kilda-street, Elsternwick.
Danks, John, Esq., 42 Bourke-street West.
Davidson, William, Esq., C.E., Melbourne Water Supply Office.
Davy, J. W., Esq., 61 Bourke-street East.
Derham, Hon. Fred. T., 4 Queen-street.
Dendy, Arthur, Esq., M.Sc., F.L.S., University, Melbourne.
Duerdin, James, Esq., LL.B., 105 Collins-street West.
Dunn, Frederick, Esq., Little Flinders-street West.

Edwards, Henry, Esq., Princess Theatre, Melbourne.
Ellery, R. L. J., Esq., C.M.G., F.R.S., F.R.A.S., Observatory, Melbourne.

Fink, Theodore, Esq., Collins-street.
Foord, George, Esq., F.C.S., Royal Mint, Melbourne.
Fox, W., Esq., Robe-street, St. Kilda.

Goldstein, J. R. Y., Esq., Office of Titles
Gotch, J. S., Esq., 236 Albert-street, East Melbourne.
Griffiths, G. S., Esq., F.R.G.S., Waratah, Washington-street, Toorak.
Grut, Percy de Jersey, Esq., E. S. & A. C. Bank, Collins-street West.
Guilfoyle, W. R., Esq., F.L.S., Botanical Gardens.

Halley, Rev. J. J., Congregational Hall, Russell-street.
Hefferman, E. B., Esq., M.D., Brunswick-street, Fitzroy.
Henderson, A. M., Esq., C.E., 9 Elizabeth-street South.
Henry, Louis, Esq., M.D., Sydney-road, Brunswick.
Hewlett, T., Esq., M.R.C.S., Nicholson-street, Fitzroy.
Hicks, Johnson, Esq., Office of Patents, Melbourne.
Howitt, A. W., Esq., P.M., F.G.S., Secretary Mines Department, Melbourne.

Inskip, Geo. C., Esq., F.R.I.B.A., St. James' Buildings, William-street.

Jackson, A. H., Esq., B.Sc., F.C.S., Villa Mancunium, Dandenong-road, Caulfield.
Jager, Ernest, Esq., North-street, Ascot Vale.
James, E. M., Esq., M.R.C.S., Collins-street East.
Jamieson, James, Esq., M.D., 56 Collins-street East.
Joseph, R. E., Esq., Electric Light Company, Sandridge-road, Melbourne.
Jennings, Newton C., Esq., C.E., F.R.I.B.A., Shire Office, Heidelberg.

Kendall, W. T., Esq., M.R.C.V.S., Veterinary Institute, Brunswick-street, Fitzroy.
Kernot, Professor W. C., M.A., C.E., University, Melbourne.

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