NOTES ON THE EMBRYOLOGY OF THE AUSTRALIAN ROCK OYSTER

(Ostrea glomerata).

By W. SAVILLE-KENT, F.L.S., F.Z.S., &c.,

Commissioner of Fisheries, Queensland.

[*Read before the Royal Society of Queensland, Feb. 14th, 1890.*]

A considerable amount of uncertainty having hitherto prevailed concerning the developmental phenomena of the Australian rock oyster of commerce (*Ostrea glomerata*), I have recently devoted some attention to this subject, and propose to submit to you on this occasion a brief summary of the results of my investigations.

It is desirable that I should point out, in the first place, that the researches that have been already conducted by European and American naturalists, with relation to the commercial oysters of the Northern hemisphere, have elicited the fact that the fertilisation and development of the oyster brood or spat is formulated on two essentially distinct plans. In the case of the most familiar European type, *Ostrea edulis*, represented by the far-famed British native and the variety so extensively cultivated on the coast of France, the propagation of the species is, as will be familiar to many present, accompanied by a condition in which the oyster is unfit for consumption, and is prohibited to be sold. This is occasioned through the circumstance that the parent oyster nurses or incubates its brood within the pallial or mantle cavity, throughout the early stages of its development, and does not liberate it until the shells of the young oysters are

fully formed. An oyster eaten during the later phases of the breeding season, appears to be full of sand or grit, this being due to the presence of the many millions of minute embryonic shells. By oyster dealers at home, two distinct spawning conditions of the oyster are recognised: the one, when the embryos contained within the mantle chambers of the parent are white and colourless, being devoid of shells, is designated the "white sickness"; and the later stage when, the shells being formed, a grey or blackish tint is imparted to the entire mass, is known as the "black sickness." The close or spawning season of the ordinary European oyster, *Ostrea edulis*, extends throughout the summer, from May to September, and is popularly defined as being represented by those months in which the letter "r" is absent.

The fecundation of the ova of the European oyster necessarily takes place within the mantle cavity or brood-chambers of the female, the fertilising fluid or milt of the male being discharged into the water, and from thence it is absorbed and brought into contact with the mature ova by the ciliary currents that exercise the ordinary respiratory and food-purveying functions in the female mollusc. This plan of propagation was until within recent years supposed to apply to all descriptions of oysters. Investigations associated with the reproductive phenomena of the American commercial oyster, *Ostrea virginiana* failed, however, to discover any trace of the brood or spat within the mantle cavities of the breeding oyster, and it was ultimately demonstrated by Dr. Brooks (1880), that both the ova and milt were simultaneously discharged into the water in their mature condition, and fertilisation being there effected, the entire development of the embryo took place independently of the parent. Such being the case the artificial propagation of the species by the commingling in sea water of the matured sexual elements was considered feasible, and was successfully accomplished by the above-named authority. In the case of the typical European oyster, *Ostrea edulis*, such a method of artificial propagation is not possible, chiefly on account of the fact that the embryos are matured within the brood-chambers of the parent in a fluid medium, containing a large proportion of albuminous matter that cannot be artificially produced. Follow-

ing upon the discovery of Dr. Brooks in connection with the American oyster, it was demonstrated by M. Bouchon-Brandeley, in the year 1882, that the small Portuguese oyster, *Ostrea angulata*, exhibited developmental phenomena which coincided essentially with those of the American species, the ova being similarly discharged into the water, where they are fertilised and developed independently of the parent. The artificial fertilisation of the ova of this species, and the investigation of the more important embryological phases of this Portuguese type, were also successfully carried out by the authority cited.

The oysters of Australia, like those of the Northern hemisphere, exhibit two distinct plans of propagation. The commercial form indigenous to Tasmania and Victoria, but now so reduced in numbers by exhaustive fishing as to be scarcely known in the market, cannot be distinguished from the *Ostrea edulis* of European waters, and is usually associated by naturalists with the same specific title, but is sometimes denominated the variety *Angasi* of the same type. The reproductive phenomena of this oyster have been personally investigated by me, and were found to coincide precisely with those of its European congener, the embryos, in like manner, being fertilised and developed within the mantle or pallial cavities of the parent. Similar phenomena have also been found by me to obtain, in association with the closely allied New Zealand mud oyster, and which is also apparently a local variety only of the same species.

The most important commercial oyster of Australia is undoubtedly the familiar rock oyster, *Ostrea glomerata*, of which Queensland enjoys the enviable position of producing the largest supplies, Moreton Bay and Wide Bay alone growing sufficient quantities not only for home consumption but also for exportation to the neighbouring colonies. The method of propagation of this oyster to which I have paid some attention within the past few weeks, is, I find, in all respects identical with that of the American commercial species, *Ostrea virginiana*. The fertilisation of the ova is brought about by their coming in contact with the milt or sperm cells in the open water, the young embryos being thus cast adrift and thrown upon their own resources from the earliest period of their existence. The artificial propagation of this species by the abstraction of the matured sexual elements, the ova and spermatozoa, and their admixture in a little sea water,

may in consequence be easily effected and yields a most interesting and instructive embryological study. The method of procedure successfully adopted in accomplishing such artificial propagation, and the more conspicuous metamorphoses through which the embryo passes before assuming the parent form, may be described as follows :—

The aid of a microscope with a magnifying power of about 200 diameters is, in the first instance, indispensable for securing the most satisfactory results. On opening a number of oysters, the cream-coloured fat-like mass near the hinge or joint of the bivalve shell represents the seat of the reproductive elements. Inserting a fine spatula into the midst of this mass a small portion may be abstracted, and spread out in a drop of sea water or the natural juices of the mollusc on an ordinary glass slip. Placed under the microscope, the ova or germs of the female oyster will be at once recognised by their ovate or pyriform contour, the separate ova having an average diameter of the $\frac{1}{500}$th part of an inch. The male elements or spermatozoa when abstracted and similarly treated, present a widely different aspect. Its separate elements are so diminutive as to appear as minute granules only under the same magnification, and a considerably higher amplification is requisite to illustrate their individual structure. This is then shown to consist of a minute bulbous head and an exceedingly slender flexible hair-like tail, the proportions between the two being much the same as that of the head and shank of an ordinary pin. After a little experience it will be found easy to distinguish the comparatively coarse granular ova from the cloudy masses of spermatozoa, when placed on the glass slip, with the aid only of an ordinary pocket lens or even the unassisted vision. The assistance of the microscope is, however, desirable to insure the most favourable results, and is altogether indispensable for tracing the further development of the embryos. In many instances it will be found, what can be recognised only with the microscope, that the ova or spermatozoa, are not sufficiently matured, or in the case of oysters purchased in the market have become deteriorated by isolation from their native element for too long a period to permit of perfect fertilisation. The conditions being satisfactory, the ova under the microscope should present a clean and evenly rounded outline, while the vitality of the spermatozoa should be manifested

by their active oscillating and vibratory movements. Should the sperm cells fail to exhibit this vitality, their admixture with the ova will prove of no avail.

In practice it will be found that the number of oysters containing the female elements or ova is greatly in excess of those producing the milt or sperm cells, the average proportion associated with many hundred examples recently examined being one male to six or seven females. The small quantity of milt that is required to fertilise a very large number of ova satisfactorily explains Nature's economy in this direction. No peculiarities of external structure exist, so far as I have been able to ascertain, that permit of distinguishing between the male and female oyster before it is opened. Healthily matured milt and ova having been successfully obtained, portions of each, the ova predominating, may be mixed in a watch-glass half full of sea water, and well stirred together. The ova, being heavier, will soon sink to the bottom, leaving the spermatozoa diffused as a cloud through the water. After an interval of ten minutes the top water may be poured off or withdrawn with a pipette and fresh supplied, and any fragments of lacerated tissue or tufts of immature milt be removed with a needle; these, if left, will decay and pollute the water. The pouring-off process should be repeated until the top water is quite clear and the bottom consists entirely of fertilised ova. If a small drop of water containing the mingled milt and ova is examined at short intervals some remarkable changes in the form and structure of the ova will soon be observed.

Almost immediately following upon the admixture of the two elements it will be found that the sperm cells are adhering in numbers by their dilated heads to the delicate capsular investments or vitelline membranes of the ova, and communicating to many of them, through the vigorous vibrations of their tail-like prolongations, a distinct oscillatory motion. It may also be observed that through the aperture of the narrower end of the capsule, known as the micropyle, several of the sperm cells have effected an entrance, and have been brought into direct contact with the body of the ovum. The fusion between the two elements that then takes place is not easy to trace, but the results arising from the union are speedily manifested. The ovum prior to fertilisation was distinguished by the presence of

a central clear area with a contained nodular structure, the two representing what are distinguished technically by the titles of the 'germinal vesicle' and 'germinal spot' or the 'nucleus' and 'nucleolus.' Shortly after fertilisation the substance of the ovum becomes opaquely granular throughout, and the germinal vesicle is no longer visible. Within the second hour a small globular protruberance will have made its appearance at the broader end of the ovum, and opposite to the micropyle. This is the so-called directive or polar cell. Quickly following upon this, the entire body-mass of the ovum becomes furrowed or constricted across the centre, and each half is seen to contain a central nucleus. The upper half, associated with the polar cell, now divides itself into two equal parts. These again split into four and next into eight, the aspect of the ovum or embryo, as it may now be correctly termed, at about the end of the third hour being that of a number of small coherent cells, superimposed symmetrically on the top of a large basal cell.

This condition of development represents an important phase in the life-history of the embryo oyster. There are now present all the essential elements out of which the perfect animal will be built up. Out of the smaller superincumbent cells all the investing membranes, tactile organs, and essential animal structures will be fashioned, and they are consequently, distinguished as the formative cells. The larger basal cell, on the other hand, represents the nutritive or vegetable element, out of which will be constructed the stomach, alimentary track, and all the appended viscera. Within from four to six hours the smaller or formative cells have so increased and spread as to completely enclose the large nutritive cell, and which in its turn now divides up and lays the foundation of the alimentary track. Fine hair-like cilia are at this stage developed upon the external surface of the embryo, and by means of which it progresses through the water in an irregular rotatory manner. The polar cell, which up to this stage had occupied a conspicuous position, now breaks loose and disappears. The metamorphoses from this point progress more slowly. From the tenth to about the fifteenth hour the general shape of the embryo is somewhat kidney or turban shaped, it having a slight depression on one side. This represents what is known to biologists as the gastrula stage, a structural phase which has been found to be common to some period in the

development history of almost every known form of animal life higher than the unicellular protozoa. In its most typical condition this gastrula embryo consists of a cup-shaped body composed of two single cell layers, the outer being built up of the animal or formative cells, and the inner one out of the nutritive or vegetable cells. The distinctive appellations of the 'epiblast' and 'hypoblast' are more commonly applied by biologists to these respective outer and inner cell layers.

After passing the 'gastrula' stage, development towards the typical organisation of the parent oyster proceeds apace. The central cavity representing the stomach opens out by an anterior and a posterior passage and apertures, which correspond respectively with the throat and mouth, and the intestine and vent. The shells make their appearance at a depression in the dorsal surface, and gradually increase in size until they enclose the entire body. Simultaneously with these metamorphoses a disc covered with powerful vibratile cilia has developed at the anterior extremity, and with the assistance of which the embryo oyster can propel itself vigorously through the water. As the shells grow larger and heavier the little oyster becomes less capable of sustaining itself in the water, and finally sinks to the bottom. This is a crucial epoch in the mollusc's existence. Should it settle upon a rock, shell, or other clean, hard substance, it attaches itself to it, and its life is assured; but should it, on the contrary, light upon soft mud, sand, or other material to which it cannot adhere, it inevitably perishes. The proportion of young oysters that find a secure anchorage in comparison with the vast numbers that are devoured, or become literally lost at sea, is necessarily infinitesimal.

The time taken by the embryo of the Australian oyster to pass through the series of metamorphoses enumerated, and to arrive at the attached or sedentary state, has been found by me, under favourable conditions, to average four days, two out these elapsing before the shells become conspicuously apparent. Permanent preparations of the ova and embryos in their various phases of development may be satisfactorily obtained by treatment, first with a 1 per cent. solution of osmic acid, and subsequent transfer to dilute glycerine, in the proportion of one-half glycerine and one-half-water. Several slides illustrating

oyster embryology are submitted on this occasion for examination, as also living examples of the embryo at a period of about four hours after artificial fertilisation. The more prominent embryonic phases enumerated in this communication are likewise diagrammatically illustrated on the accompanying sheet.

In connection with the investigation of the embryology of the Australian rock oyster recently conducted, I have been and am still carrying out a series of experiments with the view of accurately determining the influence upon the embryonic brood that is exercised by the advent of fresh water floods or other sudden changes in the salinity of the water. Some of the results already obtained are of a highly interesting and instructive nature. From a series of oysters recently purchased in the market a fully matured male and female were selected for experiment. Portions of milt and ova from these two individuals were abstracted and commingled under precisely the same conditions and placed respectively in water of three different degrees of salinity. The first admitted was placed in sea water of the full ordinary strength. In the second there were equal proportions of salt and fresh water, and in the third one part of salt water to three of fresh. As a result, the ova placed in the equal admixture of salt and fresh water exhibited active vitality and were quickly speeding on their developmental career. Of the ova placed in pure sea water but few were fructified, and these developed very slowly. Those finally placed in the water containing only a one-fourth proportion of sea water were entirely deprived of life and soon commenced to disintegrate. This last-named circumstance suffices to indicate the pernicious effect upon breeding oysters that may be exercised by heavy floods, and opens out a wide field for further investigation.

It is worthy of note, in association with the embryological details here recorded, that matured ova and sperm-cells were found abundantly developed in individual oysters with shells measuring as little as half-an-inch in diameter, and whose age would not exceed three or four months. This precocity in the reproductive faculties of the species furnishes a clue to the extraordinary rapidity and abundance with and in which the Queensland Rock Oyster seizes upon and spreads itself over every surface presented that possesses favourable conditions for its attachment.

PLATE ILLUSTRATING THE EMBRYOLOGY OF
OSTREA GLOMERATA.

EXPLANATION OF PLATE ILLUSTRATING THE EMBRYOLOGY OF *OSTREA GLOMERATA*.

Figs. 1 and 2. Unfertilized ova with investing vitelline membrane and micropyle, *a*: magnified about 500 diameters.

,, 3. Milt or sperm cells.

,, 4. Ovum with attached sperm cells, immediately preceding amalgamation and fertilization.

,, 5. Ovum from 1st to 2nd hour after fertilization.

,, 6 and 10. Consecutive metamorphoses observable within the 2nd and 3rd hours after fertilization.

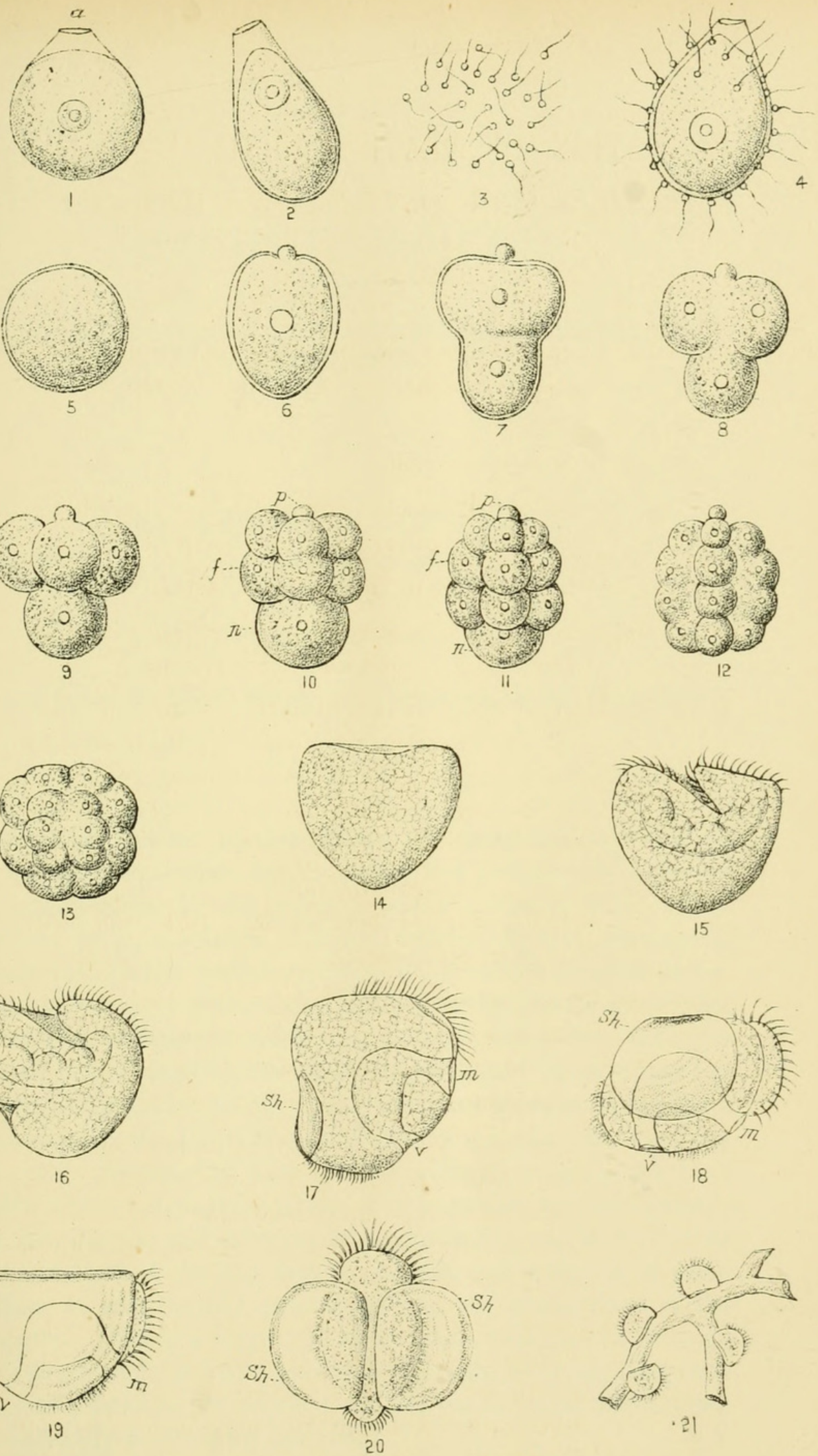
,, 11 and 13. Changes progressing within the 4th to 8th hours after fertilization, terminating in the ejection of the polar cell, *p*, and the complete investment of the larger nutritive cells, hypoblast, by the smaller formative cells or epiblast.

,, 14 and 16. Phases of the embryo, known as the "Gastrula" stage, observed between the 10th and 15th hours of development.

,, 17 and 18. Phases arrived at from within 24 to 48 hours, and in which the shells, *sh*, mouth, *m*, and vent *r*, of the perfect oyster have made their appearance.

,, 19 and 20. Lateral and dorsal aspects of an embryo, three to four days old, and in which the shells have grown to such dimensions that they entirely enclose the body when contracted; magnified about 200 diameters.

,, 21. Earliest observed attached condition of the oyster embryos or "spat," attained to within the fourth or fifth days succeeding the primary fertilization of the ovum; magnified about 50 diameters.



OSTREA GLOMERATA.

SECHIUM EDULE.

(Chayote).

ITS INTRODUCTION INTO QUEENSLAND—CULTIVATION AND USES.

By LEWIS A. BERNAYS.

(Past President).

[*Read before the Royal Society of Queensland, on 9th May, 1890.*]

The Royal Society of Queensland has signalised its career in a manner remarkable for so young and indifferently endowed an organisation, by the number and importance of its contributions to pure science. While numerically and pecuniarily weak, this Society includes among its members scientific investigators whose researches have added materially to the knowledge of various branches of science, and whose names have made for themselves a place in its ranks in older and more important centres of scientific enquiry. I should not presume to ask for a place among the contributions of such of my colleagues (as I lay no claim whatever to scientific knowledge), were it not for a belief which I strongly entertain that, in so very young a country as this, there is still much to be taught in the way of developing the resources of the soil, and by providing new objects of cultivation to add thereby permanently to the productions of the country. This is a subject in which I have taken much interest, and to which I have devoted not a little time for years past; and on such matters, therefore, I venture—with some diffidence—occasionally to speak among you.

A former Governor of Queensland remarked, on a public occasion, "that in a territory of the vast extent of Queensland we find a variety of climates, each of which is capable of bringing to perfection some particular growth or growths of animal or vegetable life. There is thus opened out an immense opportunity of usefulness before persons who are willing to address themselves to the inviting labor of adding to the productive wealth of each separate district of the colony, by means of the introduction of such novelties of ascertained value as may have only awaited the encouragement of a helping hand in order to settle down and flourish—to become acclimatised—in a thoroughly congenial latitude and soil." It is to such a novelty that I desire to ask your attention for a short time this evening.

In June, 1888, the late Sir Anthony Musgrave, whose intelligent and active interest in the development of the material resources of Queensland will be long and gratefully remembered, suggested to me the advisableness of testing the adaptability, to some part of the colony, of a food-plant well-known to him during his sojourn in Jamaica—namely, the Chocho, as it was there known in the vernacular. The plant having been described in the *Kew Bulletin*, edited by Mr. D. Morris, so long and favourably known as Director of Plantations in Jamaica prior to his appointment as Assistant Director to Royal Gardens, Kew, I wrote to that gentleman for information as to the best mode of procedure in order to procure the plant in question. This resulted, after some correspondence, in the receipt from Mr. Fawcett, Mr. Morris's successor in Jamaica, of a box of fruits of the "Chocho." There were only two alive, these by great good fortune being of distinct varieties; and having been placed in the care of Mr. William Soutter, the manager of the Acclimatisation's Society's Gardens, it goes without saying that they were nursed into vigorous growth. The plant having proved to be admirably adapted to the climate of Brisbane, and to be a useful addition to our food-plants, is, I think, worth the place in our transactions which I propose to give it.

The genus "Sechium," which seems to be peculiar to two species, derives its name from the the Greek *sekazo*, "to coop up," and that again from *sekos*, "a pen for rearing young animals," the fruit apparently having been used for fattening

hogs, although there is a host of concurrent testimony that it is largely used as a culinary vegetable by man in all places where its grows.

The "Chocho" of Jamaica (*Sechium edule*, Swartz) is known by other vernacular names in other countries. In Brazil it is "chuchu," in the French W. Indies "christophine," in Madeira "pipinella" and "chayota." From this latter locality it reaches Covent Garden Market, where it is known as "chayote"—sometimes called "chay," but this latter name is probably a mere trade abbreviation. I think the balance is in favour of "chayote," both because it is euphonious, and is the chief designation by which it is known in Europe. The chayote is a perennial cucurbitaceous plant, and a strong climber, with three to five-cleft tendrils, and a smooth somewhat stout stem, rising from a very large fleshy perennial root having the appearance of a yam. The leaves are heart-shaped, rough to the touch, and five-angled. The flowers are green or yellow, with separate male and female flowers on the same plant. The fruit in shape is like an elongated pear, about three to five inches long, covered with soft prickles, and either green or cream-coloured. There are two varieties, one having flower and fruit of a pale green, and the other with flower and fruit rather larger, cream-coloured or white. The fruit contains a single seed, like a large thin almond, situated at the very top and when ripe projecting a little and emitting roots while still on the vine.

The Chayote is now widely distributed in all parts of tropical America, in the East Indies, and in Madeira and the Atlantic Islands. De Candolle attributes its native habitat to the south of Mexico and Central America, whence it was probably transported into the West India Islands and to Brazil, in the eighteenth century.

Mr. Morris stated that in the West Indies the plant flourishes at temperatures ranging from 63 degs. to 75 degs. Fahrenheit. Experience in Brisbane proves that it fruits abundantly with a much wider range of temperature, remaining unscathed under 4 degs. of frost, while other cucurbitaceous plants blacken and succumb.

The cultivation of the Chayote presents no difficulties. A ripe fruit placed on its side, so that the incipient roots may be in contact with the prepared soil, will start into active growth in a few days. It does not do equally well, and may fail, if placed in any other position, and the seed does not bear extraction for the purpose of cultivation. The plant will also grow from cuttings, but the plan is not recommended.

The plant revels in being allowed to run over a tall bush structure of some kind, as it is a strong climber and bears most freely if unrestrained; but if circumstances do not permit this, it can be allowed to run on the surface of the ground like the annual edible cucurbits.

Under suitable conditions of climate, the Chayote fruits all the year round, increasing in productiveness after the first year from the seed. These high qualities will no doubt be modified by the character of the treatment it is called upon to encounter, and by other conditions; but a perennial plant which, under favourable circumstances, will constantly, or nearly so, give a useful and palatable food product is an important addition to the available resources of our gardens.

The average weight of the fruit at the Hakgala Gardens, Ceylon, has been found to be 3½ lbs., and this is fairly borne out by our short local experience. The number of fruits obtainable in a year from one vine will naturally depend upon the conditions and degree of care under which it is grown; but the age of the plant is an element in its productiveness, and one estimate gives from 200 to 500 fruits. Taking, however, the former number as the maximum, and the average weight as given above, a very handsome return indeed is afforded by a single plant.

The edible parts of the plant are (*a*) the fruit, (*b*) the root. The fruit is used in various ways, primarily as a vegetable. For this purpose it is best boiled for about twenty minutes, and, when soft, drained, sliced, seasoned and fried. Prepared in that way it is much like the egg-fruit with a dash of the flavour of the Jerusalem artichoke, and makes a very palatable vegetable indeed. Lunan recommends it dressed with lime-juice and spices, or made into a succedaneum for apple sauce by treatment with lime-juice and sugar. All this, however, may be left to the

Queensland housekeeper; who, having before her a substantial addition to the *materiel* for the table, will soon discover methods of cooking it in palatable form.

The root of an old plant will sometimes attain the weight of 20lbs. It resembles a yam in appearance and is very nutritious, containing a large proportion of starch, as is shown by the following analysis by Professor Herrera, given by P. L. Simmonds in his "Tropical Agriculture":—

Water	71·00
Starch	20·00
Resin soluble in water	0·20
Sugar	0·32
Albumen	0.43
Cellulose	5·60
Extractive matter Tartrate of Potash Chloride of Sodium Sulphate of lime and silica	2·25
Loss	0·20
	100·00

It is stated that during its second year the root throws off small tubers which can be removed for use, and that this operation may be repeated for six or eight years; but longer experience will be required to verify this here. The *Sechium* is also credited with being free from diseases which affect other tuberous plants.

The foregoing notes are taken from various authorities; tested by the local experience, in and about Brisbane, of one year only. When the plant has been better distributed we shall know more of its capabilities, grown at various elevations, and in climates differing in temperature and moisture; but I am strongly of opinion that in the "chayote" we have an introduction good in quality as an addition to the food productions of the country, and important from the simplicity of its cultivation and its heavy cropping capabilities. I shall watch its progress with interest, having been instrumental in its introduction, and believing that as a work of acclimatisation it will prove a signal success.

THE

Royal Society of Queensland,

With which is Incorporated

THE PHILOSOPHICAL SOCIETY OF QUEENSLAND.

FOUNDED 1859.

PROCEEDINGS

OF THE

ANNUAL MEETING,

WITH

REGISTER OF MEMBERS

FOR 1890.

Brisbane:

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1891.

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Royal Society of Queensland.

ADJOURNED ANNUAL MEETING,

22nd NOVEMBER, 1890.

The adjourned Annual Meeting for the year 1889-90 was held in the Lecture Hall of the College of Pharmacy, on Saturday, 22nd November, 1890. There were present 73 officers, members, and visitors. Amongst the members present were Messrs. F. M. Bailey, F.L.S. (President), Hon. A. Norton, M.L.A., W. Saville-Kent, F.Z.S., F.L.S., L. A. Bernays (Past Presidents), Drs. T. L. Bancroft, Rendle, R. Thompson, Lauterer, E. Hirschfield, Professor Shelton, Capt. Townley, Messrs. O'Connor, J. Thorpe, D. R. Eden, J. S. Michael, G. Watkins, P. R. Gordon, A. B. Chater, D. R. McConnell, H. J. Oxley, H. Stokes, A. Jardine, F. McFadyen, Mrs. Coxen, W. J. Ryott-Maughan, C. Woodcock, A. Armstrong, P. Fewings. Amongst the visitors present were Mesdames Saville-Kent, Hudson, Woodcock, Oxley, O'Connor, Kelynack, Jordan, the Rev. Manley Power, Dr. Wheeler, and Messrs W. H. Kelynack, Leresche, J. G. Anderson, Hudson, O'Connor, Townley and Bernays.

The President for the year 1890-91, Mr. F. M. Bailey, F.L.S., took the chair, and called upon the Honorary Secretary, Mr. W. J. Ryott-Maughan, to read the following Report:—

To the Members of the Royal Society of Queensland.

Your Council have pleasure in submitting the report of the work done during the past year.

Publication of Proceedings.

Your Council regret that they have been unable to print the many valuable papers which have been contributed by members of the Society, and other kind friends in the Southern Colonies. The heavy expense in connection with the printing of Vol. VI. for the year 1888-9, would not allow your Council to incur fresh liabilities, until the financial position of the Society would warrant it. It is hoped, however, that at an early date, the proceedings will be published regularly as heretofore. Some reference may be appropriately made at this point, to the hope entertained by the Council, that in recognition of the practical and scientific aims and achievements of the Queensland Royal Society, the Government will feel justified in according to it, some measure of that material assistance towards the publication of its transactions, that is, or has been accorded to almost every scientific society, occupying a like status, in the adjoining colonies. In this direction it may be mentioned, that the Royal Society of Victoria received up to last year an annual Government grant of £500, and this year receives £250; the Royal Society of New South Wales receives £1 for every £1 collected, and at its commencement was subsidised to the extent of £1000; the Proceedings of the Royal Society of Tasmania are printed by the Government; the Royal Society of South Australia receives £1 for every £1 collected.

It is furthermore worthy of record, that the Queensland Royal Society, in the earlier years of its existence, was likewise subsidised to the amount of £100 per annum, and which subsidy was permitted to lapse, apparently, through the negligence of the Society to energetically support their claims for its continuance.

It is a matter of much regret to the Council, that under present conditions, many valuable papers relating to Queensland science, offered to the Society by members and others, have to be refused, and are remitted for publication in the Proceedings of Societies outside Queensland.

Accommodation.

On the removal of the Department of Public Instruction to their new offices, the Honourable J. Donaldson, (Minister for Education), was kind enough to again place a room at the disposal of the Society, but it being found totally unsuitable for the objects of the Society, the Council accepted the kind offer of the Pharmacy Board, to have the use of their rooms for meetings. It is, however hoped that, the Government will, at some future date, render to the Society similar concessions, as regards suitable accommodation, as that granted to kindred societies, both at home and in the neighbouring colonies.

Sections.

On a requisition signed by Messrs. Shirley, Hedley, and Corrie, the Council's approval was granted for the establishment of a microscopical section; and it is the fervent wish of the Council to see this, as well as other sections, become important factors in furthering the Society's objects.

Ordinary Meeting of Members.

The Council are much gratified at being able to report that the attendance of members, at the ordinary monthly meetings, has been considerably increased. Doubtless, a variety in the evening's programme is in some way accountable for this fact. Eight monthly meetings have taken place, the attendances being as follows:—

1889.—August 16th	...	Members present	... 17
September 13th	...	,, ,,	... 19
October 18th	...	,, ,,	... 7
1890.—February 14th	...	,, ,,	... 13
March 21st	...	,, ,,	... 22
April 12th	...	,, ,,	... 16
May 9th	...	,, ,,	... 22
June 13th	...	,, ,,	... 17

Following the practice carried out by other societies, your Council decided to go into recess for the three hotter months, viz., November, December, and January.

Deceased Members.

Your Council deeply regret to record the death of three members, in the persons of His Honor Mr. Justice Mein, who died in Sydney; also, Messrs. Alexander Archer and J. C. Garner, who lost their lives in the ill-fated "Quetta." The two first-named gentlemen had been connected with the Society for many years, and always most heartily supported the good work the Society was carrying on.

Change of Officers.

Mr. W. Roth, B.A., who, at the last Annual Meeting was appointed Hon. Librarian, found it necessary to resign on October 14th, 1889, having been called to take up work in South Australia. Mr. Chas. Hedley, F.L.S., who was appointed Hon. Secretary at the last Annual Meeting, had to relinquish his duties in order to proceed to British New Guinea. The duties of these two offices are now fulfilled by Mr. W. J. Ryott-Maughan. Your Council has great pleasure in placing on record, their appreciation of the valuable services, collectively and severally, rendered by these past and present honorary officers.

Explanatory.

A few words are desirable in explanation of the circumstance of the annual accounts and presidential address being submitted to the members of the Society at so late a date. In consequence of the absence of the president, Mr. W. Saville-Kent, F.L.S., F Z.S., on official duties in Northern Queensland, and which absence extended over several months, and the honorary secretary, Mr. J. Ryott-Maughan, in the southern colonies, it was considered advisable by your Council to postpone the submission of these accounts together with the communication of the customary address until the president's return. Steps were at the same time taken to elect the new officers and council for the succeeding year 1890-91, the list of which is herewith appended :—

Patron:

His Excellency General Sir HENRY WYLIE NORMAN, G.C.M.G., K.C.B., C.I.E.

President:

F. M. BAILEY, F.L.S.

Vice-President:

W. SAVILLE-KENT, F.L.S., F.Z.S

Hon. Secretary and Librarian:

WM. J. RYOTT-MAUGHAN.

Hon. Treasurer:

GEORGE WATKINS.

Council:

T. L. BANCROFT, M.B.

L. A. BERNAYS.

W. FRYAR.

W. H. MISKIN, F.E.S.

J. F. SHIRLEY, B.Sc., F.L.S.

Trustees:

JOSEPH BANCROFT, M.D.

Hon. A. C. GREGORY, C.M.G., F.R.G.S., M.L.C.

W. A. TULLY, B.A.

ATTENDANCE OF OFFICERS AND MEMBERS OF COUNCIL, 1889-90.

Office.	Name.	Meetings.	Attended.
President ...	W. Saville-Kent, F.Z.S., F.L.S. ...	11	4
Vice-President	J. F. Shirley, B.Sc., F.L.S.	11	8
Hon. Treasurer	L. A. Bernays	11	2
Hon. Secretary	C. Hedley, F.L.S. (resigned April 8)...	8	7
Hon. Secretary	W. J. Ryott-Maughan (elected April 8)	3	3
Hon. Librarian	W. Roth, B.A. (resigned October 14)	3	1
Hon. Librarian	W. J. Ryott-Maughan (elected October 14, resigned April 8)	4	4
Members of Council ...	A. Corrie	11	4
	C. W. De Vis, M.A.	11	3
	W. Fryar	11	6
	W. H. Miskin, F.E.S.	11	6
	R. Mar, F.C.S.	11	1

NEW MEMBERS, 1889-90.

Ordinary Members.

Name.	Date of Election.
Mr. W. D. Percival	August 16, 1889.
Dr. Vereker Bindon	September 13, 1889.
Mr. A. E. Holland	September 13, 1889.
Mr. Buckland	September 13, 1889.
Mr. Tregaskis	September 13, 1889.
Mr. Ogg	September 13, 1889.
Mr. Coane	September 13, 1889.
Mr. Garner...	September 13, 1889.
Mr. W. Thompson	February 14, 1890.
Miss Pells	March 21, 1890.
Dr. Griffin	March 21, 1890.
Dr. Southam	March 21, 1890.
Mr. P. McMahon	March 21, 1890.
Mr. P. McLean	March 21, 1890.
Professor E. M. Shelton	May 9, 1890.
Mr. G. Pocock	May 9, 1890.
Mr. Charles F. Yeo	May 9, 1890.
Mr. A. Johnston	June 13, 1890.
Mr. H. Oxley	June 13, 1890.
Mr. H. G. Stokes	June 13, 1890.
Mr. A. E. Harte	June 13, 1890.
Dr. Ellison...	June 13, 1890.

Corresponding Members.

Name.	Date of Election.
Rev. R. Harley, M.A., F.R.S., F.R.A.S. ...	March 21, 1890.
Dr. Cockle, London	March 21, 1890.

MEMBERS RESIGNED.

Name.	Date of Resignation.
Mr. Birch	February 10, 1890.
Mr. Percival	February 10, 1890.
Mr. A. Bennett	July 22, 1890.
Mr. T. Connah	July 22, 1890.
Mr. Jas. Cowan	July 22, 1890.
Mr. Campbell	January 20, 1890.

SCIENTIFIC WORK OF THE YEAR.

No.	Title of Paper.	Author.	Date.
1	*Macro lepidoptera* of Queensland	T. P. Lucas, M.R.C.S....	Aug. 16, 1889.
2	The resins of the two Queensland species of *Araucaria*...	J. H. Maiden, F.L.S. ...	
3	On the distillation of native essential oils viewed from a commercial point ...	T. L. Bancroft, M.B. ...	,,
4	Notes on a remarkable lichen grown in connection with a new species of Sticta, with descriptions of both ...	Rev. F. R. M. Wilson...	,,
5	On genera of plants collected by Sir W. MacGregor ...	Baron Sir F. von Mueller	Sept. 13, 1889.
6	A popular description of Filaria and Hæmatomonas ...	T. L. Bancroft, M.B. ...	,,

SCIENTIFIC WORK OF THE YEAR—*(continued)*.

No.	Title of Paper.	Author.	Date.
7	Notes on the Embryology of the Australian rock oyster, *Ostrea glomerata*... ...	W. Saville-Kent, F.L.S., F.Z.S....	Feb. 14, 1890.
8	Meteorological notes... ...	Mrs. Chas. Coxen ...	,,
9	Temperature of the earth as exhibited in mines, with special reference to observations in some of the deepest mines on the Gympie goldfield	W. Fryar	Mar. 21, 1890.
10	Tea, its cultivation, manufacture, and adaptability to the climate of Queensland	J. S. Michael	Apr. 12, 1890.
11	Hydatids in Marsupials, *Echinococcus hominis* in a Marsupial	T. L. Bancroft, M.B. ...	May 9, 1890.
12	New Queensland plants ...	F. M. Bailey, F.L.S. ...	,,
13	Introduction of the "Cho-cho" into Queensland ...	L. A. Bernays	,,
14	1. Notes on Ringworm as affecting stock	T. L. Bancroft, M.B. ...	June 13, 1890.
	2. *Actinomyces*, fungus of the disease *Actinomycosis* ..	,,	,,
	3. The mite *Demodex* probable cause of mange in dogs	,,	,,
	4. The *Echinococcus hominis* from a Marsupial ...	,,	,,
15	Botanical notes on new species	J. F. Shirley, F.L.S., B. Sc.	
16	Notes on new economic entomological specimens ...	H. Tyron	
17	Notes on remarkable Queensland spiders	W. Saville-Kent, F.L.S. F.Z.S.	,

EXHIBITS AND DESCRIPTIONS.

No.	Title.	Exhibitor.	Date.
1	Various pests, animal and vegetable, which injure rose trees in the vicinity of Brisbane	H. Tryon	Aug. 16, 1889.
2	New fish, *Regalecus masteri*	C. W. DeVis, M.A. ...	Oct. 18, 1889.
3	Undescribed bird, *Amblyoris macgregoriæ*	C. W. DeVis, M.A. ...	,,
4	Luminous fungus *Agaricin*...	W. Saville-Kent, F.L.S. F.Z.S.	Feb. 14, 1890.
5	New and rare plants, Bellenden Ker	F. M. Bailey, F.L.S. ...	Mar. 21, 1890.
6	Australian *Cypræidæ*, Cowrie shells	Mrs. Chas. Coxen ...	,,
7	New plants from Bellenden Ker...	F. M. Bailey, F.L.S. ...	Apr. 12, 1890.
8	Photographs and notes on the Australian morepork, *Podargus strigoides*	W. Saville-Kent, F.L.S., F.Z.S.	,,
9	*Mimetic larvæ*, simulating Lichens on gum tree ...	W. Saville-Kent, F.L.S., F.Z.S.	,,
10	Botanical specimens, with notes	J. H. Simmonds ...	May 9, 1890.
11	New *Lepidoptera*, with notes	T. P. Lucas, M.R.C.S.	,,
12	New standard weights and measures, with notes ...	Trustees Museum, per C. W. DeVis, M.A....	,
13	Photos with notes on giant herrings, *Chanos salmoneus* and *Megalops cyprinoides*	W. Saville-Kent, F.L.S., F.Z.S.	,,

The following is a list of Societies and Public Institutions with which an exchange of publications has been arranged, or to which our proceedings are forwarded :—

Adelaide	Public Library, Museum and Art Gallery.
,, ...	Royal Society of South Australia.
Auckland	The Auckland Institute.
Batavia	Natuurkundig Tijdschrift voor Nederlandseh-Indie.
Bologna	Reale Accademia delle Scienza dell' Instituto.
Bonn	Naturhistorischen Nerein.
Boston	The American Academy of Arts and Sciences.
Brisbane	Acclimatisation Society of Queensland.
,, ...	The Museum.
,, ...	The Parliamentary Library.
,, ...	School of Arts, North Brisbane.
,, ...	,, ,, West End.
Brussels	L'Academie Royale des Sciences des Lettres et des Beaux Arts.
,, ...	Société Royale Malacologique de Belgique.
Calcutta	Asiatic Society of Bengal.
,, ...	Geographical Survey of India.
Edinburgh	Botanical Society of Edinburgh.
,, ...	Royal Society.
Frankfurt am Main	Senkenbergische Naturforschende Gesellschaft.
Geneva	Société de Physique et d'Historie Naturelle.
Genoa	Musca Civica di Storia Naturale di Genova.
Hamburg	Verein für Naturwissenschaft.
Hobart	Royal Society of Tasmania.
Kazan	Society of Naturalists of the University.
Leeds	Leeds Philosophical and Literary Society.
,, ...	Conchological Society of Great Britain.
London	Royal Geographical Society.
,, ...	Royal Society.
Madrid	Real Academia de Ciencias Extras Fisicas y Naturales.
Manchester	Literary and Philosophical Society.
Melbourne	Field Naturalists' Club of Victoria.
,, ...	Geological Society of Australasia.
,, ...	Public Library Museum, and Art Gallery.
,, ...	Royal Society of Victoria.
,, ...	"Victorian Engineer," Editor of,
Montreal	Royal Society of Canada.
New York	American Geographical Society.
,, ...	New York Academy of Sciences.
,, ...	Zoological Gardens.
Ottawa	Geological and Natural History Survey of Canada

PARIS	La Feuille des Jeunes Naturalistes.
	La Société d' Etudes Scientifiques.
PHILADELPHIA ...	Academy of Natural Sciences.
,, ...	Zoological Society.
PISA	Societa Toscana di Scienze Naturali.
ROCKHAMPTON ...	Natural History Society.
SANTIAGO DE CHILI ...	Deutschen Wissenchaftlichen Verein.
ST. PETERSBURG ...	La Société Imperiale Russe de Geographie.
SAN FBANCISCO ...	California Academy of Sciences.
SINGAPORE	Straits Branch of the Asiatic Society.
SYDNEY	Australasian Museum.
,, ...	Department of Mines.
,, ...	Linnean Society of N. S. Wales.
,, ...	Natural History Association.
,, ...	Royal Society of N. S. Wales.
TASMANIA	The Royal Society.
TOKIO	Seismological Society of Japan.
TORONTO	Canadian Institute.
VIENNA	Anthropologische Gesellschaft.
WASHINGTON	Smithsonian Institution.
WELLINGTON	Geological Survey of New Zealand.
YOKOHAMA	Asiatic Society of Japan.

Also donation of books, papers. &c., from F. M. Bailey, F.L.S.; L. A. Bernays, Brisbane; W. Saville-Kent, F.L.S., F.Z.S., Brisbane; J. Maiden, F.L.S., Sydney; Prof. Liversidge, F.R.S., F.L.S.; The University, Sydney; Baron Sir F. von Mueller, K.C.M.G., F.R.S.; W. H. Rands, Maryborough; H. C. Russell, Esq., F.R.S., Sydney; J. F. Shirley, B.Sc., F.L.S.; Dr. Thorpe, R.N., Kingston, Ireland.

W. SAVILLE-KENT, F.Z.S., F.L.S., F.R.M.S.,

President.

WM. J. RYOTT-MAUGHAN,

Honorary Secretary

ROYAL SOCIETY OF QUEENSLAND.

Dr. *Statement of Receipts and Disbursements for the Year ending July 11th, 1890.* **Cr.**

	£	s.	d.
To Balance brought forward from last Statement	19	1	9
,, Members' Subscriptions—			
1887 ... ... £2 2 0			
1888 ... ... 6 6 0			
1889 ... ... 26 5 0			
1890 ... ... 56 14 0			
	91	7	0
,, Life Membership (Hon. A. Norton)	10	10	0
,, Entrance Fees—			
1889 ... ... 6 6 0			
1890 ... . 10 10 0			
	16	16	0
,, Associates' Subscriptions, 1890	2	2	0
,, Exchange added to Cheques	0	2	6
	£139	19	3

	£	s.	d.
By Muir and Morcom, account of Printing, 1888-9	85	0	0
,, J. Brown, Printing, 1888-9	1	2	1
,, C. Edmunds, Litho.	6	0	0
,, Office Cleaner, 1889-90	4	0	0
,, Advertising	1	1	6
,, Alterations and making new Book Shelves ...	11	8	9
,, Removal Expenses	2	5	9
,, Gordon and Gotch	2	15	6
,, Petty Cash, per— £ s. d.			
C. Hedley, Postage of Proceedings, &c. 11 5 9			
W. J. Ryott-Maughan, ditto ... 2 0 0			
	13	5	9
,, Exchange	0	5	6
,, Cheque Book	0	5	0
	£127	9	10
Cr. Balance—			
Queensland National Bank ... 2 19 11			
Cheques and Cash in hand ... 9 9 6			
	12	9	5
	£139	19	3

LEWIS A. BERNAYS, *Hon. Treasurer.* WM. J. RYOTT-MAUGHAN, *Hon. Secretary.*

Examined and found correct, Brisbane, 21st October, 1890.—ALEX. J. TURNER, *Auditor.*

As against the Credit Balance of £12 9s. 5d. there is an overdue obligation for Printing of £60 3s. 2d.—A.J.T.

The adoption of the Report of the Council and the financial statement was moved by the Hon. A. Norton. M.L.A., seconded by Mr D. O'Connor, and carried.

The Chairman then called upon Mr. W. Saville-Kent to deliver the presidential address for the year 1889-90.

PRESIDENTIAL ADDRESS.

By W. Saville-Kent, F.L.S., F.Z.S., &c.,
Commissioner of Fisheries, Queensland.

Following habitual custom, it has been incumbent that your retiring president should prepare and submit for your consideration, an essay upon some subject in harmony with the general scope of the scientific Society which conferred upon him the high honour of election to its presidential chair.

The theme selected for this address, should preferably be one with which the author finds himself in a position to speak with some amount of confidence, and in this direction I trust that I have chosen one containing, or that may stimulate into life, some few germs of thought, that in the no very distant future, may bring forth a profitable harvest. The excellent address delivered by your last year's retiring president, eloquently championed the just claims of Queensland to possess a university, whereat her rising youth should be afforded the means of obtaining that systematic training for the liberal professions, which under present auspices, they are accustomed to seek in either Europe or the neighbouring colonies. Another year's circuit has served but to emphasise the necessity for the provision of these advantages, within the boundaries of the colony. The gain that will accrue from the highest and widest system of education, being readily accessible to all classes of the community, has already commanded such an extent of public recognition, that a committee has been appointed to discuss and decide upon the most efficient scheme for the establishment of such a university for Queens-

land. Another year will not elapse, I trust, before the consultations and recommendations of that committee will have taken a tangible shape.

Not the least prominent among the many subjects that will find a place in the curriculum of the newly established Queensland university, will be the science of biology. In association not only with the higher walks of the learned professions, but also, along the crowded highway of every day life, the importance of a fundamental knowledge of the laws that regulate and govern the well-being and profitable production of all animal and vegetable organisms of direct utility to man, is becoming increasingly apparent. The briefest consideration will suffice to indicate to what a considerable extent the wealth of Queensland is dependent upon its organic products, and to demonstrate the importance that attaches to their scientific comprehension and treatment. Making a rough extract from the official statistics of this colony, it is found that the animal and vegetable exports within the last few years, have been represented by an average annual value of close upon £4,000,000, or almost precisely double that of its mineral products, which is represented by something less than £2,000,000. In face of these figures, it can scarcely be questioned that the organic produce represents the backbone or mainstay of the colony's existence, and it is consequently, of the first importance that every effort should be made to foster and further develop every industry connected with it. Now in order to keep abreast of the times, in association with the profitable utilisation of nature's productions, it is incumbent at the present day, to abandon the unskilled and haphazard methods of former years, and to conduct every operation on a thoroughly scientific basis. This scientific treatment necessarily involves the possession of technical knowledge and a previous scientific training; and it is here that the rôle of the university becomes apparent. At the present time, in almost every matter threatening to seriously affect the welfare of the higher branches of agricultural, pastoral, and allied industries, the engagement of an expert from beyond the borders of the colony, is an almost unavoidable necessity.

With the inauguration of a university, all this should be changed. At the biological laboratories associated therewith, those fell diseases which periodically work so much havoc among our sheep, cattle, and other live stock, will receive special attention; and the more widely diffused knowledge that will thus accrue concerning their primary nature, causes and effects, will no doubt enable the rising generation of pastoralists to cope with, or minimise the effects of these diseases, to an extent that will represent the saving of untold wealth to the colony. With respect to the departments of agriculture, arboriculture, and forestry again, the college courses devoted to plant anatomy and physiology, with their associated laboratory work and probable experimental agricultural farms, should similarly impart or evoke information that will ensure the successful treatment of the many destructive plant diseases. And on the other hand, give an enormous impetus towards the fuller utilisation of the vast areas which at present lie waste, or which through the absence of technical knowledge, are cultivated with such crops, or in such manner, as to yield but a fractional proportion only of the profits they might be brought to realize, under scientific treatment.

The information and experience gained in the university lecture-rooms and laboratories, and which will arm the agricultural and pastoral student with the technical knowledge and acumen enabling him to successfully handle the many problems of animal and vegetable physiology and pathology he will encounter in his work-a-day life, have necessarily to be of a thorough-going and comprehensive order. Types representative of every important section of the animal and vegetable kingdoms have to be intelligently comprehended, and, if possible, practically investigated with the aid of the scalpel and microscope. The mutual relationship and interdependence of one group to or upon another, it may be as a direct means of support or it may be as a check serving to preserve the balance of power, is so subtly adjusted that unless they are studied collectively they cannot be intellegently understood. In this manner, certain of the diseases rife among cattle and other live stock are now known to be

occasioned through the presence, in their vital fluids, as parasites, of incalculable numbers of the lowest and most minute forms of vegetable life, which are distinguished by the name of Bacteria, or Bacilli. Many of these disease organisms have been successfully cultivated in biological laboratories, and, as has been demonstrated by those schools of research, of which M. Pasteur and Dr. Koch are the respective founders, these parasitic organisms are capable, under such conditions, of complete extirpation, or of such modification or attenuation, that they can be utilized for the purposes of inoculation, as in the case of vaccination for small-pox, the cattle thus inoculated being effectively protected from further fatal attacks of the disease. To rightly comprehend the true nature or physiological phenomena of this class of diseases and their effective treatment, the student has to make himself familiar with the external aspects and vital phenomena, not only of the specific form producing the disease, but of an extensive series of the minute vegetable organisms belonging, or allied to, the same order. Other diseases affecting live stock, such as those producing what is known as "staggers," and liver-fluke in sheep, are due to the presence of endo-parasitic worms, traceable in most instances to causes that can be effectually controlled, but involving the knowledge of an altogether distinct biological group. Various other diseases, such as the form of mange with which the horses of this colony have been seriously affected within recent years, require to be more extensively investigated and understood before an effective antidote can be prescribed. The disease just mentioned, represents but one out of a number, that at the present day specially invite the patient research of the biological expert.

Among the numerous organic types that engage the attention of the university student, in his laboratory course, are those which pertain to marine aquatic life. So important is a knowledge of this biological section, that in connection with many of the European and American universities special seaside laboratories, of either a stationary or transportable construction, have been established for the express purpose of providing advanced students with

opportunities for extending their area of experience, throughout the domain of marine biology. As an advance upon these less pretentious marine laboratories, have been evolved those more perfectly appointed institutions, such as the Zoological Station at Naples, or the more recently erected Marine Biological Station at Plymouth. The Naples station, founded by Dr. Dohrn, has been established for the more exclusive object of purely scientific research, and is resorted to for this purpose by scientists from every country in Europe. Oxford University, among others, pays, or until recently paid, a subsidy to Dr. Dohrn, for the privileges of having a "table" at his station reserved for the use of her students and graduates, while the same institution has been in receipt of a yearly grant of £100 from the British Association for the Advancement of Science, to assist towards the furtherance of its exclusively scientific aims. The University of Pennsylvania, in the United States, also holds a table at this Marine Zoological Station, on the same terms as that of Oxford.

At the more recently established British Zoological Stations and Marine Laboratories, and likewise at those in America, a more practical element has been introduced. In addition to the researches connected with organisms of purely scientific import much attention has been given to acquiring a knowledge of the embryology, life habits, and general economy of all fish, and other marine products having a direct economic value. At the Scottish Marine Biological Laboratory, associated with the Edinburgh University, by way of example, most valuable investigations have been conducted by Professor Cossar Ewart and others, with relation to the spawning habits of the common herring, and both here and at the Plymouth station, the turbot, sole, lobster, oysters, and other commercial products of the sea, have been subjected to scientific investigation with the object of solving the many problems associated with their reproduction, and with the object of increasing their rates and areas of distribution by artificial means. The progress made in the science of fish propagation, through the instrumentality of seaside and riverine labo-

ratories, in the United States and Canada, surpasses, as is well known, in practical results all that has so far been accomplished in the Old World.

The rôle that Australia in general, and Queensland in particular, is destined to play in the advancement of marine biological science, and in the scientific development of her fisheries, through the medium of kindred marine laboratories or zoological stations, has yet to be discovered. That Queensland, in connection with the university she is shortly promised, will sooner or later supplement her class-room and laboratory instruction with practical operations at the seaside, may be taken for granted.

In recognition of the extraordinary potentialities that are possessed by this colony, for the occupation of a prominent position in the development of Australian biological investigation, I have selected this topic, on the present occasion, as one upon which I might appropriately offer a few remarks and suggestions.

The peculiar advantages possessed by Queensland are associated with the circumstance that she possesses a line of sea-board stretching far up into the tropics, and embracing the world-famous Great Barrier coral reef, and the many islands entering into the composition of the Torres Straits Archipelago. This extensive area is rich beyond imagination, in the production of a marine fauna redundant with forms possessing both an economic and a scientific value. My professional vocations having, within the past two years, occasioned the devoting of a considerable interval of time to the investigation of the fishery products of this tropical region of Queensland, the fact just alluded to has made a strong impression, and likewise forced upon me a recognition of the grand results that might be accomplished through the medium of a well appointed zoological station and marine biological laboratory, established at a suitable location in this district. The indication of a suitable site for such an institution is a comparatively easy task. Nowhere probably, throughout the Australian littoral, does there exist a spot so naturally adapted, in every way, for the establishment and maintenance of a marine

biological observatory as that of Thursday Island. Situated in Torres Straits, at a distance of twenty miles only from Cape York Peninsula, with a climate far more temperate than that of the mainland, and constituting a weekly or bi-weekly port of call to various lines of mail steamers, it represents a perfect paradise for the naturalist. As the central depôt of the Torres Straits pearl and pearlshell and the bêche-de-mer fisheries, it takes the leading position in the colony with regard to the value of its fisheries exports, and which, with reference to the two items last named alone, represent a collective annual value of close upon £100,000.

Through the acquirement of accurate knowledge concerning the life histories and conditions of growth of these valuable commercial products, coupled with the application of approved methods of scientific culture, there is but little doubt that their existing export value might be immensely enhanced, and probably more than doubled. Experiments personally made, during the limited durations of my visits to this district, have established with absolute certainty that the mother-of-pearl shell, *Meleagrina margaritifera*, can, notwithstanding previous local assertions to the contrary, be successfully transported from the outer fishing grounds, and laid down and cultivated in inshore waters. A number of shells thus experimented upon by me on the occasion of a former visit, and deposited in a selected area on the Thursday Island foreshore, had on my return, eight months later, thriven beyond expectation, increasing in diameter to the average extent of one inch. There were, moreover, no losses to record, except in the case of a few specimens that had been ignorantly appropriated and eaten by some of the Javenese survivors from the "Quetta" wreck, who were temporarily lodged at Thursday Island.

The results obtained by these experiments, though conducted on a relatively small scale, are pregnant with practical suggestions, and are capable of exerting a far-reaching influence. They demonstrate the possibility of establishing extensive artificial beds or reserves, and through their medium of re-stocking the

large areas in Torres Straits which, in consequence of their nearness and convenience of access from Thursday Island, have been depleted and laid waste through overfishing. They have demonstrated the feasibility of bringing in all the shell alive from the outer grounds to the home stations, so that they can be opened and the pearls which they contain can be secured to the rightful proprietors, instead of, as under present conditions, constituting for all practical purposes the perquisites of the divers and boats' crews, and by whom they are surreptitiously traded away. The possible formation of artificial beds in conjunction with the existing shelling stations, or as independent undertakings, on which young shell can be laid down to grow and multiply after the manner of ordinary oysters, has been clearly established by these experiments, and the way is thus opened up to an entirely new development of the pearl-shell industry. Doubtless with that true conservative instinct that distinguishes fishermen all the world over, the great majority of those engaged in this important industry will be content to continue working along the same groove with which they are alone familiar, reaping all they can of this grand harvest of the sea from where they have not sown, and without the slightest care or compunction for the reapers that follow after. This short-sighted policy especially commends itself to those who, as in many instances, have only a passing interest to serve, and who act merely as representative managers for some absentee firm or employers. Better results may, however, be looked forward to when the boat and station owners have a direct stake in the future prosperity of the industry, and when they are empowered, as I have recommended, to obtain leases of foreshore and water areas, with secure tenure for themselves and their posterity, for the culture of pearl-shell on a basis identical with that on which the oyster fisheries are regulated. In the not very distant future it may be confidently anticipated that all of the most favourable water areas in the vicinity of Thursday Island will be utilised for this purpose, the pearl-shell industry not then being in the hands of those who have to proceed, or to send their agents, as now, to distant grounds in search of shell,

but every proprietor of a holding with a favourable foreshore having a pearl-shell bed under personal supervision.

There is yet another direction in which substantial profits may arise through the recently-demonstrated possibility of artificially cultivating pearl-shell. As already indicated the pearls, as well as the pearl-shell, will be under the control of the cultivators, in place of being smuggled away as so usually occurs under the existing conditions of the fishery. Going beyond this, I am prepared to maintain that the artificial production of pearls is by no means beyond the pale of human possibility. This suggestion as an idea is by no means a novel one; it has occurred to many minds, the chief obstacle hitherto to its practical development being the inability to obtain the living material to work upon. Knowing what the Chinese have accomplished towards the production of artificial pearls and pearl-coated images of Buddha in the fresh water mussel, *Dipsas plicatus*, it is reasonable to infer that as much or more might be achieved by the scientific treatment of the true pearl-shell, *Meleagrina margaritifera*. A little later on, I shall possibly be in a position to record something more definite upon this interesting subject, and will refer to it on the present occasion only as one that might be scientifically approached, and successfully followed up, at a marine laboratory established at Thursday Island. In addition to the large mother-of-pearl shell, many other allied species of the genus *Meleagrina* and *Avicula* occur in Torres Straits, and are well worthy of attention with relation to their pearl-producing capabilities. Many of these abound indeed throughout the Queensland coast.

The bêche-de-mer fisheries represent another important industry that might be substantially benefitted by the establishment of a marine observatory, with a trained staff of scientific investigators, at Thursday Island. Little or nothing is known as yet concerning the reproductive phenomena and life habits of the numerous commercial species of trepang or bêche-de-mer. It is quite possible that their propagation might be greatly accelerated by the application of methods of culture, discoverable only in connection with prolonged scientific investigations, at such an

institute as is now under consideration. There are many other crops to be cultivated in these northern waters, that only await the advent of the scientific labourer. Sponges of fine texture and of commercial value, are now and again brought in by the pearl-shell and bêche-de-mer fishermen from the grounds they frequent in pursuit of the special objects of their industry. Beds of this organic product, of sufficient extent to constitute a prolific fishery, would doubtless reward the investigation of experienced hands. Here again, however, science would be in a position to play an important rôle. By experiments independently conducted in the Adriatic Sea and in the neighbourhood of the Florida reefs, the possibility of scientific sponge culture has been amply demonstrated. Unshapely sponges even, may be divided up into small fragments, and planted over suitable areas, like cuttings in a garden, each fragment in the course of a year or two growing into a symmetrical sponge. This fact is of itself redundant with suggestions of what might, under scientific auspices, be accomplished on the Queensland coast line.

In close alliance with the sponges, some attention may be directed to the group of the corals. Although the red or precious coral of commerce, *Corallium rubrum*, has not yet been discovered in Australian waters, it does not necessarily follow that it is non-existent. A closely allied, if not identical species, has been obtained from the neighbourhood of Japan, and is also imported into China from Singapore, Sumatra, and the Philippine Islands. It is therefore reasonable to anticipate that this species possesses a considerable range of distribution in the Pacific Ocean. Even if not naturally existing, its artificial introduction and establishment, on the Australian coast line, would by no means be an impossible or even a very difficult task to accomplish. This coral may be seen growing luxuriantly under artificial conditions in the tanks of the Aquarium at the Naples Zoological Station, and it would only be a matter of mechanical detail to construct portable tanks, with a circulating or oxyginating arrangement for the water, combined with appliances for the regulation of the temperature, to transport the living organism

from the Mediterranean to Australia. The conditions favourable to the growth of *Corallium rubrum* are not limited to tropical waters and would be more nearly approximated in the neighbourhood of Moreton Bay or Port Jackson. Some idea of the importance of this article and its consequent worthiness of attention, may be derived from the circumstance that the annual value of this material, as obtained from the Sardinian coast is estimated at £60,000, while that obtained from the coast lines of Algeria and Tunis are estimated to represent an annual value of £100,000. Coral to the value of 20,000 per annum is also obtained from the Cape de Verde Islands. The industry, as prosecuted in the Mediterranean alone, is estimated to give employment to over 10,000 fishermen. Especial success in the fishery for coral attended some recent experiments made with the aid of diving apparatus, such as is used by the pearl-shell divers in Torres Straits, in place of the primitive engine formed of wood, in the shape of a cross, and garnished with swabs and tangles, and which is simply lowered and dragged over the surface of the coral ground. A coral of commercial value, which is occasionally collected by the pearl-shell divers in Torres Straits, is the black coral, *Antipathes arborea*. This species constitutes a special fishery at Jeddah, in the Red Sea, and commands a ready sale for the manufacture of mouth-pieces for cigars, beads, amulets and other ornaments. I am informed that the produce of the Jeddah Fishery has greatly diminished within the last few years, and that the discovery of any new sources of supply would be gladly welcomed. There is, I consider, every element in favour of the development of a profitable black-coral fishery in North Queensland waters. Like *Corallium rubrum*, this black variety is probably susceptible of artificial cultivation.

Leaving for awhile the consideration of those forms of corals that possess an universally recognised commercial value, some attention may be directed to that wealth of varieties that enter into the composition, or are intimately associated with the growth, of coral reefs, and are technically known by the title of madrepores or stony corals. It is in this direction more particularly that Thursday Island may be referred to as a paradise

for the naturalist, its immediate vicinity abounding with easily accessible forms of infinite variety of shape and colour. Concerning the aspect and structure of the living polyps, of which these corals in their more familiar bleached condition constitute but the inorganic skeletons, much yet remains to be discovered. In no locality probably, could they be so effectively studied as at a zoological station or biological laboratory established at Thursday Island. The record of a few observations of interest, relating to the structure and appearances of certain coral animals and allied organisms, personally made during my recent visits to this island and the Torres Straits district, may help towards indicating a few landmarks in the extensive field that exists here for original work by the biologist. To assist in the faithful representation of the natural aspect of the living organisms, I, on the last occasion of my visit, enlisted the aid of the camera, and thus availed myself of such opportunities as occurred of photographing the animals, as naturally expanded in the rock pools, or when transferred to suitable receptacles. The results obtained have, on the whole, been so successful that they will, I think, recommend themselves to the attention of all interested in marine biology, and lead to the extensive adoption of the method employed.

Among the examples that are more especially noteworthy, I may refer to the several photographs illustrative of what are known as mushroom corals, *Fungiæ*, in various stages of contraction and expansion.

In most standard works on corals, including Milne Edwards' "Histoire des Corallaires," J. D. Dana's "Report on Zoophytes," "U.S. Exploring Expedition," and "Corals and Coral Islands," the tentacles of the living animals of the mushroom corals are represented as being comparatively small and inconspicuous; Dana, more particularly, maintains this feature to have been true of all the living *Fungiæ* he examined, and adds, that the power in their tentacles must reside wholly in their urticating or lasso cells. From the observations made by myself and recorded by the camera, of certain of the Torres

Straits species, one is driven to the inference that Dana did not succeed in observing these corals in their fully expanded state. One species more particularly, and which seems to be identical with the *Fungia crassitentaculata* described by Quoy and Gaimard, presents, as shown by the photographs taken, a most luxurant development of the tentacular elements, and is not unlike, in general aspect, though not in colour, the large so-called Dahlia anemone, *Bunodes crassicornis*, of the British seas. The tentacles, however, of this mushroom coral, in their fully extended condition, are relatively larger than in the foregoing species, and vary in colour from a brilliant grass green to a bronze green, or dark brown hue, with distinctly inflated whitish or pale yellow tips. Other species of *Fungiæ* observed, exhibited similar structural phenomena, though the tentacles, while conspicuously developed, were of somewhat less relative dimensions than observed of *F. crassitentaculata*. Several interesting illustrations of the characteristic stalked condition of the young *Fungiæ*, are included among the photographs taken. In some instances these are attached to coral branches of various species, while in one instance, as many as ten individuals are crowded together on the disk of their defunct parent, and from which they apparently arose by a process of gemmation. At an early date, the stalks by which the young individuals are attached become ruptured and they henceforward lie freely on the sea bottom, after the manner of their parents.

Another group of corals, which is abundantly represented at Thursday Island, is the genus *Euphyllia*. The expanded polyps in this genus are exceedingly beautiful objects, being surmounted by large tufts of cylindrical tentacles, the extremities of which are knobbed or inflated, and of a distinct colour. Much variation in tint exists among separate clusters of these corals. In one species, *Euphyllia glabrescens*, the tentacles vary from a rich seal-brown to dark myrtle-green, the rounded tips being white, blue-grey, or golden yellow. In a smaller form, apparently *Euphyllia rugosa*, the tentacles are more commonly slate-grey or lilac, and the rounded tips a brilliant emerald green. An

interesting observation was made, with reference to the variation of colour that may exist among the polyps belonging to the same corallum of *Euphyllia glabrescens*, and with relation to the amount of light to which they are exposed. An example noticed was so growing that certain of the polyps projected underneath, and were completely concealed from the light by surrounding coral growths; here the tentacles were transparently white, with pale primrose-coloured tips. Where the light only partially fell on them, the tentacles were sage-green, with brighter yellow tips; while, in the fully exposed area, all the tentacles were dark brown, with deep golden terminations. Analagous illustrations of the effect on the colours of the coral animals, produced by the absence of light, were also observed by me among representatives of the genera *Mussa* and *Galaxea*, and in which the polyps were similarly bleached, after the manner of cultivated celery and sea-kale when screened from the light. Examples of *Euphyllia* in a condition of semi-extension, illustrating the characteristic structure of the polyps, were also successfully photographed.

A remarkably beautiful coral, that occurs in tolerable abundance in the vicinity of Thursday Island, is a representative of the same family of the *Euphylliidæ*, and is known to science by the name of *Pleroqyra laxa*. It consists of clusters of polyps, united in undulating linear series. As seen in their expanded state, the centres of the polyps are emerald green, variegated with brownish striæ, while the tentacles are primrose or lemon yellow, with brilliant lilac or magenta tips. In their fully extended state, the tentacles are over an inch in length, and the lilac tips are spherically inflated. When, however, only partially extended, as represented in the photographs secured, the tentacles do not exceed half-an-inch in length, and are simply terete.

One of the most interesting corals, that grows abundantly in the same district, is the form popularly known as the organ pipe or music coral, *Tubipora musica*. The species takes its name from the fancied resemblance of its corallites to the pipes of an organ. The corallum of *Tubipora* is remarkable for its deep crimson hue, while the polyps, by which it is secreted, are pale

emerald green. A very satisfactory photographic picture of this coral, in its living and fully extended state, was obtained, and is herewith submitted. It is worthy of note that the organ pipe coral belongs to a separate order, as compared with the ordinary reef-forming corals. In the corals last named, the tentacles are invariably a multiple of six, and are simple in structure, while in the organ pipe coral, and all allies of it, there are always eight tentacles only, which are feathered or pinnately branched. This peculiarity of structure is well shown in the photograph exhibited.

One other coral, that is not unfrequently obtained in the neighbourhood of Thursday Island, invites brief notice. This is the blue coral, *Heliopora cerulea*, remarkable for the circumstance that its interior substance, when broken through, is coloured a deep indigo blue. The true affinity of the coral was, to within a recent date, a matter of conjecture, and even up to the present time I have not been able to discover that the polyps have been observed in their expanded state. Professor H. N. Moseley obtained the species in connection with the Challenger expedition, and determined, from an investigation of preserved and retracted examples, that the organism was referable to the same order as the organ pipe coral, *Tubipora*, it possessing in a similar manner eight tentacles, upon which there were evidences of short, stout, lateral tubercles. This species was obtained by myself last year, in the neighbourhood of Warrior Island, in Torres Straits; but, though preserved in constantly-changed sea-water, and carefully watched for many days, the polyps refused to expand. During my recent visit to Torres Straits, I was accorded a passage to Thursday Island in H.M.S. "Rambler," and stopped for some days on the way in the vicinity of Adolphus Island, near the scene of the terrible catastrophe that befel the "Quetta." This ground the "Rambler" had been deputed to survey, and the opportunity was consequently afforded me of exploring the neighbouring coral reefs. On one of these, near the Mid-brother Rock, I again obtained specimens of the blue coral, *Heliopora*, and its investigation on this occasion produced some totally unexpected results. The surface of the corallum in

this species is perforated with cylindrical pores of two descriptions, larger and fewer ones, which, however, have a diameter of less than a millimetre, and interspersed among these, innumerable smaller perforations, that are about one-fourth of the diameter of the larger pores. Relatively considerable areas may, moreover, occur, in which the corallum, while riddled with the smaller, are entirely deficient in the larger pores. Within a few hours after bringing specimens from the reef, and placing suitable fragments in sea-water, living organisms, in the form of two slender transparent tentacles, were seen protruding from each of the smaller pores, followed by a short portion of a cylindrical semi-transparent body. The aid of a pocket lens was necessary to make out these details distinctly. At first sight it was suspected that the organisms were allied to the bitentaculate hydroid zoophyte, described many years since, by Mr. P. H. Gosse, under the title of *Lar sabellarun*, and which inference, had it proved correct, would have approximated *Heliopora* to *Millepora* and other *Hydroidea*. Following, however, the superficial examination by sections through the corallum, laying open the pores from which the tentacles protruded, the true character of their owners was revealed. It was then shown that these tentacles were the terminal appendages of a long, slender, setiferous worm, since ascertained to belong to the same family, and to be very closely allied to, *Leucodore ciliata*, a species that has been recently accredited with compassing the destruction of the New South Wales oyster beds. Hundreds of these worms were exposed to view in a section of the coral less than one inch square, and either remained ensconced in their respective tubules, or, wriggling out, fell through the water to the bottom of the glass dish, in which they were under examination. The investigation was continued, with the object of ascertaining whether any separate organisms were associated with the larger pores. These pores, however, appeared to be hermetically closed, with one or two exceptions, and in which worms, similar in aspect to, but of larger size than those inhabiting the smaller pores, were seen protruding from their orifices. It appeared reasonable,

under these circumstances, to anticipate that these larger pores probably represented the brood chambers of the adult worms, and that the entire corallum was built up by the worms that had been placed so conspicuously in evidence. It is desirable that I should remark at this point that I was at the time unaware of the Alcyonarian interpretation, that had been associated with *Heliopora* by Professor Mosely. The subject was one to which I had not given systematic attention for some years, and I retained merely a dim recollection that the living zooids of the organism had not yet been exhaustively examined. A brief summary of the results of my examination of this coral was accordingly almost immediately forwarded to the scientific journal, "*Nature*," to be followed later by fuller systematic details.

Meanwhile, a specimen of the *Heliopora* was placed in a small coral pool at Thursday Island, and was examined from time to time, as the tide and other engagaments permitted, during my visit, for the detection of any new developments. Up to the close of five weeks from the day that the specimen was first collected, no alteration was noticed in the external aspect of the coral. The worms, as previously observed, continued to manifest the same state of activity, protruding and extending their tentacles on all sides from the smaller pores, in search of food.

The afternoon before leaving Thursday Island, a last visit was paid to the coral pool, when to my no small astonishment, zooids, each with eight pinnate tentacles, were seen protruding from the larger pores. The fact was not at the time actually realised, that these were alcyonoid polyps; there are also pinnately tentacled annelids or worms, and this circumstance justified the conjecture that they probably represented the matured growth of the undoubted worms which inhabited the more numerous smaller pores. On raising the specimen nearer to the surface of the water, for more careful examination, the animals retreated again into their respective cells, and were seen no more in the living state. Other engagements prohibited the further investigation of the organism on this occasion, and it was placed in spirit for future examination. I have recently satisfied myself that Pro-

fessor Moseley's interpretation of the Alcyonarian nature of the zooids, associated with the larger pores, is correct. The fact still remains established however, that the exceedingly more numerous smaller pores, are inhabited by a worm allied to *Leucodore*. To what, if any extent, these annelids contribute to the formation of the corallum of *Heliopora*, or to the moulding of its characteristic porous structure, remains to be discovered. As so far investigated, the coral is shown to represent a most interesting example of what is known as "commensalism," or the sharing of a common residence, by two entirely distinct organisms. Much remains yet to fully elucidate the precise relationship that subsists between the two organisms, associated together in *Heliopora cerulea*, as also to make known their developmental histories, and respective histiological details. I propose now, to leave this coral as one among the many attractive lures, calculated to attract the biological student to the marine laboratory, I hope to see established in the near future, at Thursday Island.

While on the subject of commensalism, a passing reference may be made to one or two additional instances of this strange natural phenomenon that attracted my attention in the same district. Among the reefs in the neighbourhood of Thursday Island, are some enormous sea anemones, having not unfrequently an extended diameter of at least two feet, and apparently referable to the genus *Discosoma*. One of these has frequently associated with it a fish, about three inches in length, of a brilliant vermillion hue, with three broad white crossbands, and which I have identified with the *Amphiprion percula* of Lacepede. This fish takes up its abode within the gastric cavity of the anemone, and into which it swims back for refuge after having been dislodged with a stick. In Day's "Fishes of India," an example of the species is described as having been obtained from the stomach of a sea-anemone, the inference being, however, that it found its way there accidentally, and simply as an article of food. No indication concerning its interesting commensal habits is given, either here, or in Macleay's "Fishes of Australia," where it is also recorded.

In a second species of sea-anemone, allied to the one providing board and lodging for the *Amphiprion*, but of rather smaller size, and having the tentacles represented by globular bead-like prominences, I found a singular form of prawn associated in a similar manner. This species was, however, more common in the neighbourhood of Tud, or Warrior, Island. This prawn, which I have not yet had an opportunity of identifying, was further remarkable for being coloured red and white, after the manner of the fish just described. These hues in the two organisms, no doubt, fulfil some important function in the economy of the host or guest, or probably of both. Possibly, it may be that their brilliant colours attract the notice of other predatory fish, and which, on rushing to seize an apparently easy prey, fall victims themselves to the passively expectant sea-anemones. The anemones' guests would thus, in return for secure and comfortable lodgings, enact for their hosts the parts of very effective baits. Among the sea-anemones of the Torres Straits district, noteworthy for their intrinsic beauty, reference may be made to a form frequently found rooted in the sand among the coral pools, and in which the tentacles, which are twenty-four in number, are delicately subdivided, like the fronds of certain ferns. A highly characteristic photograph of an example of this species, of the natural size and in its fully extended condition, was secured. It it apparently referable to the genus *Thalassianthus* of Leuckart.

A subject that could be studied very effectively in connection with a Zoological Station established at Thursday Island, and one that is intimately connected with both practical and scientific interests, is that of the formation and growth of coral reefs. Next to nothing is as yet known concerning the individual rate of growth of the numerous and extensively diverse species of madrepores, that contribute extensively towards the composition of this submarine architecture, and it is only through investigations prosecuted in a persistent and systematic manner, and as they would be under the auspices of such an institution as is here advocated, that anything approaching a comprehensive knowledge of this very complex subject can be acquired. Some of the reef-

forming corals undoubtedly increase—as compared with others—at a greatly augmented ratio, in consonance with their structure and their individual conditions of environment. To arrive at an exact knowledge of their specific peculiarities in this respect, living coral masses must be selected and carefully measured from time to time, and their bearings recorded with reference to other corals growing on the same reef. As an experimental step towards the accomplishment of the investigations suggested, I availed myself of the opportunity afforded at Thursday Island, of making a few observations regarding the dimensions and relative proximity of the coral on certain of the most easily accessible reefs, and which observations may subserve as a basis for more systematic investigations in the same direction. In this manner an isolated portion of the reef, on the extreme edge of Vivian Point, Thursday Island, as exposed by the low spring tide early in the month of June, was measured off, and the dimensions and relative positions of the various descriptions of corals growing on it carefully recorded. The substratum of this isolated point of the reef consists of a dense mass of *Porites*, which measures 19 feet in its largest diameter. The several descriptions growing upon it, and whose dimensions have been taken, are referable to the several genera—*Madrepora*, *Pocillopora*, *Meandrina*, *Mussa*, and *Symphyllia*. An adjoining coral block is a grey-green *Astrea*, measuring 8 feet 2 inches across its longest axis. A channel, exactly 2 feet wide in its narrowest point, separated these two coral blocks at the date of measurement. A rough outline plan of the positions and measurements recorded is herewith submitted. It will be an easy task, with the aid of this plan, to ascertain from time to time the extent to which the several coral masses have enlarged their dimensions. The same system of registration is capable of application on an extended scale, throughout considerable areas in the vicinity of Thursday Island, and would be productive of valuable results. The most unerring and efficient assistant in mapping out the salient characters, dimensions, and relative positions of coral growths is, no doubt, the camera. This instrument was somewhat extensively utilised

by me for this purpose, both at Thursday Island and various stations connected with the Great Barrier System as far south as Bowen. A reference to these photographs obtained (exhibited) will convey a very tolerable idea of the aspect of various descriptions of coral reefs and coral growth, as exposed to view at extreme low spring tides. The element of colour, however, is the one thing wanting to render the imagery complete. As will be observed, separate varieties of corals predominate in the different views. One of these represents an almost unbroken field or forest, many acres in extent, of a branching *Madrepora*, coloured brown with white or pale yellow tips. In another, a corymbese form of the same genus—*Madrepora*—tinted a dull green with yellow terminations, forms encrusting masses throughout the landscape. Large massive *Astreas*, *Symphyllias*, and *Meandrinas* enter most extensively into the composition of a third series, while a fourth will be found to contain a commingling of species too extensive for enumeration, and presenting, as seen in a state of nature, a variety of form and colour challenging comparison with that of the gayest flower bed.

From a practical point of view, the acquisition of reliable data concerning the rate of growth of coral reefs and of their component corals is of considerable import. There is strong reason for suspecting that a large portion of the reef-forming species increase in dimensions at so appreciable a rate, that waters in the coral seas surveyed and declared safe for navigation, twenty years ago or more, may now contain many hidden dangers arising from the upward growth of isolated or accumulated coral masses. The true nature of the submarine obstacle upon which the ill-fated "Quetta" came to an untimely end, has not yet been determined, though the probabilities are that it is a pinnacle of rock capped with a continually upward growing coral mass, that has within recent times been brought to within striking distance of the keels of deeply laden vessels. That such phenomena are in course of progress was moreover substantially proved by H.M.S. "Rambler," during her recent survey in search of the Thales rock in the direction of the Booby Lightship, to the north west of Thursday

Island. Several uncharted shallow patches were then discovered, and a professional pearl-shell diver being employed to investigate their nature, ascertained that they consisted of recently formed and growing coral. These patches are somewhat out of the accustomed track of the ordinary mail steamers, and are at present of insufficient altitude to constitute a danger to passing shipping. It is anticipated, however, that within a few years' time, they may so increase in proportion as to fall within this category, and I have reccommended that their position should be marked, and a periodical investigation made, in order to determine the rate of growth and altitude of the corals of which they are composed.

Apart from the vital processes by which reefs and their component corals are continually adding to their bulk, there can be but little doubt that a slow motion of upheaval is progressing throughout the region of Torres Straits and the great Barrier system, and this too must tend towards rendering the older charts untrustworthy. The coral reefs volunteer their own evidence upon this point. At many stations throughout this region, the circumstance may be noted that large expanses of dead coral intervene between high water mark and the living banks. This dead coral here referred to, is not the broken *débris* that has been cast up by storms, such as commonly exists all along extreme high water mark, but occurs at a lower level *in situ* as it originally grew, and is only lacking in vitality to distinguish it from the living reefs. The Albany pass, between Cape York and Albany Island, yields a prominent illustration of this phenomenon. On either side of the passage there is a fringing coral reef, the living inner margin of which, composed chiefly of a branching Madrepora, is only exposed at the lowest spring tides. Immediately adjoining this living bank, between it and the foreshore, there is a belt of the same species of coral, but entirely dead and brittle, like rotten ice, to walk upon. Within a few more years this dead belt will no doubt be broken up, by the action of the waves and chemical disintegration, and be added to the existing inshore area of coral mud and *débris*. An examination of the circumstances that have brought about the present

condition of the reef, show that this dead belt of coral is now exposed to atmospheric influences, which are antagonistic to its growth, with every ordinary spring tide; while the living coral, as before observed, is only visible above the water at the exceptional or lowest springs At the period that the inner belt of dead madrepora was alive, and which from its state of preservation cannot be long ago, it must have grown at a similar lower level as that now living, and nothing but the general upheaval of the area on which it throve can logically explain the fact of its decadence. The fringing reef off Magnetic Island, near Townsville, presents closely analogous phenomena. Dead bivalve shells of large size, such as *Tridacnas* and *Pinnas*, also occupy their original positions here, in close contiguity to the dead corals. Yet more substantial evidence of the upheaval in this district was afforded me, by a station holder on Magnetic Island, and by whom I was informed that, within the time he had been located there, a very perceptable change had taken place in the small bay facing his property. In former years boats could approach the landing place at all tides, excepting very low springs, whereas now it was not possible to bring a boat in at even ordinary low tide. The shallowing of the water could not be accounted for by the silting-up of the bay, there being no fresh water flow into it, while the rocky bed of the bay itself had apparently been raised to a higher level. The instances now recorded might easily be multiplied. Sufficient have, however, I think, been adduced to indicate how extensive a field for exploration exists in North Queensland, with relation to the growth and composition of coral reefs, and with regard to the geodic phenomena now in course of progress and influencing their development. Thursday Island, as previously suggested, would constitute a most suitable basis for the inauguration of a thoroughly scientific investigation of this very important subject.

To enumerate one tithe of the forms of animal life of economic or scientific import, as yet unnoticed, that would invite attention in connection with a zoological station established at Thursday Island, would be exceeding the object of this address, and the

limits of your patient hearing. It will suffice to observe, that every animal group, from the lowest *Protozoa* to the highest, is represented in the Torres Straits district, by forms of special interest to the biologist. It is not even necessary to except from this category the crowning work of creation—the genus *Homo*. As has been proved by the excellent work recently accomplished by Professor Haddon, with reference to the customs and folk lore of the various tribes inhabiting the Torres Straits Islands, in the neighbourhood of Thursday Island, the anthropologist will also find here a mass of the rarest material for investigation.

One small *bonne bouche* I have reserved for the termination of this discourse. The delicacy known as *Palolo* is probably not unknown to many Queenslanders. It is a small marine worm, allied to the genus *Nereis*, that at a certain season of the year appears in vast shoals on the surface of the sea, in the vicinity of Samoa, Tonga, Fiji, and other of the Pacific Islands, and is regarded by the natives as one of the daintiest luxuries that their territories produce. The epoch of its appearance is reported to be confined to two days only, in the months of October and November, and these being the day before and the day upon which the moon enters her last quarter. In anticipation of the forthcoming feast, the natives assemble in numbers, the night previously, at the localities among the reefs where the *Palolo* is to be obtained most abundantly. At dawn of day on the following morning the worms make their appearance in countless myriads, sport on the surface of the water for two or three hours and then mysteriously disappear. On the second day, they appear at the same time in even greater quantities than on the first one, and are ladled into the canoes with the hands, nets, baskets, bowls, or any other available utensils. They are eaten both raw, and tied up in bread-fruit leaves and baked, while large quantities are sent inland by way of barter, or as presents to those who are unable to take part in the fishery.

I am by no means beyond hope that *Palolo* may become a Queensland standard dish. Soon after daybreak, on one of the reefs at Thursday Island,—I might intimate, that it is the early

bird only that gets the worms, both literally and metaphorically in this case,—I witnessed, in October last year, an assemblage of *Nereids* on the surface of the water, which, though of somewhat smaller size, resembled in form, and manifested all the peculiar movements, decscribed of the *Palolo*. In like manner, they also, within a few hours, entirely disappeared from view. By a close examination of these worms disporting upon the surface of the water, and also isolated in suitable receptacles, and with the aid of the microscope, I was fortunate in discovering the *raison d'être* of their early revels. It was in fact, their general wedding morn, and these their wedding junkettings. Each worm was laden with ova or milt, and which was discharged in little thin milky streams, one from each side of the body, as they swam through the water. The reproductive elements commingling under these conditions were fertilized after the manner of the spawn of certain fishes, such as the *Gadidæ* or cod tribe. It may be taken for granted, that the periodical appearance of the Polynesian *Palolo* at the surface of the water is similarly associated with the animal's propagation. Concerning the Thursday Island variety, it is well worthy of further investigation from both a scientific and gastronomic point of view. Premising a happy combination of the two, we may look forward, in the not very distant future, to a nineteenth century revival of the "Diet of Worms" at the Thursday Island Zoological Station, and which shall be annually discussed by the ministry of North Queensland, with all the dignity and decorum of a Greenwich whitebait dinner.

In conclusion: the keynote of this brief address, viz., the establishment of a zoological station or biological laboratory at Thursday Island, will not, I trust, die away without wakening up some sympathetic chord or chords, that will be in such full harmony with the aspirations and exigencies of the times, that the institution shall become an accomplished fact. The mainstay of such an institution should, no doubt, be the Queensland University. It would be one, however, that should command the support of every Australasian scientific society, and more

especially that of the Australian Association for the Advancement of Science, and from whom, when the time is ripe, material assistance may, no doubt, be depended on. The Queensland Royal Society will also, I trust, when that day arrives, be in the position to take a leading part in the establishment and maintenance of an institution capable of yielding the highest practical and scientific results, and of which, moreover, it will possess some claim for recognition as having given birth to the germ of its initiation.

The President (Mr. F. M. Bailey, F.L.S.) remarked that the address that had just been delivered was one of the most interesting he had ever been privileged to listen to, and expressed the hope that Mr. Saville-Kent would favour the Society with many more papers of a similar character.

Mr. L. A. Bernays, in moving a vote of thanks to the retiring President for his address, said that if the ladies and gentlemen present had listened to it with the keen interest that he (Mr. Bernays) had, they must have been largely impressed with the advantage of having in the colony a gentleman of Mr. Saville-Kent's scientific attainments. His paper had shown that not only was he a scientist in the technical sense of the term, but one who could explain his investigations in such a manner that they were interesting and readily understood by the common and non-technical mind.

Mr. Palmer, M.L.A., seconded the motion, and stated his concurrence with the views of the mover in respect to the address. The more scientific portions of it were highly interesting, but it was the practical way in which the subject was dealt with that impressed his mind. Unless science was addressed to the practical part of life in the colony, it would not be greatly taken notice of, for this was a utilitarian age. One difficulty in connection with the establishment of a university in Queensland was the fear that it would not beneficially affect matters practical. But there was no doubt that Mr. Saville-Kent's suggestion as to the advisableness of establishing a

Plate N° I.

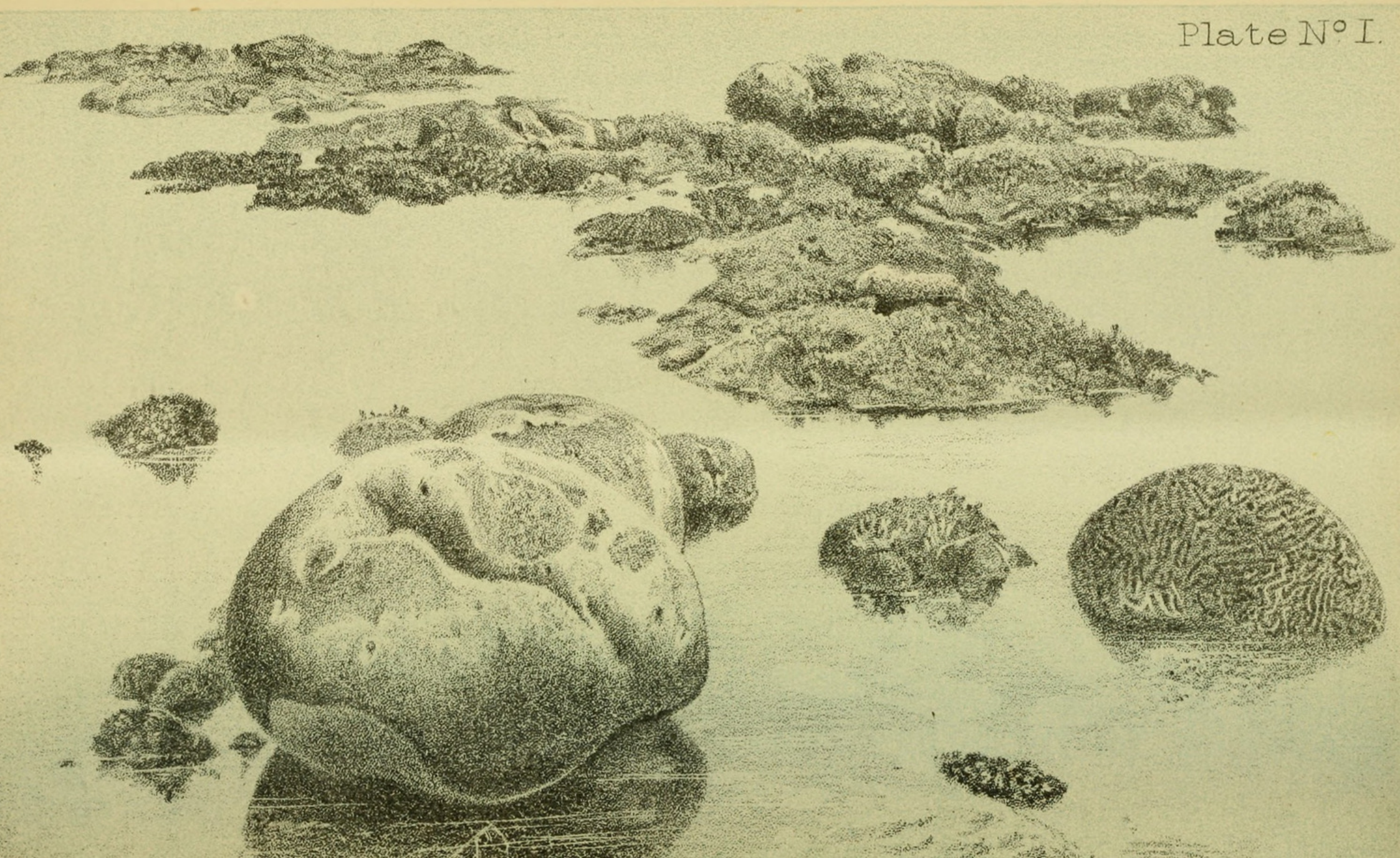
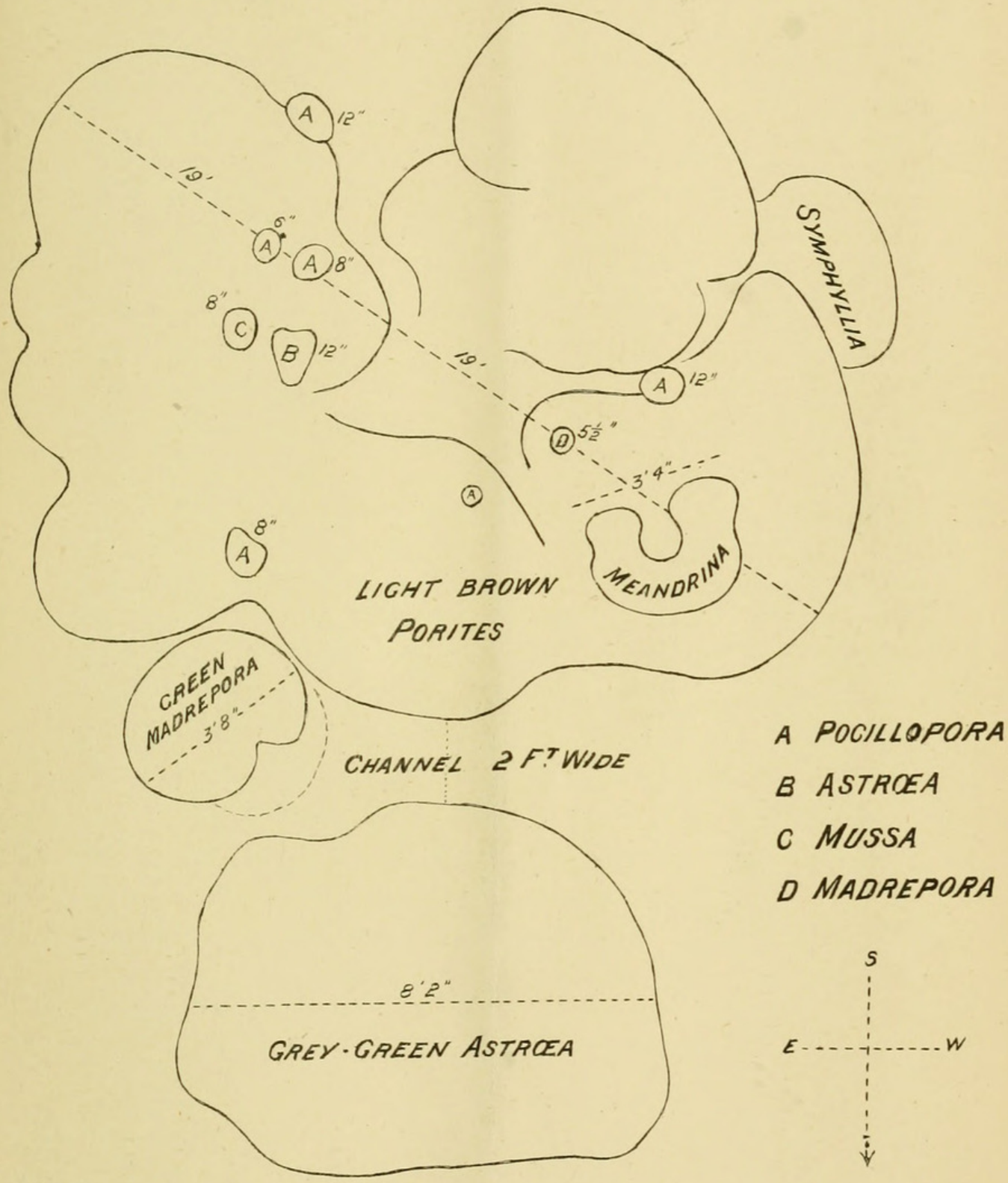


Plate N° II.



GROUND-PLAN OF LIVING CORAL BLOCKS AT THE EXTREME END OF VIVIEN POINT, THURSDAY ISLAND. AS EXPOSED AT LOWEST EBB OF SPRING TIDE. JUNE 9TH 1890.