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REPORT ON SPONGES FROM THE COASTAL BEACHES OF
NEW SOUTH WALES.

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INTRODUCTORY NOTE.

[IN August of last year (1900), the Trustees received from the Fishery Commissioners a very large donation of Sponges from the coast of New South Wales. The collection was made by the various Inspectors of Fisheries stationed on the sea-board, and the object in view was to ascertain the number suitable for commercial purposes, or that might be rendered suitable by cultivation.

After Mr. Whitelegge had made a preliminary examination, I became so convinced of the high importance of the suggested investigation, that I recommended he should discontinue the work on which he was at the time engaged—the description of the Crustacea of the “Thetis” Trawling Expedition, in itself a highly important piece of work—and solely confine his attention, for the time being, to the elaboration of the Sponges in question; this was at once approved of.

Throughout his labours I was kept well informed of the difficulties Mr. Whitelegge encountered, and on several occasions have consulted with him on intricate and debatable points. To arrive at anything like a satisfactory result, no other method than that adopted by him would have been successful. At the inception of the undertaking neither of us for a moment foresaw the amount of labour or trouble that the investigation would entail, through the unsatisfactory nature of previous researches on the Sponges of New South Wales.—R.E., Jnr.]

THE collection consists of about six hundred and thirty specimens; of these forty belonged to the commercial class, representing about twelve species and varieties, seven of which may be regarded as having an economic value.

In Dr. von Lendenfeld's Monograph of the Horny Sponges,¹ there are sixty-one species and varieties enumerated under the genera *Euspongia* and *Hippospongia*, both of which furnish the sponges of commerce. Of the sixty-one forms, thirty-five are recorded as occurring in Australasian waters, and seventeen of these are recorded for New South Wales; the remainder are chiefly confined

¹ Lendenfeld—Mon. Horny Sponges, 1889.

to North and West Australia. Of the thirty-five forms mentioned, six are identical with the bath sponges usually sold in Sydney; three of which are stated to occur on the New South Wales coast. These are as follows:—*Euspongia discus*, D. & M.; *E. zimocca*, Schulze; and *Hippospongia equina*, var. *elastica*, Lendenfeld. To these may be added *Euspongia illawarra*, sp. nov.; *E. irregularis*, var. *areolata*, var. nov.; *E. irregularis*, var. *silicata*, Lendenfeld; *E. irregularis*, var. *dura*, Lendenfeld; and *Hippospongia mollissima*, Lendenfeld. These eight forms are all represented in the collection except *E. zimocca*, Schulze; the first three can be purchased at any dealer's store in Sydney, and the remaining five are fairly common on the coast. Of the latter, from an economic point of view, *Euspongia illawarra* is the most important, being quite equal, if not superior, to many of the kinds used for domestic purposes. The texture is soft, elastic, tough, and durable, and the main fibres are entirely free from foreign bodies, such as sand grains and spicule fragments, which are invariably present in fibres of the imported bath sponges. In Dr. Lendenfeld's tabular lists enumerating the contents of the main fibres, only four out of a total of sixty-one forms are given as being free from foreign bodies, but these are not noted as being of economic value:—

Euspongia irregularis, var. *areolata*, var. nov.—This is moderately tough, soft, and highly elastic, but it is very irregular in habit, and only a small proportion of the specimens could be utilized for domestic use.

E. irregularis, var. *silicata*, Lendenfeld.—This variety is very tough, rather hard, and strongly elastic; but, notwithstanding its hardness, it would be highly valuable for the washing of vehicles and for use in the stable.

E. irregularis var. *dura*, Lendenfeld.—This form is usually very hard, but many of the larger flabellate examples are fairly soft, very tough, and they would be suitable for many purposes, the texture being very even, close, and fine.

Hippospongia mollissima, Lendenfeld.—This species is about equal or slightly superior to *H. equina*, var. *elastica*, in value, being somewhat closer and finer in texture.

It is thus evident that at least eight species and varieties, which are valuable commercially, occur on our coast; and if systematic investigation were instituted, no doubt many other forms of equal or superior value would be discovered. It must be remembered that the Sponges herein dealt with were obtained on the various beaches along the coast, specimens that had been washed ashore during heavy gales, and in many cases water-worn or dried with a considerable proportion of the animal matter remaining around their fibres, which has the effect of rendering them hard and very often incompressible.

It will be seen from the preceding remarks that there are certain commercial sponges in our coastal waters, and that others are procurable from North and West Australia; possibly a supply might also be obtained from the various Pacific islands.

In prospecting for useful sponges, many preliminary details would have to be carefully attended to: such as ascertaining the best localities for obtaining them, the habit, size, and colour, and the depth and situations in which they occur. If a favourable sponge ground were located, it would be necessary to select a series of living examples, some for preservation in the flesh, and others to be macerated and made into skeletons, so that any given species or variety could be easily recognised in either condition, by comparison with well prepared specimens.

When a thorough knowledge of the habitat and characteristics of any useful sponge is acquired, means might be taken to ensure its increase both in size and in number of the individuals. This could be accomplished by the judicious weeding of the ground, and removing all organisms which might enter into competition with the sponge for food, or interfere with its growth in any way; while at the same time such weeded spaces would afford opportunities for young sponges to settle down under favorable conditions, provided the weeding process did not actually diminish the number of organisms which contribute to the nutrition of the sponge: the latter phase of the question can only be decided by practical experiments.

Young specimens, attached to small stones or other objects, might be transplanted to positions that would favour rapid growth, either on the spot, or to remote localities, if proper means were taken to protect the sponge against injury in transit. The transplanting of living sponges has been successfully accomplished in various parts of the world, and the possibility of cultivating them artificially and profitably fairly proved. The results of these cultural experiments have been published, and the following is a brief summary of the contents of some of the reports on the subject:—

According to Mr. E. J. Allen,² Filippo Cavolina pointed out in the year 1785 that sponges could be transplanted from their original place of attachment, and that they were "capable of fixing themselves and continuing their growth."

In 1862, Prof. Oscar Schmidt called attention to the fact "that if a perfectly fresh sponge is cut into suitable pieces, and if these pieces, properly protected, are again placed in the sea, they will grow and finally develop into complete sponges.

² Allen—"Report on the Sponge Fishery of Florida, and the Artificial Culture of Sponges," Journ. Mar. Biol. Ass. c. United Kingdom, (n.s.), iv., 1896, pp. 183-194.

In 1863, experiments in sponge culture were commenced at the island of Lesina, in the Adriatic Sea, under the direction of G. Buccich. The results were fairly successful, but the experiment was discontinued in 1872, owing to the opposition manifested by the sponge fishermen. Dr. Emil von Marenzeller published a detailed report on these experiments³ from notes made by the director. Since the latter date, many experiments have been made, both in Europe and America, of which the American culturists appear to have been the most successful.

The results of experiments in Florida are summarised by Mr. E. J. Allen⁴:—"The first trials were made at Key West, by the agent of Messrs. McKessan and Robbins," of which the following brief report was prepared: "The sponges were all raised from cuttings; the localities in which they were planted were not the most favourable for sponge development, and their growth was therefore less rapid and perfect than might otherwise have been the case. They were fastened to the bottom, in a depth of two and a half feet of water, by means of wires and sticks running through them. The four specimens sent to Washington were allowed to remain down about six months before they were removed. Fully four months elapsed before they recovered from the injury done in the cutting, and the actual growth exhibited was for about two months only. The original height of the cuttings was about two and a half inches. One was placed in a cove or bight, where there was little or no current, and its increase in size was very slight. The other specimens were placed in tide-ways, and have grown to from four to six times their former bulk. Two hundred and sixteen specimens in all were planted at the same date, and at the last accounts those that remained were doing finely."

The Florida experiments indicate a more rapid growth of the cuttings than those conducted at Lesina. In the latter locality the planted cuttings increased to about twice or thrice their original size during twelve months' growth; whilst at the former place the increase was from four to six times in six months, the actual growth taking place in two months. G. Buccich, who directed the Lesina operations, estimated that it would take from five to seven years for sponge cuttings to grow to a marketable size.

Mr. G. Bidder,⁵ in summarising the Florida experiments, calculates that two and a half-inch cuttings would attain a marketable size in six months. Mr. T. Lee⁶ reports that the

³ Marenzeller—Ver. K. K. Geol. Bot. Ges. Wien., xxxvii., 1879, pp. 687–694.

⁴ Allen—*Loc. cit.*, p. 193.

⁵ Bidder—"Notes on Projects for the Improvement of the Sponge Fisheries," Journ. Mar. Biol. Assoc. United Kingdom, (n.s.), iv., 1896, App., p. 201.

⁶ Lee—U.S. Fish. Commission Report, 1886, p. 664.

Nassau fishermen say that the young sponges reach marketable size in three months after attachment. Mr. E. Lamiral⁷ states that exhausted fisheries are regenerated in three years.

From the foregoing authorities it is evident that the rate of growth is subject to great variation, and no doubt this is due to local conditions, such as temperature, food supply, and the situation in which the cuttings were planted.

Mr. E. J. Allen, in a supplement to his paper already quoted,⁸ published a letter, giving the results of Mr. R. M. Monroe's experiments in sponge culture. This is a very excellent report, and is worth reprinting, as it contains a full account of the methods adopted, and the results obtained.

Mr. Monroe, in his letter to the United States Fish and Fisheries Commissioners, states that he commenced work in November, 1889, "at Biscayne Bay, a place admirably adapted to such experimenting, far more so than any other place on the coast, having a greater range of bottom from the oozy marls of the inner lagoons to the hard coral reef, waters of all degrees of density, from the Gulf Stream to fresh, and currents to suit. Being already well provided with a vessel, boats, sponge-hooks, and water glasses, the question of suitable material for attaching to and sinking the cuttings to the bottom, gave some trouble, although apparently a simple problem. Saplings of white wood, which were plentiful, fairly proof against worms, and heavy enough to retain their place in tide-ways, were finally chosen. They were about twelve feet in length, with a cross-piece at one end to prevent rolling over. The cuttings were fastened to them by various contrivances, wedged into holes with pegs, wires around the pole, etc.; but the quickest, if possibly not the best, as it afterwards turned out, was short pieces of brass-wire, doubled and driven into the pole with a peculiar grooved punch, which could be done rapidly. At other stages of the experiment, I used bamboo stakes, long double lines of twisted wire, connected by cross pieces of white wood, with the cuttings inserted between the strands, also flat pieces of coral rock with drilled holes and wooden wedges. Galvanized iron in any form did not answer, especially wire, as it quickly corroded. Most of the first plantings were lost by its use; and I am inclined to condemn brass-wire on account of the possible poisonous effects of the salts formed on it, although some of the best results were obtained when it was used. Having prepared the sinkers, and hooked up sufficient sponge for several days' work, placing them in nets hung from the side of the schooner, the process was as follows:—Taking the poles or other sinker material in a small boat, two kedge anchors, a small long line, and the sponge in buckets in which the

⁷ Lamiral—Bull. Soc. d'Acclim., viii., 1861–1863, p. 329.

⁸ Allen—Journ. Mar. Biol. Assoc. United Kingdom, iv., (n.s.), 1896, p. 289.

water was changed every few minutes. (In this connection, it has been generally understood that exposure to air and sun for even a few minutes was fatal to a sponge, and at first I was very careful in this respect; subsequently I found that several hours of such exposure did not hurt them to any extent; stagnant water, however, will kill them in a very short time). A cutting-board, and knife, the latter very thin and re-sharpened often, owing to the calcareous matter imbedded in the sponge. Having reached the locality which was at first selected by the natural sponge growth already on it, the two kedges are let go at either end of the long line, and by hauling along this line the planking could be kept quite regular, and when finished were marked by range stakes set up on the adjacent dry banks. The depth of water ranged from eight feet to less than one foot at low tide, at which latter depth many fine sponges are found. By use of a water-glass, the plantings could be observed at any time without disturbing them. In cutting the sponge it was done as nearly as possible in a line with the radial circulating canals, and that each piece should have on it a part of the outer cuticle. As many were not cut in this way, and lived, it may not be at all necessary. Each piece was about one inch square on top, and somewhat more in length, coming to a point, averaging 25 to a sponge. In cutting, care was taken not to express the natural juices or milk, and quickly attaching to the sinkers, were immediately put into the water. The poles held on an average 12 pieces, placed 12 inches apart; and with one assistant I was able to plant about 200 cuttings per day. With a more suitable boat, having a well to keep the Sponge in, and another assistant, I could easily plant from 600 to 800. This work was continued, with intervals, from November, 1889, until 11th June, 1891, with various results, under all the conditions of bottom, depth, current, etc. With but few exceptions, the sponge survived the cutting process and began a good healthy growth, to be afterwards lost or destroyed in various ways. In many cases, notably one lot planted back of Elliott's Key, in 4 feet of water, on hard bottom, 75 per cent. lived, and in 6 months had doubled in size; these were mostly taken up before reaching maturity, as a gale would have swept them away, and did so with those that were left. Mature specimens were gotten from many of the other plantings, but the average loss from defective fastenings and other causes were greater. The results can be summed up as follows:—

“Material for anchoring cuttings.—While very many things other than those used suggested themselves in the progress of the work, I kept strictly within the limits of what was economical and practicable; therefore poles and stone seemed best suited, preferably the former arranged so as to be elevated a short distance

above the bottom to avoid smothering with silt, and to avoid the coral, etc., which is apt to grow in with the sponge. Fastenings of just the right character have yet to be invented.

“*Location*.—Anywhere within the bays and lagoons free from heavy sea, too strong current, and too much fresh water, and in moderate depths for easy handling and observation.

“*Growth*.—This is faster in strong currents, but the shape is apt to be poor and quality harsh. This point, however, is not fully determined. Under favourable conditions the cuttings double their size in 6 months; consequently 18 months to 2 years will produce marketable sponge. The sheepswool sponge was the only one of the useful kinds experimented on, although a few cuttings of velvet, grass, and others seemed to thrive and do equally well. It is quite possible that with State protection to the planters, and better methods to be determined upon by further experiment, sponge culture might be quite profitable. My belief is, gained in oyster culture from spawn, is that a similar method with sponge will eventually prove the correct one; but until more is known of sponge biology, it would be useless to suggest methods, notwithstanding the fact that several points in connection with it have been, to my mind, quite clearly demonstrated.”

The above clearly shows that sponges may be grown by cultivation, and that to ensure success particular regard must be given to the means by which the cuttings are attached to their support, and more especially to the locality in which they are planted. The cultivation might perhaps be more successful if means were taken to provide material for the young motile sponge to settle upon. After fixation, the material with the attached sponge could be transported to places calculated to encourage rapid growth; and in planting cuttings, it might be advantageous to fix them with the apical portion down. If suspended in this manner, the inhalent pores would be less liable to the influence of silt or mud. It is within my own experience that the finest specimens of sponges, and many other fixed organisms, are generally found suspended under stones or from the roof of caves. Under such conditions they are shaded from excessive light, and possibly have a more abundant food supply, or the inverted position gives the sponge a better chance of obtaining food. A sponge suspended from the roof of a cave or from a large stone is less liable to injury from large heavy moving objects than it would be on the bottom.

My colleague, Mr. Edgar R. Waite, informs me that during his diving experience in 1894, in search of the eggs of *Heterodontus*,⁹ he noticed many sponges *in situ*. He was particularly struck

⁹ Waite—Jour. Linn. Soc., Zool., xxv., 1895, p. 326.

with the fact that whenever an overhanging ledge was met with, the under-surface supported a luxuriant growth of sponges, and formed the opinion that such sheltered situations are much more adapted to the furtherance of sponge-life than more exposed positions.

Mr. J. Brice, in a Report on the Fish and Fisheries of the Coastal Waters of Florida,¹⁰ gives an account of the sponge industry at Key West, Florida. The following quotations are from it:—"The sponge fishery is carried on with vessels of a schooner or sloop rig, ranging from five to forty-seven tons (averaging about thirteen tons), which resort chiefly to the grounds in the Gulf of Mexico; and with smaller vessels, mostly sloops of less than five tons' burden, which make most of the catch on the grounds about the keys of the southern and eastern Florida coasts. The larger vessels carry from five to thirteen men, the smaller ones from three to five. Two men go in each of the dingies or small boats from which the sponging is done, the odd man of the crew being left in charge of the vessel. . . . Sponges are taken by means of a three-tooth hook, attached to a long pole. Poles of various lengths are used, to correspond with the different depths of water in which the sponging is done. Before the depletion of the shoal grounds, comparatively short poles were employed, but as the spongers have extended their operations into deeper and deeper water, longer poles have been required, until at the present time the limit seems to have been reached in a length of fifty or fifty-two feet. . . . The only other apparatus required in taking sponges is the very simple but effective water-glass. This is an ordinary water-bucket, the bottom of which has been replaced by glass. By means of it the sponger is able to distinguish objects on the bottom with great clearness, even in comparatively deep water, and he finds it an essential article in all of the sponging now carried on, except in shallow water. One glass is the complement of each boat. While one man is steadying or propelling the boat with an oar, the other member of the crew leans over the side of the boat and manipulates the water-glass and pole, and as the sponges are brought into view by aid of the glass, he detaches them by inserting the hook beneath them and pulls them to the surface. . . . When first taken from the water, the sponges are black and slimy. The essential treatment they subsequently receive before being sold consists (1) in exposing them to the action of the sun and air, on the vessel's deck, until they are killed, which usually requires several days; (2) in placing them for about a week in the 'crawls' or pens where the decay of the 'gurry' or animal matter, that began on the vessel, is continued; (3) in beating the sponges, while wet, with a wooden paddle to drive out the decomposed animal matter, and in scraping with a

¹⁰ U.S. Commissioner's Report Fish., 1896 (1898), p. 299.

knife those sponges to which the black scum still adheres; (4) in squeezing them to force out the remaining gurry and water, and placing them on shore; (5) in threading them by means of a large needle, threaded with coarse twine, and tying them in bunches about five feet in circumference. . . . The use of the Mediterranean diving system in the Florida Sponge Fishery has been experimentally tried . . . It is reported that a thorough test of the feasibility of this method was made, and that it was found impracticable . . . The principal reasons for abandoning this attempt to introduce improved methods into the fishery are as follows:—(1) The expense of maintaining a crew of divers was out of proportion to the value of the sponges taken. (2) It is stated that sponges were not found anywhere in very dense beds, and that a hooker could secure more sponges on the same grounds and in the same time. (3) The uneven character of the bottom is reported to be unfavourable for divers. (4) The heavy and cumbrous diving apparatus had the effect of destroying the growth of young sponges—a result already observed in Europe and Turkey, and had led to the passage of a law prohibiting the use of the diving method on the sponge grounds. In 1889 a law was enacted by the Florida legislature which is still in force, forbidding the taking of sponges by diving either with or without diving suits.”

The above extract from Mr. Brice's report is a very complete account of the methods adopted for obtaining and preparing sponges for the market.

Mr. P. L. Simmonds¹¹ deals with the economic sponge at some length, and gives a most complete history from a commercial aspect. The following statistical information is gleaned from his work:—The Florida fishery is conducted on the share-principle; the crew receives two-thirds, and one-third is allowed for the vessel, the total amount paid out per annum reaching about £48,000. At the Bahamas, “about five hundred vessels are constantly engaged in the trade, three thousand men find employment, and through it £20,000 to £30,000 sterling are annually circulated and spent in the colony.” The total value of sponges imported into the United Kingdom in 1870 (no returns published since) amounted to £160,162. The above figures are quoted to show the value of sponges as articles of commerce.

In commencing the work of identification, I had serious misgivings about undertaking the task—not from any lack of material for comparison, but from the want of a series of authentically named specimens. The Museum collection is extremely rich in sponges; it includes upwards of a thousand examples from Port Phillip,¹²

¹¹ Simmonds—Commercial Products of the Sea, 2nd ed., 1883, pp. 155–195.

¹² Presented by the late Mr. J. B. Wilson, of Geelong, Victoria.

most of which are undetermined; and an equal number, dredged, trawled, or collected on the coast by the writer, and others, during the past fifteen years. The exhibition cases contain over six hundred specimens, representing about four hundred species, of which number two hundred and ninety-five belong to the type collection as named and described in the "Catalogue of Sponges in the Australian Museum,"¹³ by Dr. R. von Lendenfeld. Since his departure in 1885, the Trustees have received numerous donations of sponges from various parts of Australia.

With a view to subsequent remarks, I deem it advisable to give a short account of this type collection.

During 1884-5, Dr. Lendenfeld was employed by the Trustees to write a Descriptive Catalogue of the Sponges in the Australian Museum, and a considerable portion of the work was accomplished in my presence, as the author of the Catalogue and the present writer occupied the same study. When the work of determination was concluded—just previous to his departure for Europe—Dr. Lendenfeld carefully labelled and numbered all the specimens; the dry examples had the labels tied on, and those in spirit had a black-lead label and a number placed on each bottle. From the time of his departure to the publication of the Catalogue, the collection remained undisturbed, and was under my care. Shortly after the book was issued, it was found that the published names did not agree with the manuscript names accompanying the sponges. The author, at the request of the Trustees, subsequently forwarded a numbered list with the amended nomenclature. It devolved upon the writer to add the correct names as they appeared in the Catalogue, and this was accomplished without disturbing the original labels or numbers.

In 1894, the collection was placed on exhibit: the dry examples were mounted on black wooden stands, the original label pasted underneath, and the stand numbered in accordance with the list. The specimens in spirits were in most cases mounted in the original bottles, and their contents left intact. In the process of mounting I took especial care to avoid any error or mixing of the labels. The numbers in the manuscript list and the specimen numbers were found to correspond in all cases, excepting some few which were marked with a query by the author.

In identifying sundry collections by means of the Catalogue and the Lendenfeldian types, I have found numerous discrepancies between the descriptions and the types; and in working out the Fisheries' donation I have encountered so many similar disagreements between the specimen and the description, that I regard the Catalogue as unreliable for the determination of species. A few of the more striking errors noted, may now be mentioned:—

¹³ Aust. Mus. Cat., xiii., Sponges, 1888.

NAME.	Spicules of the fibres as described.	Kind of Spicule actually present.
<i>Arenochalina mirabilis</i> , Lendenfeld	oxea.	styli.
<i>Echinonema anchoratum</i> , Carter.		
var. <i>ramosa</i> , Lendenfeld.....	oxea.	styli.
var. <i>densa</i> , Lendenfeld	oxea.	styli.
var. <i>lamellosa</i> , Lendenfeld ...	oxea.	styli.
<i>levis</i> , Lendenfeld	styli.	oxea.
<i>Clathria macropora</i> , Lendenfeld ...	oxea and styli	oxea.
<i>australis</i> , Lendenfeld	styli.	oxea.
<i>Plectispa macropora</i> , Lendenfeld ...	spined styli.	smooth styli
(echinating)		
<i>arborea</i> , Lendenfeld	smooth styli.	spined styli
(echinating)		
<i>Thalassodendron typica</i> , Lendenfeld	styli.	oxea.
<i>Axinella aurantiaca</i> , Lendenfeld ...	curved styli.	oxea and strongyla

More than half the above-mentioned forms are the undoubted types, with which I have long been acquainted, having been present when they were obtained by the trawl or dredge.

Clathria australis, Lendenfeld, really belongs to the genus *Plumohalichondria*, Carter. *Clathria macropora*, Lendenfeld, and *Echinonema levis*, Lendenfeld, are—if not identical with *C. australis*—varieties distinguished by difference in habit only. The spicules in the fibres of *C. australis* are described as “straight styli,” *C. macropora* is stated to possess “oxea and styli,” and in *Echinonema levis* they are described as “straight or slightly curved” styli. The types of *C. australis* (Nos. 285–413), *C. macropora* (Nos. 267–290), and *Echinonema levis* (Nos. 213–278–443), when carefully examined, were found to have the fibres cored with smooth straight oxea, without any trace of smooth styli. The descriptions of all the three forms are devoid of any reference to the numerous isochelæ present in the ground substance; and no mention is made of the abundant smooth oxea and spined styli scattered throughout the body of the sponge, and which form a dense external crust, nearly 1 mm. in thickness.

Axinella aurantiaca, Lendenfeld.—The figured type of this species (No. 245), is a well preserved spirit specimen. The description states that the “skeleton consists of a dense network of slightly curved styli, measuring 0.29×0.007 mm., pervaded by fibres 0.1 mm. thick, composed of similar spicules in the axis.” The actual figured type, when examined, was found to have the fibres composed of oxea and strongyla, and the styli were so scarce that only three were observed after prolonged search, in fact it is possible that they did not belong to the sponge

but were of foreign origin. The spicules were examined *in situ*, and, after boiling in nitric acid, they were found to be as follows: Megaseleres, oxea, strongyla, and styli (?).

- (a) Slightly curved oxea, either abruptly pointed or tapering from the middle. Size—0.25 to 0.35, by 0.007 to 0.012 mm.
- (b) Strongyla, curved or sinuous. Size—0.5 to 1.25, by 0.003 to 0.006 mm.

Thorecta ramsayi, Lendenfeld (No. 60), is a discoloured example of *Clathriopsamma lobosa*, Lendenfeld.

Holtenia pourtalesii, Schmidt (No. 188), is according to the original label in the cup of the sponge *Holtenia carpenteri*, Wyv.-Thomson, and was obtained by "H.M.S. Porcupine" in 1870.

There are many other instances of errors in identification and incorrect descriptions which will be found noted in the accounts of the species. The foregoing are sufficient to show the difficulties encountered in the work of identification by means of the "Catalogue of Sponges in the Australian Museum," notwithstanding all the advantages in the shape of an immense collection for comparison, an extensive acquaintance with the types, and a general knowledge of the Australian sponge fauna. It would be much more difficult for a worker at a distance, who lacks the above advantages. Descriptions, such as indicated in the tabular list, are responsible for wrong identifications, and the augmentation of synonymy.

In proceeding with the work of determination, two courses were open—one easy, the other difficult. The former course would be to compare any given specimen with the type, and accept the name as correct, more especially when the examples compared were the exact counterpart of each other. After consultation with the Curator, I decided to follow the safe or difficult method; and in all cases I tried to ascertain the whole of the characters of the species before attempting its identification. This being accomplished, the description was consulted; if this failed to agree, then the type was examined, and critically compared with the example selected for identification. Frequently the latter had to be laid aside and a thorough examination of the type begun; and often the result involved the re-description of the latter, either wholly or in part. Upwards of one hundred and twenty of the exhibited specimens have thus been subjected to a careful microscopical examination, and many sections mounted for future use. In each case, when dealing with the Lendenfeldian collection, the specimen number has been given.

After realising the position I was placed in by the want of an authentic series of named specimens, it was decided by the Curator and myself to ask the assistance of Professor Arthur Dendy, of

Canterbury College, Christchurch, New Zealand, who very generously presented to the Trustees seventy-nine microscopic slides, representing about seventy-four species, many of which contained sections used in the preparation of his "Catalogue of Non-calcareous Sponges." Subsequently the Trustees received another instance of his generosity in the loan of about two hundred and twenty-four pieces of sponges, originally taken from Carter's specimens in the British Museum, including forty-seven types. Sections from these examples were prepared and mounted in canada balsam for future reference. The above-mentioned slides have proved of great value in the work of determination; and personally I am greatly indebted to Professor Dendy for his kindness in so promptly obliging me.

SUB-CLASS NON-CALCAREA.

ORDER MONAXONIDA, *Ridley and Dendy.*

FAMILY HOMORRHAPHIDÆ.

SUB-FAMILY RENIERINÆ.

RENIERA, *Nardo.*

RENIERA DENDYI, *sp. nov.*

(Plate x., fig. 1).

Sponge cup-shaped, shortly pedunculate, generally broader than high, sides more or less longitudinally folded, margin thin, acute, rarely continuous, often lobate, and sometimes exhibiting deep incisions between the lobes. Surface pretty even, harsh to the touch, minutely porous throughout, vents not evident. Texture in the dried condition hard, moderately tough and flexible. Colour yellowish cream, often tinted with red. The largest example measures 110 mm. in height, 160 mm. in breadth, and from 3 to 5 mm. in thickness. The skeleton consists of rather stout multi-spicular primary lines, which curve gracefully outwards and terminate in dermal tufts of spicules. The primary lines are 0·05 mm. or less in diameter, and from 0·1 to 0·15 mm. apart the secondaries are uni- or bispicular, and rather irregularly disposed. The spicules consist of oxea of two sizes:—(a) Short, slightly curved, subfusiform, and gradually sharp pointed. Size—0·2 by 0·01 mm. (b) Elongate, curved, or slightly sinuated, cylindrical to within a few diameters of the rather variable extremities. As a rule, both ends are gradually and equally sharp pointed, sometimes one or both ends are subacute, and in rare cases obtuse. Size—0·6 to 0·8 by 0·01 to 0·012 mm.

Four examples; two from Lake Illawarra, and two from Tuggerah Beach.

RENIERA CORTICATA, *sp. nov.*

(Plate x., fig. 2).

This species exhibits two marked forms, simulating in this respect *Halichondria panicea*, Johnston. One is lobulate and consists of six or more erect lobes, which arise from a short peduncle; the lobes anastomose here and there, tapering above and below the middle; the surfaces exhibit a few rounded elevations. Each lobe has a large central tube, which commences at the base and terminates in a circular aperture at the summit; their diameter varies from 5 to 10 mm. The walls of the tubes are regularly perforated with oscula-like openings about 1 or 2 mm. in diameter. The dermal membrane is fine, very close, and renieroid in texture; in water-worn examples the subdermal surface exhibits numerous round or oval pores, these are uniformly distributed and generally under 1 mm. in diameter.

The other form is flabellately expanded, and consists of two or more lamellæ, with prominent oscula scattered over the surface and along the semicircular margin; their diameter rarely exceeds 3 mm. The texture in the dry state is hard and scarcely compressible; when wet very soft and elastic. There is a distinct cortical layer, about 1 mm. in thickness, it is tough and often remains intact after the inner ground substance has been washed out. Sections of well preserved specimens exhibit a much larger proportion of spengin in the cortex than in the ground substance.

Skeleton consisting of a number of more or less distinct main fibres, two or three spicules wide, which curve outwards from the centre to the surface; these are united by unispicular secondaries, with generally a triangular mesh. Spicules slightly curved and gradually sharp-pointed oxea. Size about 0.11 by 0.006 mm. Colour grayish brown or light stone.

Two specimens from Tuggerah Beach.

This species would naturally fall into the genus *Pellina*, Schmidt.¹⁴

HALICHONDRIA, *Fleming.*HALICHONDRIA PANICEA, *Johnston.*

Halichondria panicea, Johnston, Brit. Sponges, 1888, p. 114, pl. xi., fig. 5; Bowerbank, Mon. Brit. Sponges, i., p. 278, pl. xix., fig. 303; Bowerbank, *ib.*, pp. 97-99, pl. xxxix., pl. xl.; Ridley and Dendy, Chall. Rep., Zool., xx., 1887, p. 2, pl. ii., figs. 2-3 (spicules).

A single much worn example of this species is present in the collection from Tuggerah Beach. The length of the larger oxeote spicules is about 0.7 mm.

¹⁴ See remarks on the genus by Ridley and Dendy--Chall. Rep., Zool., xx., p. 15.

SUB-FAMILY CHALININÆ.

PACHYCHALINA, *Schmidt*.

Pachychalina aurantiaca, Lendenfeld, Zool. Jahrb., ii., 1887, p. 768; Dendy, Cat. Non-Calcareous Sponges, Proc. Roy. Soc. Vict., n.s., vii., 1895, p. 241.

A single example is here with some hesitation referred to this species. This form is rather common on the coast. In habit it varies from simple strap-shaped to palmate or digitate; the branches are generally flattened and about twice as broad as thick. The margins are thin, and bear one or two rows of closely placed vents, from 1 to 2 mm. in diameter; occasionally one or more vent-bearing ridges are present on the anterior or posterior surfaces. In well preserved examples there is a distinct dermal layer of oxeate spicules, forming a white incrustation. The surface spicules are held together by a minimum of spongin, hence beach specimens are usually denuded of the dermal crust. The subdermal surface is neatly reticulated, and exhibits numerous round pores, about 0.7 mm. in diameter, and from 0.5 to 1.5 mm. apart.

The description given by Dendy agrees in the main, but the spicules are rather stouter than in the example from Port Phillip. (R.N. 823 Dendy).

The spicules are slightly curved oxea, tapering gradually to within two diameters of the ends, from thence suddenly to acute points. Size—0.14 by 0.0065 mm.

In the Port Phillip specimen, the spicules (according to Dendy) measure 0.14 by 0.004 mm.

In length the spicules are pretty constant, but they vary considerably in diameter.

A fine specimen from Maroubra Bay is 450 mm. in height, the main branch is 30 mm. wide and 15 mm. in thickness.

One example, from Tuggerah Beach.

PACHYCHALINA PUNCTATA, *Ridley and Dendy*.

Pachychalina punctata, Ridley and Dendy, Chall. Rep., Zool., xx., 1887, p. 24, pl. vi., figs. 2, 2a, 2b, 2c, pl. xlvi., figs. 1-2; Lendenfeld, Zool. Jahrb., ii., 1887, p. 776.

Over twenty specimens of this common form are in the collection. These have been compared with sections of the type from the British Museum. The largest measures 400 mm. in height, 300 mm. in breadth, and between 40 and 50 mm. in thickness. The sponge usually consists of a broad basal plate, from which arises a compressed peduncle, about twice as high as wide, with several pillar-like supports at the base; the top of the peduncle rapidly expands, and gives rise to two or more large flabellate fronds, disposed in the same plain, and more or less fused together basally.

The margins of the lamellæ are split into numerous large or small fronds, these again producing other compressed lobes. The thickness of the lamellæ rarely exceeds 7 or 8 mm. The surface exhibits many wavy lines of growth; the texture is fine, close, elastic, and very tough; the colour is dark amber-brown. The oscula are generally confined to the inner aspect of the lamellæ; their diameter is between 1 and 2 mm.; the margins are thin and somewhat elevated, the walls being supported by pillars of fibre between which occur several circular apertures. The spicules consist of slightly curved oxea from 0·07 to 0·09 mm. in length, and about 0·005 in diameter.

In habit this species is extremely variable, ranging from bunches of lingulate branches to flabellate or half cup-shaped.

A Museum specimen, labelled *Plachochalina pedunculata*, var. *dura*, Lendenfeld (No. 230), is identical with the above.

A single plate-shaped specimen, from the Hawkesbury River, resembles *Euplacella australis*, Lendenfeld, yet the spicular characters are the same. The example arises from a central peduncle, 60 mm. in length. The circular plate-like lamina is over 300 mm. in diameter, and from 3 to 5 mm. in thickness. The sponge exhibits five or six longitudinal folds; the outer surface presents numerous concentric ridges or growth lines; these lines are also visible on the outer half of the upper surface; the latter is closely sprinkled with oscula, about 1 mm. or less in diameter, and from 1 to 2 mm. apart. The spicules are curved oxea, gradually sharp pointed. Size—0·07 to 00·8, by 0·004 to 0·005 mm.

From Tuggerah Beach.

PACHYCHALINA COMMUNIS, *Lendenfeld, sp.*

Chalinissa communis, Lendenfeld, Zool. Jahrb., ii., 1887, p. 772; *id.*, Aus. Mus. Cat., xiii., 1888, p. 87, pl. vii.

This species is very common in Port Jackson, and also along the coast. It exhibits great variation in habit, ranging from flabellate to digitate. In the quiet waters of Port Jackson, the sponge usually consists of a flabellate or folded lamella, or it may be composed of a bunch of flattened branches, which are connected at the base, forming broad lamellæ here and there, as represented by the figured type. In the rougher waters of the coast, large subflabellate examples are absent. The habit is digitate, with narrow angular or subcylindrical branches. It appears highly probable that *P. communis*, with its varieties *flabellum* and *digitata*, Lendenfeld; *P. macropora*, Lendenfeld; *P. elegans*, Lendenfeld; *P. elongata*, Lendenfeld; and *P. tenuifibris*, Lendenfeld; are all close allied forms, differing in habit and density according to the habitat in which they have grown. The number of intermediate stages between them are endless, and a well grown

example would furnish branches which, if taken singly and compared with the descriptions and figures, might pass as distinct species or varieties. This species presents a regular series of variable forms, similar to *Chalina polychotoma*, Carter. The oscula vary from 1 to 5 mm. in diameter; in *P. communis* they are slightly prominent, and have thin elevated margins; the aperture displays features similar to *P. punctata*, as figured by Ridley and Dendy.¹⁴ In the rest of the forms, the surface is marked by angular projections and generally more or less elongated ridges; the latter are acute and bear numerous small oscula along the ridge, and often a large one at its termination. In some cases *P. elegans* exhibits, at the margins of the compressed branches, long rounded ridges, which finally terminate in short incipient branches with a large osculum at the summit of each branch; the smaller oscula are rare or absent. The oxeote spicules are variable in size, ranging from 0.55 to 0.8 mm. in length, and 0.003 to 0.006 mm. in diameter.

Six specimens from Tuggerah Beach.

CHALINA, *Grant*.

CHALINA GLOBOSA, *Lendenfeld, sp.*

(Plate x., fig. 4).

Cacochalina globosa, Lendenfeld, Zool. Jahrb., ii., 1887, p. 762, pl. xviii., fig. 1.

The sponge usually occurs in circular cake-shaped masses, about 150 or more mm. in diameter, and from 70 to 100 mm. in height. The upper surface is pretty even, but fibrous; the under-surface invariably exhibits deep depressions, indicating attachment to some angular projecting rock. The circular oscula are fairly numerous, and scattered irregularly over the upper surface; they vary from about 1.5 to 4 mm. in diameter. The texture in good examples, in the dried state, is tough, hard, and scarcely compressible; beach-worn specimens are frequently soft and easily broken.

Colour when fresh, light sandy yellow; after prolonged exposure they become dark rusty brown, and very similar in appearance to some species of *Thorecta*.

The skeleton consists of a rather open irregular reticulation, with stoutish main fibres, which traverse the sponge from the base to the apex, with numerous slender more or less transverse connecting fibres. The fibres contain rather dense masses of oxeote spicules, cemented by little obvious spongin. The oxea are straight or slightly curved, gradually tapering to within three

¹⁴ Ridley and Dendy—Chall. Rep., Zool., xx., 1887, pl. vi., fig. 2b.

or four diameters of the extremities, thence tapering rapidly to acute points. Size—0·16 by 0·004 to 0·006 mm.

There are seven specimens from Tuggerah Beach, four from Swansea, and three from the Hawkesbury River.

CHALINA PALMATA, *Lamarck*.

Chalina palmata (Lamarck), Ridley and Dendy, Chall. Rep., Zool., xx., 1887, p. 26, pl. v., fig. 4.

Cladochalina euplax, Lendenfeld, Zool. Jahrb., ii., 1887, p. 769, pl. xxvii., fig. 26; *id.*, Aust. Mus. Cat. xiii., Sponges, 1888, p. 85.

Sponge variable in habit, occurring in roundish clumps, with several points of attachment, either palmate, flabellate, digitate, or half cup-shaped, with digitate or subflabellate branches along the margins, which generally exhibit dichotomous division. The outer surface is usually concave, and the inner convex. The oscula are mostly confined to the inner surfaces. In well preserved specimens the margins are thin, even, and slightly elevated; in worn examples they are irregularly substellate. Colour when alive, drab or dark slate; beach-worn examples vary from sandy yellow to dark rusty brown. The spicules are slightly curved oxea; they occur in the ground substance as well as in the fibres. Size—0·07 by 0·0024 mm.

There are twenty-five specimens from Tuggerah Beach, three from the Hawkesbury River, and two from Swansea.

CHALINA FINITIMA, *Schmidt*.

Chalina finitima, Schmidt, Grundzüge einer Spongien-Fauna Atlantischen Gebietes, 1870, p. 33.

Acervochalina finitima, Ridley, Zool. Coll. "Alert," 1884, p. 399.

Ceraochalina finitima, Lendenfeld, Zool. Jahrb., ii., 1887, p. 781.

This is probably the most common sponge occurring on the coast. There is one specimen in the Lendenfeldian collection which bears the manuscript name of *Cladochalina irregularis*, Lendenfeld (No. 323). The sponge generally consists of a pair of irregular, elongated, subflabellate expansions, more or less connected at their inner bases. Occasionally the intervening spaces between the thick lamellæ are filled in with fibre, leaving two long ridges with a more or less distinct valley between. The height rarely exceeds 100 mm., whilst the length is often over 200 mm.; the thickness varies between 10 and 20 mm. The oscula are from 1 to $\frac{1}{4}$ mm. in diameter; they are abundant on the upper inner aspect of the often truncated margins, and are also present on the inner surfaces, rarely on the outer; frequently they occur on the inferior borders of the lamina. The spicules are very slender hair-like oxea, measuring 0·1 by 0·0018 mm.

This form is probably identical with *Chalina*, sp. (b) of Ridley and Dendy.¹⁵

Of this species there are twenty specimens from Botany Bay, and twenty-seven from Lake Illawarra, and fragments from almost all the other localities enumerated.

CHALINA CYLINDRICA, Lendenfeld, sp.

Dactylochalina cylindrica, Lendenfeld, Proc. Linn. Soc. N.S.W., x., 1886, p. 570; *id.*, Zool. Jahrb., ii, 1887, p. 812; *id.*, Aust. Mus. Cat. xiii., Sponges, 1888, p. 101.

Several examples of this species were obtained at Tuggerah Beach.

The spicules measure about 0·085 mm. in length, and 0·002 mm. in diameter; they are abundant in the ground substance as well as in the fibres.

CHALINA ? SPICULIFERA, sp. nov.

(Plate x., fig. 5).

Sponge digitate, with usually a basal plate and a short cylindrical peduncle; the branches are numerous, elongate, round, or compressed, dichotomously divided and frequently anastomosing. In two examples the branches are round and somewhat nodular, and from 5 to 8 mm. in thickness. A third specimen exhibits flattened branches, chiefly in one plane, with frequent fusions in the lower half of the sponge. In the latter form the oscula are almost wholly confined to the lateral margins of the branches; they are 1 mm. or less in diameter, very prominent, and give an irregular appearance to the margins when viewed in profile. In the cylindrical form the oscula are either scattered or seriate; they are not prominent, and generally under 1 mm. in diameter. Texture firm, tough, compressible but not very elastic. Surface even and finely reticulate, to the unaided eye appearing smooth, but very harsh to the touch. Colour when dry, yellowish stone.

Skeleton with rather wide and usually angular mesh; main fibres stoutish, frequently branched, and gracefully curving outwards from the centre to the surface; they are cored with a dense axial string of oxeote spicules. The stouter secondary fibres rarely have more than two or three spicules in a row; the rest of the secondaries and the dermal reticulation consist of very slender unispicular fibres. The spicules, as a rule, are placed end to end, and shortly overlap each other at the points; some of the longer fibres have as many as six spicules thus arranged.

The dermal skeleton is renieroid, with a more or less triangular mesh, formed by the union of three spicules, which meet and

¹⁵ Ridley and Dendy—Chall. Rep., Zool., xx., 1887, p. 28.

cross each other at the points. The fibres contain very little spongin. The axial string of spicules in the primaries occupies the whole of the fibre, whilst the spicules in the secondaries and dermis are invested with a sheath of spongin about twice the diameter of the spicule. The spicules are stout slightly curved oxea, tapering rather suddenly to acute points at about two or three diameters from their extremities. Size—0.11 by 0.01 mm. A few slender forms occur in the ground substance.

In habit and appearance this species is like a *Chalina*, yet the small amount of spongin present and the stout spicules are not in strict conformity with the generic definition.

Three examples, obtained at Tuggerah Beach.

CHALINA LIGULATA, sp. nov.

(Plate x., fig. 6).

Sponge usually with an attachment expansion—a short, thick angular or compressed peduncle, from which a tangled mass of branches arises; they are mostly disposed in a single plane, and are dichotomously divided. The branches at their origin are short, compressed, or angular, and frequently coalesce; the middle and distal branches are flat, thin, strap-shaped and of nearly equal width throughout their length, with evenly rounded apices; they vary from 5 to 20 mm. in breadth, 1 to 3 mm. in thickness, and from 10 to 150 mm. in length. Texture of the basal portion of the branches dense, hard, and incompressible; upper parts of the sponge tough, flexible, and elastic. Colour in the dried state sandy yellow. Surface even, smooth, with a thin dermal incrustation, supported by a very fine meshed reticulation. There are numerous pores about 0.1 mm. in diameter, and abundant oscula scattered over the surface and along the margins of the branches; their diameter varies from 0.8 to 1 mm.

Skeleton consisting of a fine rectangular network. The main fibres are from 0.15 to 0.25 apart, 0.08 in diameter, and are cored with an axial thread of rather irregularly disposed oxea, usually about three or four spicules wide. The primaries bend outwards from the centre towards the surface; they are pretty evenly connected by secondaries, about 0.04 in diameter, forming square or oblong meshes from 0.1 to 0.2 mm. in width. The axial series of spicules in the finer fibres are few, disconnected, and frequently absent, and rarely form more than a single row in the stouter ones. The spicules are straight or but little curved oxea; they are cylindrical to within three or four diameters of the acutely pointed extremities. Size—0.07 by 0.003 to 0.004 mm.

Seven examples are in the collection from Tuggerah Beach. Several specimens were obtained by the writer at Newcastle in 1889.

SIPHONOCALINA, *Schmidt*.SIPHONOCALINA PROCUMBENS, *var. FLABELLIFORMIS*, *Carter*.*Patuloscula procumbens*, *var. flabelliformis*, *Carter*, *Ann. Mag. Nat. Hist.*, (5), xvi., 1885, p. 286.

Four specimens from Tuggerah Beach.

SIPHONOCALINA INTERMEDIA, *Ridley and Dendy*.*Siphonochalina intermedia*, *Ridley and Dendy*, *Ann. Mag. Nat. Hist.*, (5), xviii., 1886, p. 231; *id.*, *Chall. Rep.*, *Zool.*, xx., 1887, p. 30, pl. vii., fig. 1, pl. xlvi., fig. 3.*Phylosophina intermedia*, *Lendenfeld*, *Zool. Jahrb.*, ii., 1887, p. 800, pl. xxiii., fig. 47; *id.*, *Aust. Mus. Cat.*, xiii., *Sponges*, 1888, p. 93.

This sponge, when well grown, forms dense low rounded masses, often over 200 mm. in diameter, but rarely exceeds about 80 mm. in height. Usually it has several points of attachment, with a few root-like processes. The branches frequently anastomose, either about the middle or at the dilated summit; in some cases they fuse along the whole length, and the upper surface is sub-continuous. The large oscula, in well preserved specimens, are usually contracted at their summits, the margin being thin and elevated. The colour, when alive, is dark slate; when dry, drab or silver gray. The spicules are sharp pointed oxea. Size—0·1 by 0·004 to 0·006 mm.

There are seven examples from Tuggerah Beach, one from the Hawkesbury River, and two from Port Stephens.

SIPHONOCALINA STALAGMITES, *Lendenfeld*.*Siphonochalina stalagmites*, *Lendenfeld*, *Zool. Jahrb.*, ii., 1887, p. 799, pl. xxiii., fig. 49; *id.*, *Aust. Mus. Cat.*, xiii., *Sponges*, 1888, p. 94.

There are numerous examples in the Museum collection, and several in the Fisheries donation.

The sponge is generally somewhat flabelliform in habit, and consists of a series of tubular processes more or less fused together. The sides are covered with prominent elevations in the form of short, thick, and generally transversely disposed ridges, which gives the surface a peculiar gnarled aspect. In some specimens the ridges are ill-defined, in others they project outwards a distance equal to the transverse diameter of the tubes.

Examples from the Wollongong district are frequently overgrown by a species of *Alcyonaria* (*Callipodium*). The surface of the sponge not occupied by the *Callipodium* continues to grow and partly invest the organism. In beach-worn examples which have had the alcyonarian growth removed, the surface presents a series of meandering grooves, and the usual warty processes are scarcely noticeable.

The spicules are slightly curved oxea, which are abruptly narrowed at the ends, but not very sharp pointed. Size—0.75 by 0.0075 mm.

Three specimens from Lake Illawarra, and two from Tuggerah Beach.

ARENOCHALINA, *Lendenfeld*.

ARENOCHALINA MIRABILIS, *Lendenfeld*.

(Plate x., fig. 7).

Arenochalina mirabilis, Lendenfeld, Zool. Jahrb., ii., 1887, p. 821, pl. xxvi., fig. 70; pl. xxvii., fig. 28; *id.*, Aust. Mus. Cat., xiii., Sponges, 1888, p. 103.

This species is common on the coast, and is represented in the Museum collection by a fine series of specimens. Owing to the very open character of the mesh, the ground substance is easily washed away, and most of the examples met with present a washed out skeleton not unlike some species of Thorecta. The habit is subject to great variation. The sponge may consist of a single, elongate, finger-like lobe, about twice as broad as thick. One example is 220 mm. in height, 40 mm. in its widest part, and 15 mm. in its lesser diameter. Some individuals are hand-shaped, having a short peduncle and a palmated lamina. One specimen of this kind measures 230 mm. in height, 210 mm. in breadth, and the basal half from 10 to 12 mm. in thickness. The distal branches are flat, and are somewhat variable in breadth and length, but uniform in their narrow diameter. Abundant oscula occur on the lateral margins, their diameter ranging between 2 and 3 mm. Texture in the dried state, firm, slightly brittle, and not very elastic. Colour when alive, reddish-purple; when washed, gray with a rusty or purplish tint in the deeper parts, especially near the base.

The skeleton is accurately described in the Catalogue of Sponges, and a portion is figured in the Zool. Jahrbüch., on plate xxvii., fig. 28. There is, however, one serious error in the account of the spicules, they are described as "oxea 0.02 mm. long, and 0.004 mm. in thickness." All the spicules seen *in situ* in the secondary fibres proved to be straight styli, with a small rounded base and an abruptly pointed apex. Size—0.19 to 0.02 mm. by 0.004 to 0.005 mm.

Although this species is enumerated in the Catalogue of Sponges, there is no example named by the author. The name occurs three times in the manuscript list, each time with a query (Nos. 136, 275, 276). Upon examination, the specimens proved to be two examples of *Hircinia caliculata*, Lendenfeld, and one *Siphonochalina intermedia*, Ridley and Dendy. The latter bears the number 274 in the list, which may account for the mistake.

There are two specimens in the Fisheries' donation from Tuggerah Beach.

FAMILY HETERORRHAPHIDÆ.

CHONDROPSIS, *Carter*.CHONDROPSIS KIRKII, *Carter*, *sp.*

Dysidea kirkii, Carter, Ann. Mag. Nat. Hist., (5), vii., 1881, p. 374.

Sigmatella australis, Lendenfeld, Aust. Mus. Cat., xiii, Sponges, 1888, p. 195; *id.*, Mon. Horny Sponges, 1889, p. 611, pls. xl., xli., and xlii

Sigmatella corticata, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 199; *id.*, Mon. Horny Sponges, 1889, p. 618, pls. xl. and xli.

Chondropsis kirkii, Dendy, Proc. Roy. Soc. Vict., (n.s.), vii., 1895, p. 251.

There are three water-worn specimens from Tuggerah Beach.

RHAPHISIA, *Topsent*.RHAPHISIA RUBRA, *Lendenfeld*, *sp.*

Halichondria rubra, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 80, pl. ii., fig. 1.

The types (Nos. 212 - 372, and 450) present the features of a *Rhaphisia*, and exhibit abundant hair-like raphides. The original description states that "The spicules are straight oxystrongyla, with sharp or blunt points, 0.2 mm. long, and 0.006 mm. thick. Similar but more slender spicules are scattered abundantly through the ground substance."

No. 372 appears to be a portion of the figured type of the var. *digitata*. The abruptly pointed oxea measure from 0.15 to 0.2 by 0.004 to 0.0045 mm. The raphides are variable in length; usually they measure about 0.25 mm. No. 450 agrees with the description as to habit; the oxeote spicules are, however, slightly longer and stouter than in the var. *digitata*, they measure from 0.2 to 0.25 by 0.0045 to 0.006 mm. The microscleres are about the same as in the variety.

The sponge is light, open, spongy, and bread-like in texture. It varies from simple finger-like processes, to massive, with incipient dome-shaped branches; the latter are generally surmounted by one or more oscula from 5 to 10 mm. in diameter. The abruptly pointed oxeote spicules form distinct main and secondary fibres, very similar in diameter and arrangement to that exhibited by Carter's *R. anonyma*, but the spicules are much more abundant, shorter and stouter in *R. rubra*. Blunt ended megascleres are present, but very scarce.

There are seven examples from Port Stephens.

FAMILY DESMACIDONIDÆ.

PSEUDOHALICHONDRIA, *Carter*.PSEUDOHALICHONDRIA FIBROSA, *sp. nov.*

(Plate x., fig. 8).

Sponge subtriangular in outline, consisting of a stout short stem, with numerous compressed branches, more or less disposed in a single plane; their apices attain to nearly the same level. All the branches have one or more continuous longitudinal grooves, which in the living sponge probably terminated in oscula; the grooves are from 2 to 4 mm. in diameter. Surface villous and conulose; the dermal membrane exhibits numerous round pores about 1 mm. in diameter. Texture hard, rather inelastic, but tough, fibrous, and harsh to the touch. Colour in the dried and somewhat water-worn condition, yellowish-gray.

Skeleton consisting of a rather loose rectangular network of strongly developed fibres. Primary lines rather sinuous, about 0.2 mm. in diameter, generally 0.6 mm. or less apart, cored with abundant cylindrical styli, held together by a minimum quantity of spongin. Secondary connecting fibres usually at right angles to the primaries, and densely multispicular; they measure from 0.05 to 0.1 mm. in diameter; even in the most slender fibres it is difficult to estimate the number of spicules occurring in a row. The dermal membrane contains abundant spinose C-shaped microscleres, superposed by a dense layer of smooth stylole spicules.

Megascleres—Straight, smooth, cylindrical styli, with a well rounded base and acute or subacute apex. Size—0.24 to 0.27 by 0.005 to 0.007 mm. These occur abundantly in the dermis ground substance and in the fibres.

Microscleres—Spined isochelæ, sparingly scattered through the ground substance, and densely packed in the dermis. Size—0.018 mm. in length. The chelæ—apart from their larger size—do not differ from those of *Pseudohalichondria clavilobata*, as figured by Carter.¹⁶

This species differs from the type of the genus in the total absence of foreign matter, and in the remarkable development of the fibres. Height 145, breadth 190, thickness from 5 to 15 mm.

A single specimen was obtained at Lake Illawarra.

DESMACIDON, *Bowerbank*.DESMACIDON DENDYI, *sp. nov.*

(Plate x., fig. 9).

Sponge massive, light, open, and cancellous throughout. The walls of the reticulated surface have their edges directed outwards, they are slightly conulose and vary between 1 and 2 mm. in

¹⁶ Carter—Ann. Mag. Nat. Hist., (5), xviii., 1886, pl. x., figs. 8a.-d.

thickness; the areolation is mostly rounded, the spaces being 2 to 3 mm. in diameter. Oscula scattered, about 5 mm. or more in diameter. The surface presents a delicate porous membrane, which is abundantly charged with scattered spicules. Texture spongy, inelastic, and somewhat brittle. Colour yellowish-gray.

Skeleton consisting of a series of wavy longitudinally arranged wispy fibres, with a moderate amount of pale spongin; secondary connecting fibres abundant but ill defined, occasionally with three or four spicules in a row, but more frequently consisting of scattered wispy bundles. Main fibres about 0·1 mm. in diameter, and 0·15 to 0·2 apart. Mesh very irregular, angular to oblong, often filled in with scattered spicules.

Megascleres—(a) Strongyla of the fibres and ground substance straight or slightly curved, with well rounded and often inflated ends. Size—0·21 to 0·25 by 0·007 to 0·009 mm. (b) Slender strongyla, generally straight, with or without oval heads, abundant in the dermal membrane and scattered in the ground substance. Size—0·15 to 0·2 by 0·0025 to 0·0035 mm.

Microscleres—(a) Large tridentate isochelæ, with but little bent shaft and well developed flukes. Size—0·025 mm. in length. (b) Small isochelæ, probably young forms of (a). Size—0·018 mm. (c) Sigmata simple and contorted. Size—0·035 to 0·04 mm. The microscleres are extremely abundant in all parts of the sponge.

The larger specimen measures 70 mm. in height, 160 mm. in length, and 125 mm. in breadth.

Two examples were obtained at Port Stephens.

SUB-FAMILY ECTYONINÆ.

MYXILLA, *Schmidt*.

MYXILLA ISODICTYALIS, *Carter, sp.*

Halichondria isodictyalis, Carter, Ann. Mag. Nat. Hist., (5), ix., 1882, p. 285, pl. xi., fig. 2; *id.*, Ann. Mag. Nat. Hist., (5), xvii., 1886, p. 52.

Myxilla isodictyalis, Dendy, Proc. Roy. Soc. Vict., (n.s.), viii., 1896, p. 30.

Sponge compressed, measuring 55 mm. in length, 45 mm. in breadth, and 20 mm. in thickness. The texture is brittle and somewhat bread-like. Colour, dark cream.

The spicules are as follows:—(a) Smooth styli, often tending towards tylostyli; generally with a slight bend at the basal fifth or sixth, the rest of the shaft is straight and tapers to within about two diameters of the end, from thence it is abruptly narrowed and acute. Size—0·17 by 0·007 mm. (b) Straight smooth tylosta, the ends about equal to the middle in diameter. Size—0·25 by 0·005 mm. (c) Isochelæ. Size—0·021 mm. in length. (d) Sigmata, simple and contorted. Size—0·018 mm. in length.

The megascleres are slightly stouter than in Dendy's example (R.N. 793). They agree in size with the British Museum specimen of *Halichondria incrustans* (Reg. 86-12-15-391).

This species would fall into the genus *Lissodendoryx*, Topsent.

A single much worn example was obtained at Tuggerah Beach.

CLATHRIA, *Schmidt*.

CLATHRIA TYPICA, *Carter, sp.*

Echinonema typica, Carter, Ann. Mag. Nat. Hist., (5), vii., 1881, p. 378.

Echinonema anchoratum, Carter, Ann. Mag. Nat. Hist., (5), vii., 1881, p. 379.

Echinonema flabelliformis, Carter, Ann. Mag. Nat. Hist., (5), xiv., 1885, p. 352.

Echinonema pectiniiformis, Carter, Ann. Mag. Nat. Hist., (5), xiv., 1885, p. 353.

Phakellia ventilabrum, var. *australensis*, Carter, Ann. Mag. Nat. Hist., (5), xviii., 1886, p. 379.

Clathria typica, Dendy, Proc. Roy. Soc. Vict., (n.s.), viii., 1896, p. 32.

This species has a superficial resemblance to *C. australis*, Lendenfeld. The specimens from Tuggerah Beach have been compared with several from Port Phillip, and although they differ in habit they agree in their spicular characters.

The Megascleres are as follows:—(a) Spined styli, 0.04 to 0.05 by 0.007 mm. (b) Smooth styli, 0.2 to 0.25 by 0.004 to 0.006 mm.

Microscleræ—(a) Small isochelæ, 0.012 to 0.014 mm. in length. (b) Curved toxa and toxadragnata.

Under *Echinonema anchoratum*, Carter, Dr. Lendenfeld described three varieties.¹⁷ In this instance there is no specimen bearing this name in the collection, and there is no locality given under the description. It appears highly probable that *E. anchoratum*, Carter, was accepted as an ideal species, around which the three new varieties might be grouped. Throughout the catalogue many such species have been created, which consist solely of a series of varieties, often of forms that have previously been described as species.

During the examination of *Clathria typica*, it was found necessary to compare the types of the varieties of *Echinonema anchoratum*, var. *ramosa*; var. *dura*; and var. *lamellosa*. The localities, as given in the catalogue, do not agree with the labels; the latter, in Dr. Lendenfeld's own handwriting, gives Western Australia as the habitat for each of the three forms. The labels are no doubt correct, and the specimens were collected by the late Mr. Bailey, a Victorian naturalist. There is, however, a series of errors in

¹⁷ Lendenfeld—Aust. Mus. Cat. xiii., Sponges, p. 319–320.

the descriptions of the spicular characters; in each case they are described as "oxea." The specimens, when examined, only yielded smooth styli. The following is a brief summary of the examination of the types:—

Echinonema anchoratum, Carter, var. *ramosa*, Lendenfeld, (No. 307).

The description is perfect as applied to the outward form:—"Small, erect, digitate sponges, with irregular and high processes all over the surface." The colour is reddish-brown, with purplish tints in the interior. Height of specimen 55 mm., breadth 35 mm., and the thickness of the ultimate branches about 5 mm.

Megascleres—(a) Stout, strongly spined, echinating styli. Size—0.1 by 0.008 mm. (b) Stout, smooth styli, occurring in the fibres and also in the ground substance. Size—0.8 by 0.01 mm. A few slender forms, with slightly inflated bases, are also present. Chelæ not observed.

Echinonema anchoratum, Carter, var. *dura*, Lendenfeld, (Nos. 309–322).

The description of the habit does not agree with the specimens. The types are very similar in appearance. The larger example consists of numerous meandering coalesced lamellæ, with their edges directed outwards, forming a honeycomb-like structure with very large cells. The surfaces of the lamellæ are longitudinally corrugated; the distal margins are thin and uneven. A few indistinct grooves are present near the base, these gradually fade away before reaching the summits of the laminae. The texture is hard, tough, and minutely porous throughout. The surface reticulation is very fine, and cannot be seen distinctly with the unaided eye. Height of specimen 90 mm., breadth 90 by 100 mm., thickness of the lamella 3 to 5 mm. Colour dull stone with a slight tint of red in the unexposed parts. The fibres are abundantly echinated with spined styli; the primaries are cored with a moderate number of stout smooth styli; the connecting fibres are generally uni- or bi-spicular. A few stout styli and many slender forms are present in the ground substance, together with some ill-defined and hair-like and a fair number of small isochelæ.

Megascleres—(a) Spined styli, with the spines more pronounced in the middle and at the subtruncated base. Size—0.06 by 0.006 mm. (b) Stout smooth styli. Size—0.15 by 0.01 mm. (c) Slender smooth styli. Size—0.17 by 0.0035 mm.

Microscleres—Isochelæ 0.01 in length.

Although the description of the outward form does not agree, the MS. name is strictly applicable to this form, i.e., "*Antherospongia dura*."

Echinonema anchoratum, Carter, var. *lamellosa*, Lendenfeld, (No. 317).

The type is flabellate, and measures 175 mm. in height, 165 mm. in breadth, and varies from 3 to 5 mm. in thickness. There is a short, broad peduncle, and six or seven small lamellæ at right angles to the main frond; the distal margin of the latter is even and slightly rounded. The surface is longitudinally ridged throughout; the ridges are about 1 mm. apart, nearly straight, but very uneven, the surfaces being studded with minute conulæ. The depressions between the ridges exhibit numerous round pores, about 0.4 mm. in diameter. Texture hard, close, and tough. Colour dark stone. The specimen is slightly beach-worn, and without dermal incrustation.

The fibres of the skeleton form a close and somewhat fasciculate reticulation; the primaries rarely exceed 0.05 mm. in diameter, and the secondaries are usually about 0.02 mm. Both kinds are moderately echinated by spined styli.

Megascleres—(a) Spined echinating styli, with a slightly enlarged base, and the shaft studded with numerous minute spines. Size—0.8 by 0.006 mm. (b) Smooth stout styli, tending to become tylostyli, often with a well defined constriction above the base. Size—0.28 by 0.0095. (c) Slender smooth styli or tylostyli. Size—0.16 by 0.0035.

Microscleres—(a) Small isochelæ 0.0012 in length. (b) A few slender hair-like spicules.

With regard to the above three varieties, it seems very doubtful if they have any relationship with *Clathria typica*, Carter, more especially if the difference in habit, texture, and spicular characters are duly considered. I feel assured that the specimens examined are the genuine types, as the manuscript names, specimen numbers, and list numbers are all in accord; but it is very singular that the spicules occurring in the fibres and ground substance should in each case be described as oxea, when they possess styli only.

CLATHRIA TENUIFIBRA, *sp. nov.*

(Plate xi., fig. 10).

Sponge clathrate, flabellate, consisting of very numerous compressed main branches, each of which gives off many short branchlets; the latter are subtriangular and frequently anastomose. The spaces between the branches and branchlets are very irregular in shape and somewhat dentate, owing to the numerous short incipient branchlets. As growth proceeds, many of the short branchlets meet and coalesce, forming connecting bars, and in the lower parts of the sponge the spaces become filled in. Spaces that have thus almost closed usually exhibit a central vent-like opening, surrounded by five or more radiating grooves. The oscula are scattered over the whole surface, including the margins;

they are about 1 mm. in diameter. The specimen is perforated by a small Isopoda, and it is impossible to distinguish the oscula from the holes occupied by the crustacean. Surface even, reticulation very fine and regularly porous; the pores vary from 0.1 to 0.2 mm. in diameter. Texture compact, tough, and highly elastic. Colour when alive, bright red; when dry, dark stone, with a tint of red in the deeper parts.

Skeleton closely reticulate, with oval or oblong mesh, from 0.3 to 0.5 mm. in the longer diameter, and about 0.1 to 0.15 mm. in the shorter. Primary fibres from 0.1 to 0.15 mm. in diameter, with much yellow spongin, and a few ill-arranged stylote spicules, rarely with more than six in a row, frequently four or less. Secondary connecting and dermal fibres, usually bi- or unispiculous, diameter from 0.025 to 0.05. The echinating styli are abundant, and irregularly scattered on the fibres, but rarely more than their length apart.

Megascleres—(a) Stout, slightly curved, subfusiform, smooth styli; base rounded, with or without a contraction about one diameter from the end; shaft gradually tapering from the middle to the acute apex. Size—0.14 by 0.01 mm. (b) Slender straight smooth styli, a little inflated at the base, and rather suddenly acute at the apex. Size—0.11 by 0.004 mm. (c) Spined styli, gradually tapering from a rounded or slightly swollen base to an acute apex; spines numerous, but small. Size—0.7 by 0.0075 mm.

Microscleres—(a) Small isochelæ. Size—0.008 to 0.01 mm. (b) Short stoutish toxa, with a central bend about 0.03 mm. in depth; the shaft is gracefully curved on each side of the centre, and the ends are smooth and sharp pointed. Size—0.08 to 0.1 mm. (c) Rather slender toxa, with a slight median band, the ends are smooth and acute. Size—0.13 to 0.13 mm.

One specimen from Lake Illawarra.

I collected two examples of this species at Wollongong some years ago.

CLATHRIA DURA, sp. nov.

(Plate xi., fig. 11).

Sponge rather variable in habit, consisting of a series of compressed or cylindrical branches which are often united at various points, especially near the base. The largest example is flabellately expanded; it is about 150 mm. in height, 230 mm. in width, and in the thickest part 30 mm.; individual branches are rarely more than 5 mm. in their lesser diameter. The branches arise from a short stout peduncle; they are compressed, subradiate, and disposed in one plane, and more or less connected along their lateral margins; in some portions the frond is continuous, and in others clathrate. The main branches retain their individuality, and can generally be traced to their origin; the terminal branches are

mostly free, and exhibit dichotomous branching. Surface even, rather harsh to the touch, with a minutely reticulated dermal membrane. Oscula scattered over the surface or confined to the margin of the free branches, about 1 mm. or less in diameter. Texture very fine, dense, and tough; in the lower parts of almost stony hardness; the upper portions are scarcely compressible between the fingers. The tips of some of the washed out branches are compressible, and highly elastic. Colour sandy yellow.

The skeleton consists of a close rectangularly meshed network of strongly developed horny fibre. The main fibres are about 0.04 mm in thickness; they are centrally cored with a thread of smooth styli, 0.01 mm. or less in diameter. The fibres and the ground substance contain numerous smooth and spined styli, the latter also echinate the fibres and are present in considerable numbers. The axial core of smooth styli is well defined in the secondary connecting fibres, and also in the dermal reticulation; the latter consists of a fine square meshed network of densely spiculous fibres, with little obvious spongin; the mesh is about 0.2 mm. in diameter. The ends of the main fibres project slightly through the dermis, and are ensheathed with closely placed spined styli.

Megascleres—(a) Smooth styli, slightly curved at their basal third, a little tapering to within about one or two diameters of the extremity, thence abruptly tapering to a not very acute point. Size—0.08 to 0.01 by 0.004 mm. (b) Spined styli of nearly uniform diameter to within a short distance of the apex, moderately beset with short recurved spines. Size—0.04 to 0.05 by 0.005 mm.

Microscleres—Abundant isochelæ, 0.014 mm. in length.

Four specimens from Tuggerah Beach.

CLATHRIA AUSTRALIENSIS, *Carter, sp.*

(Plate xi., fig. 12).

Wilsonella australiensis, Carter, Ann. Mag. Nat. Hist., (5), xiv., 1885, p. 366.

Clathriopsamma lobosa, Lendenfeld, Aust. Mus. Cat. xiii., Sponges, 1888, p. 227.

Thorecta ramsayii, Lendenfeld, Aust. Mus. Cat. xiii., Sponges, 1888, p. 142.

Clathria australiensis, Dendy, Proc. Roy. Soc. Vict., (n.s.), viii., 1896, p. 33.

This common species ranges from digitate to flabellate, or even incrustating or lobate. A specimen from Port Phillip consists of two flabellate lamellæ, about as high as broad, and more or less connected by vertical lamellæ within, and having on the outer aspect a series of low ridges or lamellate lobes about half the size of the lamellæ from which they originate. Examples from the

coast of New South Wales are, however, more compact, and the laminae are much stouter, at least in the deep-water specimens which are washed up on the various beaches. Littoral forms, such as occur at Jervis Bay, are flabellate, digitate, or clathrate. Coastal specimens are usually in the form of massive rounded clumps, consisting of two or more thick lamellae, with truncated or evenly rounded margins, upon which the osculae are seated. The surface, when perfect, is thinly coated with a white incrustation, consisting of foreign spicules, sand grains, and foraminifera. The oscula are confined to the margins and the inner surfaces; at the sides they are substellate, on the rounded or angular margins they are elliptic, and at the summit circular, often with narrow transverse grooves between. The oscula vary from 1 to 5 mm. in diameter, and the grooves rarely exceed about 1.5 mm.

The type of *Clathriopsamma lobosa*, Lendenfeld, (No. 401), is a spirit specimen which has longitudinally bisected. The surface is finely reticulated, the mesh being regularly polygonal and about 0.25 mm. in diameter; the fibres of the network are very irregular in outline, and under a low magnifying power they are rugose and bristling with echinating spicules. All the fibres are densely cored with sand grains and spicule fragments. Texture very hard and incompressible when dried. Colour when alive light brick red; beach-worn examples are white or gray, and after long exposure dark brown. Notwithstanding the difference in habit, the spicules are fairly constant in shape and size.

Megascleres—(a) Echinating spined styli. Size—0.07 by 0.004 mm. (b) Smooth styli, occurring in the fibres and in the ground substance. Size—0.15 by 0.004 mm.

Microscleres—(a) Small abundant isochelae. Size—0.012 mm. (b) Strongly bent toxa. Size—0.08 mm.

The spicular characters of the Port Phillip example agree with the type and other specimens examined.

Thorecta ramsayii, Lendenfeld, is a sun-burnt example of this species, its colour being like that of a *Thorecta*, and the specimen agrees perfectly with the description of the outward form. It will be noticed that *T. ramsayii* is omitted in the Monograph of Horny Sponges.

Of this species fourteen specimens are present in the collection from Tuggerah Beach, two from Botany Bay, and three from Port Stephens.

CLATHRIA RUBENS, *Lendenfeld, sp.*

(Plate xi., fig. 13).

Thalassodendron rubens, Lendenfeld, Aust. Mus. Cat. xiii., Sponges, 1888, p. 223.

A small washed out example of this species is present in the collection from Broken Bay. Under this genus there are six species and two varieties enumerated, all of which—except *T.*

digitata—have been examined. *Thalassodendron typica* and *T. viminalis* are quite distinct. *T. brevispina*, *T. paucispina*, *T. rubens* and its varieties *dura* and *lamellosa*, are very similar in external appearance, especially as to surface, differing slightly in habit but very little in their spicular characters. From a large well grown specimen it would be possible to select portions which might be passed as distinct species or varieties if the habit and general appearances alone were considered, the rest of the characters do not differ very materially. It is indeed highly probable that the above forms represent one variable species. They are all characterised by having a white incrustation,—when perfect consisting of a porous layer of stylote spicules. When the dermal layer is removed, the surface is hispid; a character which is well illustrated in *Clathria lendenfeldii*, Ridley and Dendy.¹⁸

The following descriptions are based on the examination of the types:—

Thalassodendron typica, Lendenfeld, (No. 364).

This specimen consists of a shallow vase-shaped sponge, which has been bisected. In appearance it resembles a washed-out *Chondropsis*, but the lamina is much thinner than in any species in that genus. The published description agrees with the specimen as far as the habit is concerned. The fibres and spicular characters do not agree with the diagnosis. The main fibres are densely charged with smooth oxeote spicules, held together by very little obvious spongin. Smooth "straight styli" are extremely rare. The connecting fibres are stated to be "aspiculous." I failed to find any such aspiculous fibres; even the finest consist of an axial thread of spicules, with just a trace of investing spongin. Both kinds of fibres are echinated by spined styli; and smooth styli, if present as echinating spicules, are accidental and belong to the axial thread, they are not echinating in the strict sense of the term.

Megascleres—(a) Spined echinating styli, rather blunt at the apex. Size—0.1 by 0.001 mm. (b) Slightly curved smooth oxea, abruptly but rarely acutely pointed. Size—0.02 to 0.035 by 0.0065 to 0.012 mm. (c) Straight smooth styli. Size 0.8 to 1 by 0.0015 mm.

Thalassodendron rubens, Lendenfeld, (No. 286).

The type is a washed-out specimen, having been purposely reduced to a skeleton when obtained. The spicules are as follows:

Megascleres—(a) Spined styli, rather scarce. Size—0.06 by 0.007 mm. (b) Stout smooth styli. Size—0.15 by 0.001 mm. (c) Medium smooth styli. Size—0.17 by 0.005 mm. (d) Slender smooth styli. Size 0.12 by 0.0015 mm.

¹⁸ Ridley and Dendy—Chall. Rep., Zool., xx., 1887, pl. xxviii., fig. 5.

Thalassodendron rubens, var. *dura*, Lendenfeld, (No. 343).

This variety differs from the typical form, and also from the following variety, in having a greater number of echinating styli; they are longer, sharper pointed, and less spiny than in *T. rubens* or in the variety *lamellosa*, and I failed to find any smooth styli echinating the fibres. The projecting smooth spicules were observed, but they are incipient secondary fibres with one or two smooth stylote spicules.

Megascleres—(a) Spined styli, very numerous. Size—0·08 to 0·1 by 0·006 mm. (b) Smooth styli. Size—0·27 by 0·005 mm. (c) Smooth styli. Size—0·2 by 0·002 mm.

Microscleres—Chelæ 0·0014 mm. in length.

Thalassodendron rubens, var. *lamellosa*, Lendenfeld, (No. 432).

In the figured type the spicules generally are fewer than in the typical form. The description states that the echinating styli are "pretty scarce."

Megascleres—(a) Spined styli, very scarce. Size—0·05 by 0·0045 mm. (b) Smooth styli. Size—0·1 to 0·16 by 0·006 mm. (c) Smooth styli. Size—0·8 by 0·0015 mm.

Microscleres—Chelæ 0·001 mm. in length.

Thalassodendron brevispina, Lendenfeld, (No. 361).

This form does not differ materially from *T. rubens*, var. *dura*, except in the size of the spicules.

Megascleres—(a) Spined styli. Size—0·03 by 0·005 mm. (b) Smooth styli. Size—0·18 by 0·0065 mm. (c) Smooth styli. Size—0·25 by 0·0015 mm.

Microscleres—Isochelæ 0·008 in length.

Thalassodendron paucispina, Lendenfeld, (No. 360).

In habit this form resembles *T. rubens*, and in its spicular characters agrees with the preceding, excepting that the echinating styli are more spiny and less acute.

Megascleres—(a) Spined styli. Size—0·04 by 0·006 mm. (b) Smooth styli. Size—0·18 by 0·008 mm. (c) Smooth styli. Size—0·1 by 0·002 mm.

Microscleres—Isochelæ 0·008 mm. in length.

Thalassodendron viminalis, Lendenfeld, (No. 365).

The type does not accord with the description. The latter states that: "The sponge consists of a number of pretty regular cylindrical upright branches which are not much branched." The example in the collection bearing the above name and number, is clathrate and consists of a series of short flattened branches, from 4 to 20 mm. wide, 2 to 4 mm. thick, and from 5 to 30 mm. long. The lamellæ have their edges directed outwards; towards the centre and at the sides they exhibit frequent coalescence, the

whole forming a very irregular honeycomb-like sponge, 100 mm. in height, 80 mm. in breadth, and 27 mm. in thickness. The specimen has been longitudinally bisected, and is now about half its original size. The surface is hispid throughout, and numerous small oscula are scattered in the deeper parts at the bases of the lamellæ. Texture soft, tough, and slightly elastic. Colour, yellowish-gray.

Skeleton reticulate, consisting of main and secondary fibres, the former from 0·1 to 0·15 mm. in diameter, separated by oval or elongated spaces, from 0·15 to 3 mm. in diameter, and cored by loosely arranged smooth styli; they are invested with a small amount of spongin. The connecting fibres are about 0·025 mm. in diameter, and contain a few smooth, ill-disposed styli. All the fibres are remotely echinated by scarce smooth, or nearly smooth styli. A few exhibit incipient spines, which give the spicule a slightly sinuous outline.

Megascleres—(a) Smooth or very minutely spined styli. Size—0·06 by 0·007 mm. (b) Smooth styli of various dimensions. Sizes—0·3 by 0·008, 0·17 by 0·005, and 0·15 by 0·0025 mm.

The spicular measurements in the original diagnosis are: Smooth (?) echinating styli, 0·5 by 0·005 mm., and the styli in the fibres 0·14 by 0·006 mm.

The prevailing features of this form are those of an *Echino-clathria*, in which genus it might find a place when better material is available.

CLATHRIA ARBOREA, *Lendenfeld, sp.*

(Plate xi., figs. 15, 15a).

Plectispa arborea, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 226.

Several examples of this common species are in the collection. The specimens are generally reticulately branched in one plane. The branches are compressed, and vary from 3 to 10 mm. in diameter. The spaces between the coalesced branches measure from 5 to 20 mm. or more, and are very irregular in shape, varying from round to elongate. Surface rough, covered throughout with warty elevations and numerous small circular oscula-like apertures. Texture firm, tough, and elastic. Colour when alive, brick-red; in the dried state, light stone. The main fibres are cored with numerous smooth styli, about 0·185 mm. long, and 0·008 mm. in diameter; abundant subtylostyli occur throughout the sponge, they are 0·25 mm. in length and 0·002 in breadth. Echinating styli few, rapidly tapering, acute and spined throughout. Size—0·085 mm. long, and 0·006 in diameter.

In the description of this species,¹⁹ the fibres are stated to be echinated by "very scarce smooth styli." I have examined the

¹⁹ Lendenfeld—Aust. Mus. Cat., xiii., Sponges, 1888, p. 226.

type (No. 346), and find that the styli are spined. It seems that the description of the spicules of this species has been transposed, and should be placed under *Plectispa macropora*. In the type of the latter, the echinating spicules are smooth, and not "slightly spined or rough styli."

Locality.—Tuggerah Beach. Common on all the coastal beaches after gales.

ECHINOCLATHRIA, *Carter*.

ECHINOCLATHRIA MACROPORA, *Lendenfeld*, *sp.*

Plectispa macropora, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 226.

Numerous examples of this common coastal sponge are in the collection.

In general appearance this species is closely allied to, if not identical with *Echinoclathria carteri*, Ridley and Dendy.²⁰

Specimens from the coastal beaches generally form low densely branched hemispherical or elongated clumps, with several points of attachment. They are frequently 100 mm. high, and from 100 to 200 mm. in diameter. The branches are at first simple, but when about 25 mm. or more long, they divide at the summits and become dichotomous; the secondary branches again bifurcate, and frequently each stem will exhibit five or six bifurcations. Coalescence takes place at nearly all points of contact. The diameter of the branches is very variable, ranging between 5 and 10 mm., except at the origin of two branches, then they may be 20 mm. in the longer diameter and about 8 or 10 in the shorter. The apices of the simple branches are roundly conical.

The type of this species is No. 358.—Surface regularly honey-combed, the width of the polygonal mesh being about 2·5 to 3 mm. across; walls lamellate and minutely perforate, with the smooth thin edges directed outwards. Texture when dry, moderately firm, tough, and highly elastic. Colour varying from light to dark yellowish-stone. Main fibres with a moderate amount of spongin, cored with numerous smooth slightly curved styli; they are slightly constricted near the base, and the apex is gradually tapering and acute. Size—0·1 by 0·004 mm.; frequently somewhat larger. Numerous straight or but little curved subtylostyli are present throughout the ground substance. Size—0·15 by 0·0015 mm. A few scattered isochelæ occur in well-preserved examples. Size—0·01 mm. The echinating spicules are smooth styli, 0·075 in length and 0·004 in breadth.

Locality.—Tuggerah Beach. Very common on all the ocean beaches both north and south of Sydney.

²⁰ Ridley and Dendy—Chall. Rep., Zool., xx., 1887, p. 162, pl. xxix., figs. 12, 12a, pl. xxxi., figs. 3, 3a.

ECHINOCLATHRIA ELEGANS, *Lendenfeld, sp.*

Plectispa elegans, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 226.

A single example of this rather uncommon species was obtained at Tuggerah Beach.

The type of this species is No. 347.—This form is erect in habit, generally with a short distinct peduncle, from which arise numerous subcylindrical, erect, rarely coalescent branches; frequently the branches exhibit a series of nodes, the intervening spaces being about one-third less in diameter. The mesh of the honey-comb is very small, and the walls are comparatively thick. Texture very fine, smooth, and rather brittle when dry, but highly elastic when wet. Colour yellowish-stone.

Main and secondary fibres cored with smooth, straight or curved gradually, sharp-pointed styli. Size—0·1 by 0·006 mm. Echinating spicules smooth, slightly swollen in the middle. Size—0·8 by 0·005 mm. Numerous slender subtylostyli are present in the ground substance. Size—0·14 by 0·0017.

PLUMOHALICHONDRIA, *Carter.*PLUMOHALICHONDRIA AUSTRALIS, *Lendenfeld, sp.*

(Plate xi., figs. 14, 14a—14b).

Clathria australis, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 222.

Clathria macropora, Lendenfeld, *loc. cit.*, p. 221.

Echinonema levis, Lendenfeld, *loc. cit.*, p. 220.

The type of *Clathria australis*, Lendenfeld (No. 285), agrees with the description of the outward form. It is 125 mm. high, 200 mm. broad, and 15 mm. or more in thickness. The typical form is fairly common on the coast, and there are many specimens in the collection. When alive it is brick red in colour; when dried the surface presents a white incrustation and numerous radiating grooves.

The description of the skeleton and the spicules are not in accord with the type. In the first place, the character of the fibres in regard to main and connecting, is not correctly given; secondly there are no connecting fibres without a well-defined axial core; and thirdly, the smooth spicules of the fibres are oxea, and not styli. The skeleton consists of a series of stoutish fibres; they are chiefly longitudinally disposed, presenting a very wavy outline, and give off numerous branchlets. The latter arise at very acute angles, and are axially a continuation of the parent branch. The fibres frequently anastomose, but it is only a union of the spongin, the individuality of the fibres remaining more or less distinct. The character of the mesh is very striking, varying from lanceolate to rhomboidal, with the apical and basal angles acute. In the denser parts the fibres form plexiform columns.

The main fibres measure from 0·15 to 0·2 mm. in diameter, the smaller branchlets from 0·05 to 0·01 mm. The axial core of oxeote spicules is very dense and imbedded in much spongin; the latter is abundantly charged with very spiny styli, many of which are arranged parallel with the axis, but the majority are echinating; they are exceedingly numerous, so that under a low magnifying power the fibres have a villous appearance. The dermal skeleton consists of a thin layer of smooth oxea, and a thickish external crust of slender, curved, spined styli.

Megascleres—(a) Smooth straight oxea. Size—0·18 to 0·2 by 0·006 to 0·0065 mm. (b) Spined echinating styli; base and lower two-thirds of shaft with numerous often recurved spines; apex very acute and smooth. Size—0·1 to 0·14 mm. by 0·0065 to 0·01 mm. (c) Slightly curved spined styli of the dermis and of the ground substance. Size—0·08 to 0·1 by 0·0055 to 0·006 mm.

Microscleres—Small tridentate isochelæ. Size—0·012 to 0·015 mm.

Clathria macropora, Lendenfeld (Nos. 267 and 290).

(Plate xi., fig. 14).

The types differ from *C. australis* in their branched or lobate habit. The description accurately describes the dry example. It will be noted that the surface is “undulating and grooved,” and that the “skeleton consists of a network of mostly longitudinally disposed fibres, which contain an axial bundle of slender oxea and styli, the former being the most abundant.” It is not stated whether the styli are spined or smooth. I failed to find any of the latter either *in situ* or in spicules obtained by boiling. With regard to the oscula “5 mm. wide,” I am in doubt as to their real nature, as most of them are inhabited by a small Isopod—a species of *Cymodoce*—which is found infesting many sponges on the coast. This is particularly the case with *E. levis*, which often appears as if it had been riddled by a shot gun, the holes in the flabellate forms being continued through the frond. The spicules obtained by boiling yield the following measurements:—

Megascleres—(a) Generally straight smooth oxea. Size—0·18 to 0·2 by 0·0055 to 0·006 mm. (b) Echinating spined styli 0·1 to 0·12 by 0·008 to 0·01 mm. (c) Curved spined styli 0·08 to 0·09 by 0·006 mm.

Microscleres—Small, tridentate isochelæ 0·012 to 0·016 mm.

Echinonema levis, Lendenfeld (Nos. 213, 278, 443).

(Plate xi., fig. 14a).

The types conform to the description, excepting that the axial spicules of the fibres are oxea, and not styli. Here again we note that the “skeleton consists of irregularly curved, for the most part longitudinally extending fibres.”

Megascleres—(a) Straight smooth oxea. Size—0·18 up to 0·2 by 0·0055 to 0·006 mm. (b) Spined echinating styli. Size—0·1

to 0·12 by 0·008 to 0·01 mm. (c) Curved spined styli. Size—0·08 to 0·1 by 0·006 mm.

Microscleres—Small tridentate isochelæ. Size—0·012 to 0·016 mm.

In addition to the many examples from the coast, there are several well preserved specimens in the collection, presented by the late J. B. Wilson, from Port Phillip.

RASPAILIA, *Nardo*.

RASPAILIA ATROPURPUREA, *Carter, sp.*

Axinella atropurpurea, Carter, Ann. Mag. Nat. Hist., (5), xvi., 1885, p. 359.

Raspailia atropurpurea, Dendy, Proc. Roy. Soc. Vict., (n.s.), viii., 1896, p. 47.

One specimen obtained at Port Stephens. Although water-worn it still retains its dark purple colour in the protected parts. The tips and sides of some of the branches are grayish-purple.

Height of example, 45 mm., breadth 80 mm., thickness about 25 mm., diameter of branches 5 mm.

RASPAILIA BIFURCATA, *Ridley*.

Raspailia bifurcata, Ridley, Zool. Coll. "Alert," 1884, p. 459, pl. xl., fig. j.; pl. xlii., figs. ll.

The example is much branched, and measures 75 mm. in height, 80 mm. in the shorter, and 100 mm. in the longer diameter; the cylindrical branches are about 5 mm. in diameter; a few branches are flattened and twice as broad as thick. The smooth oxea and styli are variable in size, the majority are rather less than in the "Alert" example. The spined styli are also somewhat shorter, and rarely exceed 0·08 mm. in length. The specimen is slightly water-worn, but still retains its purple colour.

A single specimen is present in the collection from Tuggerah Beach.

FAMILY AXINELLIDÆ.

AXINELLA, *Schmidt*.

AXINELLA AURANTIACA, *Lendenfeld*.

Axinella aurantiaca, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 235, pl. v., fig. 1.

The types (No. 244 dry, and No. 245 in spirit from which the photograph was taken for the illustration) have been subjected to a careful examination, and also other specimens from Lake Illawarra.

I find that the spicules do not agree with the original description. The skeleton is stated to "consist of dense network of slightly curved styli." In the skeleton of the figured type, the fibres are composed of slightly curved oxea, more or less bound together by long sinuous strongyla, which are usually disposed at right angles to the columns of oxeote spicules in the main fibres.

I failed to find a single styli *in situ*, but observed two or three in a mass of spicules obtained by boiling a piece of the sponge in nitric acid.

Megascleres—(a) Slightly curved oxea, either abruptly pointed or tapering gradually from the middle. Size—Variable, from 0·25 to 0·35, by 0·007 to 0·012 mm. (b) Strongyla curved or sinuous. Size—From 0·5 to 1·5, by 0·003 to 0·006 mm.

Two well preserved specimens were obtained at Lake Illawarra.

CIOCALYPTA, *Bowerbank*.

CIOCALYPTA COMPRESSA, *Carter, sp.*

(Plate xi., fig. 16).

Leucophloeus compressa, *Carter*, Ann. Mag. Nat. Hist., (5), xii., 1883, p. 324, pl. xiv., fig. 16.

Ciocalypta compressa, *Dendy*, Proc. Roy. Soc. Vict., (n.s.), ix., 1897, p. 240.

Two specimens were obtained at Lake Illawarra. They agree with published descriptions. A few of the larger oxea are, however, much stouter than in *Dendy's* example (R.N. 961), and measure 0·4 by 0·014 mm.

HORNY SPONGES.

ORDER MONOCERATINA.

FAMILY AULENIDÆ.

AULENA, *Lendenfeld*.

AULENA GIGANTEA, var. MICROPORA, *Lendenfeld*.

Aulena gigantea, var. *micropora*, *Lendenfeld*, Proc. Linn. Soc. N.S.W., x., 1886, p. 849; *id.*, Aust. Mus. Cat., xiii., Sponges, 1888, p. 232; *id.*, Mon. Horny Sponges, 1889, p. 100, pl. ix., fig. 2.

Three beach-worn examples of this variety were obtained at Tuggerah Beach, and two from Port Jackson.

FAMILY SPONGIDÆ.

SUB-FAMILY EUSPONGINÆ.

CHALINOPSILLA, *Lendenfeld*.

CHALINOPSILLA IMPAR, *Carter, sp.*

Dactylia impar, *Carter*, Ann. Mag. Nat. Hist., (5), xv., 1885, p. 309. *Chalinopsilla impar*, *Lendenfeld*, Mon. Horny Sponges, 1889, p. 146, pl. i., fig. 9, pl. iii., fig. 12.

Several examples are hesitatingly referred to this species. The branches are thinner and broader than in examples from Port Phillip. The main fibres, however, are filled with the same kind of large isolated sand grains.

The specimens were obtained at Lake Illawarra.

CHALINOPSILLA DICHOTOMA, *Lendenfeld.*

Chalinopsilla dichotoma, Lendenfeld, Proc. Linn. Soc. N.S.W., x., 1886, p. 570; *id.*, Aust. Mus. Cat., xiii., Sponges, 1888, p. 102; *id.*, Mon. Horny Sponges, 1889, p. 142, pl. i., fig. 1, pl. ii., fig. 4, pl. iii., figs. 3 - 11.

A single example of this species was obtained at the Hawkesbury River.

CHALINOPSILLA ARBOREA, var. MACROPORA, *Lendenfeld.*

Chalinopsilla arborea, var. *macropora*, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 110; *id.*, Mon. Horny Sponges, p. 150, pl. i., figs. 5, 10.

A small water-worn example is present in the collection from Port Stephens.

PHYLLOSONGIA, *Ehlers.*PHYLLOSONGIA DENDYI, var. DIGITATA, *Lendenfeld.*

Phyllospongia dendyi, var. *digitata*, Lendenfeld, Mon. Horny Sponges, 1889, p. 178.

Two examples of this variety were obtained at Lake Illawarra. There are numerous specimens in the Museum. At Jervis Bay it is fairly common about low-tide line.

The sponge is more or less frondose in habit, and usually consists of numerous lamellæ and digitate processes. One specimen is 120 mm. high, 100 mm. broad, and the main lamina is 5 mm. in thickness. The surface is minutely conulose, with many scattered pores, about 0.5 mm. in diameter. In the deep folds of the lamellæ, and also between the digitations, a moderate number of circular openings are present, measuring from 1 to 5 mm. in diameter. The main fibres are uneven, trellis-like, and cored with abundant spicule fragments and small sand grains.

Specimens from Western Australia are generally more regular in form and the lamellæ somewhat thinner than in the variety *digitata*, Lend., and agree closely with the description and figure of *P. dendyi*, var. *frondosa*, Lendenfeld.

LEIOSELLA, *Lendenfeld.*LEIOSELLA LEVIS, *Lendenfeld.*

Leiosella levis, Lendenfeld, Proc. Linn. Soc. N.S.W., x., 1885, p. 536; *id.*, Aust. Mus. Cat., xiii., Sponges, 1888, p. 121; *id.*, Mon. Horny Sponges, 1889, p. 213, pl. xii., fig. 14, pl. xv., fig. 6, pl. xx., fig. 14.

Numerous examples of this well marked species are in the collection from Lake Illawarra.

LEIOSELLA FLABELLUM, *Lendenfeld.*

Leiosella flabellum, Lendenfeld, Mon. Horny Sponges, 1889, p. 218, 1889, fig. 2.

Two specimens were obtained at Lake Illawarra.

LEIOSELLA SILICATA, *Lendenfeld*.

Leiosella silicata, Lendenfeld, Proc. Linn. Soc. N.S.W., x., 1886, p. 545; *id.*, Aus. Mus. Cat., xiii., Sponges, 1888, p. 122; *id.*, Mon. Horny Sponges, 1889, p. 215, pl. xii., fig. 1, pl. xx., figs. 12, 13, 16, pl. xxi., fig. 3.

This species is frequently washed up on our coastal beaches after heavy gales. There are four examples: two from Lake Illawarra and two from Tuggerah Beach.

The type specimen is evidently only a young form or a fragment, judging from the examples now under notice. The measurements of the type are 70 mm. in length, 40 mm. in breadth, and 20 mm. in height. A specimen from Lake Illawarra is 100 mm. in height, 224 mm. in length, and 180 mm. in breadth. The sponge consists of a series of lamellæ, from 5 to 15 mm. thick, generally forming irregular cups, which vary in size from a few mm. in depth and width to 100 or more mm. The margins of the cups are thick, and either rounded or truncated, with numerous depressions, like such as would be produced by pressure from the tips of fingers, depressions of the same kind occur more or less on all parts of the surface. The line of coalescence between two or more cups is usually distinct, depressed, and marked by numerous vent-like openings, generally under 1 mm. in diameter. Similar apertures are scattered over the whole surface, but they are better defined on the outer aspect of the walls. The secondary fibres exhibit a single axial row of regularly arranged spicules of many kinds. The texture is like that of the finest bath sponge, soft and velvet-like to the touch.

EUSPONGIA, *Bronn*.EUSPONGIA IRREGULARIS, var. SILICATA, *Lendenfeld*.

(Plate xii., figs. 17–17a).

Euspongia irregularis, var. *silicata*, Lendenfeld, Proc. Linn. Soc. N.S.W., x., 1886, p. 495; *id.*, Aust. Mus. Cat., xiii., Sponges, 1888, p. 134; *id.*, Mon. Horny Sponges, 1889, p. 225, pl. xiii., fig. 1, pl. xxi., fig. 10.

This variety is very common on the coastal beaches, and attains to a very large size. The description, as given in the Monograph of Horny Sponges, is not sufficiently accurate—as regards the larger specimens—for identification. The contents of the fibres are not correctly described, if the single spirit specimen (No. 54) in the Lendenfeldian collection is rightly named.

There are seven well grown examples in the Fisheries' donation, and very many others on exhibit and in the duplicate collection. These are, however, all beach-worn to some extent, and present characters not evident in the small spirit specimen.

The sponge, in its young state, is often massive, higher than broad, with incipient vertical lamellæ in the form of strongly developed ridges. In well grown adult specimens the sponge

consists of flabellate expansions, more or less semicircular in outline, with several points of attachment along the base, and frequently there are one or more vertical lamellæ placed at right angles to the main frond. The height is usually about equal to the breadth; the basal portion measures from 20 to 30 mm. in thickness, at the distal fourth the lamina gradually decreases in diameter and the upper margin is subacute. The surface bears numerous conuli, from 1 to 6 mm. high, the average being about 5 mm.; they are arranged in circles, and surround the funnel-shaped inhalant pores; the raised margins of the latter, with the conuli, form elevated longitudinal or subradiate ridges about 5 mm. wide. The pores are from 1 to 2.5 mm. in diameter. The spaces between the ridges are occupied by grooves 4 mm. in width; they are generally well developed near the distal margin, but frequently they are continuous from the base to the summit; in transverse section they form half or two-thirds of a circle; in many cases they are tubular at their origin, but rarely circular at their termination. In the massive lobose forms there are numerous scattered oscula on the sides of the lamellæ, but they are more abundant on the margins no matter what the shape may be, their diameter varies from 3 to 8 mm. Texture in the dry state very hard and scarcely compressible between the fingers; when wet, moderately soft, very tough, and highly elastic. This variety would be useful for any purpose requiring a firm, tough, durable sponge. Colour varying from dark yellowish- to purplish-brown.

Skeleton.—The arrangement of the fibres and their diameter agrees with the description; they are remarkable for their uniformity in thickness. The foreign spicules in the spirit specimen and also in all the others examined, are never so numerous as to form "a dense axial column"; they are generally two or three in a row and are very scarce in the central parts of the sponge, becoming more frequent as the surface is approached. The fibres of the conuli have an axial core, consisting of one or two rows of foreign spicules, and in well preserved specimens numerous spicules occur outside the fibres.

EUSPONGIA IRREGULARIS, var. *AREOLATA*, var. *nov.*

(Plate xii., fig. 18).

Sponge usually consisting of a main semicircular flabellate lamina, which gives off at right angles from one to four or more short lateral leaflets; the latter rarely reach to the upper margin of the main frond. The main lamina is usually about 25 mm. in thickness at the base; the average thickness is about 10 mm. The apical margins are subacute and 5 mm. in diameter. The upper semicircular margin presents a few large circular oscula, ranging from 5 to 20 mm. in diameter. On the external surface their course is more or less marked on each side by prominent rounded longitudinal ridges, and the apical external diameter of the elevated

oscula is often three or four times greater than the edge of the lamina. The margins of the oscula are generally prominent and serrated. The serrations, when viewed in profile—by transmitted light—are seen to be the terminations of dense longitudinal bundles of fibres. Numerous smaller oscula are scattered over the surface and along the margins; they are not prominent, and often the outer wall is incomplete, they are open externally, forming deep grooves which are variable in length, sometimes extending from the base to the summit; frequently near the summit, deep grooves are present on both surfaces, with a thin central partition between them. The surface exhibits numerous grooves besides those which terminate at the margin; these are separated by high irregular ridges, or a series of isolated columns, both of which are apically clothed with numerous rigid villi from 1 to 3 mm. high. The inhalent pores are very abundant, and are scattered all over the surface; their diameter is 1 mm. or less, and about the same distance apart. A series of larger openings is present here and there in the walls of the oscula and scattered over the ridges of the lamina; they are very irregular in shape and rarely circular. Texture in the dried condition, soft, elastic, but rather harsh to the touch. Colour grayish to dark fawn.

Skeleton net consisting of a close, fine reticulation. The main fibres are rather sinuous, and cored with sand grains and spicule fragments, the latter predominating; they are 0.05 mm. in diameter, and from 0.2 to 0.5 mm. apart. The stouter secondary connecting fibres are rather scarce; they are 0.03 mm. in diameter and together with the primaries form an open network, with elongated or angular mesh, about 0.1 by 0.2 mm. The spaces between primaries and the stouter secondaries are filled with slender much branched fibres, which form a very close reticulation; the fibres are generally about 0.01 mm. in diameter.

Five specimens are in the collection from Lake Illawarra. This variety is not uncommon on the coast near Sydney.

EUSPONGIA ILLAWARRA, *sp. nov.*

(Plate xii., fig. 19).

Sponge flabellately expanded; the base measures 200 mm. in length and from 80 to 100 mm. in width, and has several points of attachment. The upper margin is semicircular in outline, and about 30 mm. in thickness in the centre, the lateral margins become thinner and are subacute at their extremities. The height of the frondose lamina is 140 mm. The whole of the margin and several side processes are osculiferous at the summit. The oscula are closely placed, and are separated by walls from 1 to 2 mm. in thickness, the walls on the outer aspect of the margin are often wanting, and when viewed from above consist of about two-thirds of a circle. At the vertex of the margin the oscula form a transverse row; laterally they decrease in number, and at the extremities

they consist of a single series; their diameter is usually about 4 mm. The surface is fairly even and marked by a raised reticulation, consisting of ridges, surmounted by rather broad conuli about 5 mm. high, which tend to become seriate and follow the course of the oscula. The inhalent pores are scattered in abundance between the conulose ridges; they are funnel shaped, rather deep seated, and measure from 1 to 3 mm. in diameter; the conuli are on an average about 2.5 mm. apart.

The dried skeleton is soft and very elastic; when wet it is tough, elastic, and apparently very durable. Colour, light yellowish-brown. The main fibres are entirely free from foreign bodies, such as sand grains and spicule fragments; they are not readily distinguishable from the stouter secondaries; here and there in the central region they are trellis-like in their arrangement; usually they are 0.08 mm. in diameter, and 0.2 mm. apart. The secondary connecting fibres are generally curved, the stouter measure 0.06 in diameter, and the slender kind are about 0.03 mm. or less; the latter occur near the surface and in the less dense parts of the sponge. The skeleton mesh is generally angular or polygonal, about 0.15 mm. in diameter; the angles or corners are sharply defined, and exhibit little or no thickening at the juncture of the fibres. The above description is based on two examples from Lake Illawarra. A third specimen from Tuggerah Beach differs in shape, is much coarser in appearance, and the texture is more open. The example is only a fragment of a very large sponge; it measures 200 mm. in height, 250 mm. in length, and about 120 mm. across the broad, flat, upper border, which exhibits fourteen oscula in a tranverse row. The external surface and the fibres do not differ from those described above. This sponge is by far the best occurring on the coast, and is equal, if not superior, to many of the commercial sponges procurable in Sydney.

EUSPONGIA OFFICINALIS, var. *SPINOSA*, *Lendenfeld*.

Euspongia officinalis, var. *spinosa*, Lendenfeld, Mon. Horny Sponges, 1888, p. 273, pl. xxii., fig. 14.

A single example of this form was obtained at Coogee Bay. The specimen is incrusting, and measures 130 mm. in length and 90 mm. in breadth; on one side it is 50 mm. in height, and on the other from 5 to 15 mm. The upper surface exhibits numerous pit-like depressions from 10 to 20 mm. in diameter, and a series of irregular ridges, surmounted by numerous oscula, from 2 to 3 mm. wide; frequently the outer margins of the oscula are incomplete on one side; this marks the termination of a groove which is often branched at its origin. Occasionally the oscula are surrounded by shallow branched grooves. The surface is minutely villose and extremely harsh to the touch; this harshness is due to the number of spicules in the slender terminal fibres forming

the villi. Texture in the dried condition firm but not very elastic; when wet fairly soft and elastic, but easily torn.

A second example in the Museum collection, from Maroubra Bay, measures 80 mm. in height and 60 mm. in diameter at the middle. There is a small attachment base, and an indistinct peduncle; the surface exhibits shallow pits and low short ridges, with numerous oscula surrounded by more or less evident grooves.

EUSPONGIA OFFICINALIS, var. *DURA*, Lendenfeld.

(Plate xii., fig. 20).

Euspongia officinalis, var. *dura*, Lendenfeld, Proc. Linn. Soc. N.S.W., x., 1886, pp. 531 and 533; *id.*, Aust. Mus. Cat., xiii., Sponges, 1888, p. 130; *id.*, Mon. Horny Sponges, 1889, p. 275, pl. xii., fig. 2, pl. xxii., fig. 7.

A single massive specimen (No. 58) is present in the Lendenfeldian collection. According to the Register it was purchased from the late J. F. Bailey, of Melbourne, and was obtained in Western Australia. It is very similar to the specimen figured, and is probably half of the original.

There are three specimens from Lake Illawarra.

The sponge is incrustating, massive or flabellate, with one or more vertical lamellæ attached to the sides of the main frond. The marginal ridges in two examples are somewhat acute, and bear two or more rows of oscula, about 2 mm. in diameter; at the sides of the margins they are frequently incomplete, the outer wall is wanting, and they appear as grooves from 30 to 40 mm. in length, and 1 to 15 mm. in diameter. In a third specimen the upper margin and side lobes are broad at the apices, and bear several rows of oscula, from 2 to 4 mm. in diameter, there are also a few scattered over the sides of the lamellæ. The surface is closely covered with small slender conuli, 2 or 3 mm. high; they are somewhat seriate and disposed longitudinally, with shallow depressions between, in which the inhalent pores occur. The pores are about 1 mm. or less in diameter; transversely they are 1 or 2 mm. apart; longitudinally they are often remote, and separated by spaces of from 3 to 5 mm. Texture when dry, close, hard, and incompressible; when wet, tough, firm, and highly elastic. Colour bright sandy yellow. Height of larger example 120 mm., breadth 130 mm., the lesser diameter varying from 15 to 30 mm.

The skeleton agrees fairly well with the description. In the neighbourhood of the stouter main fibres the arrangement is often trellis-like, the connecting fibres are rather stout and slightly exceed the measurements given in the original diagnosis.

According to Lendenfeld, this variety is identical with *Spongia liqnea*, Hyatt, from near Sydney, New South Wales.

EUSPONGIA PIKEI, *Hyatt, sp.*

(Plate xii., figs. 21 - 21 a).

Stelospongia pikei, Hyatt, Mem. Bost. Soc. Nat. Hist., ii., 4, 1877, p. 532, pl. xvii., fig. 20.

Euspongia pikei, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 132; *id.*, Mon. Horny Sponges, 1889, p. 279, pl. xxii., figs. 3, 8, 12.

This species is represented in the Lendenfeldian collection by two specimens, one (No. 57) from Port Chalmers, New Zealand, and the other (No. 351) from the coast of New South Wales.

In habit the sponge varies from half-cup shape to subflabellate, and in some specimens it is flabellate, with numerous lobate processes. The sponge may be pedunculate, or have a broad base of attachment. The lamellæ rarely exceed 130 mm. in height, 80 to 100 mm. in breadth, and 10 mm. in thickness. The oscula are between 2 and 3 mm. in diameter; they occur on the rounded margins and are also scattered over the convex surfaces, where they are often prominent. The whole surface is covered with minute conuli, which are situated on the slightly elevated ridges of the reticulation; between the ridges numerous inhalent pores are situated, their diameter is about 1 or 2 mm., and rather less than that distance apart. Texture in the dry condition, light, spongy, moderately firm and elastic, but easily breaking with slight pressure. Colour, yellowish-gray, with a dull surface, quite unlike that of any other *Euspongia* known to the writer.

Skeleton consisting of bundles of trellised main fibres, which curve gracefully outwards towards the surface, these are connected by a series of very fine secondaries. The track of the main trellised bundles is marked by the presence of a thick line of foreign bodies; the latter appear to be cemented in the spaces of the trellised fibres, and do not, so far as I can determine, form an axial core in the fibres. The stouter trellis-like bundles are from 0.3 to 0.5 mm. apart, and often 0.5 mm. in diameter, with two or more strands of foreign bodies. The more slender bundles usually have a single thread of sand grains, and are from 0.1 to 0.2 mm. in diameter. The individual main fibres are 0.04 mm. in diameter, and are usually separated by spaces about 1 mm. or less. The secondaries measure about 0.01 mm.; the mesh is angular and frequently elongate, with the longer diameter transverse to the trellised bundles; length of mesh 0.1 mm.

The form described above closely agrees with Hyatt's figure; the description has been chiefly drawn from the dry example named *Euspongia pikei*, by Dr. Lendenfeld (No. 351); the latter author, in his account of the skeleton, states that "The main fibres of the skeleton are irregular, flattened, and perforated trellis-like. These perforated plates attain a maximum breadth of 0.25 mm. No foreign bodies are observed in them." If the

latter remarks were intended to apply to the single fibres they are probably correct. But a longitudinal section of the specimen bearing the name of *Euspongia pikei* in Dr. Lendenfeld's handwriting, and numbered 351, contains dense axial strings of sand grains in each bundle of trellised fibres, and under a low power this character is very peculiar, and would at once arrest the attention of the observer. These foreign bodies are present in every specimen examined; they appear to be cemented in the spaces of the trellis work and attached to the fibres. Even in specimens that have been washed about on the beach to such an extent as to lose nearly all their external characters, these strings of sand grains are still present.

There are two examples from Lake Illawarra, and two from Tuggerah Beach.

HIPPOSONGIA, *Schulze*.

HIPPOSONGIA EQUINA, var. ELASTICA, *Lendenfeld*.

(Plate xii., fig. 22).

Hippospongia equina, var. *elastica*, Lendenfeld, Mon. Horny Sponges, 1889, p. 307, pl. xvi., fig. 1.

This species is represented by seven specimens from the following localities—Botany Bay, Lake Illawarra, and Tuggerah Beach.

The largest example measures 200 mm. in height, 260 mm. in its greater and 220 mm. in its lesser diameter.

HIPPOSONGIA MOLLISSIMA, *Lendenfeld*.

(Plate xiii., fig. 23).

Hippospongia mollissima, Lendenfeld, Mon. Horny Sponges, 1889, p. 310, pl. xvii., fig. 13.

A single specimen is in the collection from Lake Illawarra.

The example is subglobose, about 100 mm. broad and 60 mm. in height.

HIPPOSONGIA CANALICULATA, var. ELASTICA, *Lendenfeld*.

Hippospongia canaliculata, var. *elastica*, Lendenfeld, Proc. Linn. Soc. N.S.W., x., 1886, p. 502; *id.*, Aust. Mus. Cat., xiii., Sponges, 1888, p. 139; *id.*, Mon. Horny Sponges, 1889, p. 321, pl. xii., figs. 4-5, pl. xviii., fig. 1, pl. xix., figs. 2, 3, 4, 7.

A single specimen of this variety was obtained at Lake Illawarra. It measures 100 mm. in height and 20 mm. in breadth.

COSCINODERMA, *Carter*.

COSCINODERMA Densa, *Hyatt*, *sp.*

(Plate xiii., figs. 24 - 24a).

Spongelia farlovii, var. *densa*, Hyatt, Mem. Bost. Soc. Nat. Hist., ii., 4, 1877, p. 536.

This species is frequently found on the coast, more especially at Wollongong. There are two examples in the Fisheries donation from Lake Illawarra, and two from Port Stephens.

The sponge is unusually flabellate, and higher than wide; generally there is a short compressed peduncle, which is often sharply defined, but occasionally it gradually merges into the lamina; the latter varies in outline, but in most cases it is sub-orbicular. The surface invariably exhibits elevated, rounded ridges, which indicate the course of the oscula tubes; they are strongly marked near the margin, at least on one side, and frequently on both. There is also a series of shallow depressions scattered irregularly over the general surface. In some specimens the main lamina gives off at right angles small oscula bearing ridges or lamellæ, which often attain to nearly the size of the original frond. The oscula are from 1 to 5 mm. in diameter; they occur at regular intervals along the upper border, and sometimes they surmount a prominent ridge or lobe at the sides of the lamina. The whole surface of the sponge exhibits a great number of inhalent pores 0·6 to 0·8 mm. in diameter, and about 1 mm. or less apart. Numerous branching grooves are present here and there, being well marked at the base and also near the margin; their width is usually under 1 mm. Texture fine, very dense, hard and highly elastic. Colour, bright yellowish-brown.

The skeleton is arranged as in *Coscinderna lanuginosa*, Carter; the fibres are, however, stouter, especially the secondaries, and the mesh is much finer; the main fibres are interruptedly cored with smaller foreign bodies. These consist of spicule fragments and sand grains; generally they are arranged in a single row, and only occupy about one-third of the dense and strongly laminated horny fibre. The primary fibres are about 0·15 mm. in diameter, and from 0·2 to 0·4 mm. apart. The longitudinally arranged main fibres of the central region are usually without foreign bodies; the stouter transverse fibres have an interrupted core, which becomes continuous as the surface is approached. The connecting fibres are free from deposits of sand grains; they vary from 0·04 to 0·08 mm. in diameter, and their distance apart rarely exceeds 0·2 mm. in the centre, and from 0·5 to 0·1 mm. near the surface.

Specimens of this species have been compared with examples of *Coscinoderma lanuginosa*, Carter, from Port Phillip, and also with a mounted section from a specimen in the British Museum. It exhibits several important differences, which may be enumerated as follows:—The texture is closer, the inhalent pores are smaller; the oscula are more numerous, less in diameter, and never project so as to give a serrated outline to the margin. The largest specimen measures 300 mm. in height, 250 mm. in width, and from 7 to 25 mm. in thickness; the peduncle is 60 mm. in length, 10 mm. in thickness at its juncture with the frond, and about 40 mm. at the base. A smaller example is 180 mm. in height,

130 in breadth, and 10 mm. in thickness, the peduncle is 75 mm. in length, 5 mm. in its lesser and 35 mm. in its greater diameter.

Thorecta farlovii, Lendenfeld,²¹ is undoubtedly distinct from the var. *densa*, Hyatt,²² as figured on plate xvii., yet this fig. 14 is quoted in the Monograph under *T. farlovii*.

Hyatt's illustration clearly exhibits "superficially extending oscula tubes and corresponding grooves in the skeleton," which ought—according to the definition of the genus *Thorecta*—to forbid its admission as a species of that genus.

The following remarks in reference to the affinities of the genus *Thorecta* are sufficient to show that the author of them had not seen examples of Hyatt's var. *densa*:—"We may derive it [the genus *Thorecta*] from *Coscinoderma*, which it resembles very closely in the structure of the canal system, and the peculiar arenaceous cortex, by assuming that the skeleton-net, which is very dense in *Coscinoderma*, has become looser, the meshes wider, and the fibres stouter."

It is very unlikely that a form such as the var. *densa*, Hyatt,—which is closer in texture than the type of the genus *Coscinoderma*—would be placed in the genus *Thorecta*. (See Plate xiii., fig. 27)

It seems highly probable that *Thorecta farlovii*, Lendenfeld, is identical with *Spongelia palmata*, Hyatt; it does not agree with Hyatt's figure 15 on plate xvii., but with one of the "two other specimens" mentioned on page 532. Hyatt remarks that "The largest is a foot broad by nine inches in height, and the surface is pitted with shallow depressions or hollows, about one half of an inch in diameter." The above lines apply to a sponge which is not uncommon on the coast, of which I have seen very many specimens. Lendenfeld's figures of *T. farlovii* are good representations of this form, but it is quite distinct from *Spongelia farlovii*, var. *densa*, Hyatt. A comparison of the figures is sufficient to prove their distinctness. Hyatt's figure exhibits a series of "superficially extending oscula tubes," and presents a broken surface on the left lower portion of the frond, which clearly indicates the density of the sponge. Such a broken surface is scarcely possible in a soft wide meshed sponge.

If the whole of the evidence afforded by the preceding remarks, and the published descriptions and figures are duly considered, it will be seen that *Spongelia farlovii*, var. *densa*, Hyatt, really

²¹ Lendenfeld—Mon. Horny Sponges, 1889, p. 353.

²² Hyatt—Mem. Bost. Soc. Nat. Hist., ii., (4), 1887, p. 536, pl. xvii., fig. 14.

belongs to the genus *Coscinoderma*, and that *Thorecta farlovii*, Lendenfeld, is identical with *Spongelia palmata*, Hyatt.

SUB-FAMILY APLYSININÆ.

THORECTA, *Lendenfeld*.

THORECTA MURRAYI, *Poléjaeff*.

Cacospongia murrayi, Poléjaeff, Chall. Rept., Zool., ii., 1884, p. 57, pl. iv., fig. 3.

Thorecta murrayi, Lendenfeld, Mon. Horny Sponges, 1889, p. 347, pl. vi., fig. 8.

A single specimen was obtained at Tuggerah Beach.

THORECTA CACOS, *Lendenfeld*.

Thorecta cacos, Lendenfeld, Mon. Horny Sponges, 1889, p. 349.

Two specimens are in the collection from Lake Illawarra.

Hitherto recorded from South Australia.

THORECTA RADIATUS, *Lendenfeld*.

(Plate xiii., fig. 26).

Thorecta radiatus, Lendenfeld, Mon. Horny Sponges, 1889, p. 350.

A single small specimen from Port Jackson is here doubtfully referred to this species. The example is pedunculate and flabellate; it is 130 mm. high, 95 mm. broad, and 25 mm. thick in the centre; the lamina is sublenticular, and rapidly decreases to the margin. The apical border is convex, and bears six oscula; the central ones are rather prominent, and measure about 7 mm. in their longer diameter. When viewed by transmitted light the main fibres are seen to be beautifully radiate and gracefully curved outwards, and in the lower half downwards, so that extremities of the fibres are lower than their origin at the centre of the sponge. The secondary fibres are not very evident at the surface; the main fibres are very conspicuous, and are radiately arranged. The texture is very similar to *Thorecta exemplum*, var., *marginalis*, but the surface lacks the reticulation which forms such a marked feature of that species.

The main fibres are somewhat knotty, and cored with abundant sand grains; the secondaries are slender and generally at right angles to the primaries in the denser parts, with oblong or square mesh. Near the surface the mesh becomes more irregular, and the sand-cored fibres are very abundant.

THORECTA MEANDRINA, *Lendenfeld*.

Thorecta meandrina, Lendenfeld, Mon. Horny Sponges, 1889, p. 350, pl. xxiii., fig. 6.

Four examples are referred to this species. The sponge has several points of attachment, and consists of a series of meandering lamellæ; the oscula are thickly scattered along the margins of the lamellæ, and occasionally on the sides; their diameter varies from 2 to 3 mm. The whole surface, except the margins, exhibit numerous inhalent pores about 1 mm. in diameter. The main fibres terminate at the surface, giving it a hispid appearance like that of *Thorecta tenuis*, Hyatt. The texture is, however, much closer, and the surface more even. The main fibres are interruptly cored with sand grains, and are very uneven, especially at the nodes, or rather at the points of origin of the secondaries. The largest example is 170 mm. in length, 100 mm. in height, and 140 mm. in breadth; the lamellæ vary from 15 to 40 mm. in thickness.

Four specimens from Swansea.

THORECTA TENUIS, Hyatt.

(Plate xiv., figs. 28 – 28a).

Spongelia rectilinea, var. *tenuis*, Hyatt, Mem. Bost. Soc. Nat. Hist., ii., (4), 1877, p. 537, pl. xv., fig. 13.

Thorecta exemplum, var. *prima*, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 143; *id.*, Mon. Horny Sponges, 1889, p. 357, pl. xxiv., fig. 7.

This species is well represented in the Fisheries and the Museum collections.

A specimen from Lake Illawarra is the exact counterpart of the example figure by Hyatt in every character except size. It measures 140 mm. in height, 160 mm. across the cup, and the cavity is 145 mm. in depth; the attachment base is 50 mm. in its lesser and 110 mm. in its longer diameter. The wall of the cup is from 15 to 25 mm. in thickness.

Another example from Botany Bay, with the sand cortex more or less complete, equals Hyatt's specimen in size, the height being 223 mm. The peduncle is generally short, very broad, and often exhibits a series of root-like processes around the outer margin. The external surface in the cup-shaped forms is usually ornamented with broad, rounded, longitudinal ridges, which are strongly marked at their origin and gradually fade away towards the upper margin; the larger ridges have a corresponding depression on the inner side of the cup. In the valleys between the ridges there are numerous inhalent pores about 1 mm. or less in diameter; on other parts they are indistinct, and when the cortex is intact they are difficult to see without a lens. The inner surface exhibits a great number of oscula from 1 to 2.5 mm. in diameter; they become smaller as the margin is approached, and cease at about

10 or 15 mm. from it. The texture is close, hard, scarcely compressible between the fingers, and very harsh to the touch; water-worn examples are, however, frequently soft, and easily yield to pressure. Colour, brownish to yellowish-olive; after long exposure yellowish-grey.

Skeleton—With stoutish knotty main fibres, cored with very unequal sand grains; the arrangement of the fibres is very peculiar; they present a feature which has not been noted. In section the wall of the cup exhibits a narrow excentric column of fibres, which are parallel, longitudinal, and situated much nearer the inner surface than the outer. On the inner side of the column the lateral branches and terminal ends of the fibres are short and obliquely bent upwards. On the outer side they are long and gracefully curved in their basal third or half, thence straight, parallel, and at right angles to the column. The ends of the main fibres are thus presented to the outer surface, rendering it bristly in appearance and harsh to the touch. The diameter of the fibres is about 0.2 mm., and they are from 0.8 to 1 mm. apart. The secondary fibres are 0.1 mm. or less in diameter; they are usually at right angles to the primaries, with square or oblong mesh 0.3 to 0.5 mm. in diameter; near the surface the fibres are finer, more branched, and the mesh becomes angular and smaller.

In the Catalogue of Sponges, and also in the Monograph, *Spongia rectilinea*, var. *tenuis*, Hyatt, is treated as being identical with *Thorecta exemplum*, var. *secunda*, Lendenfeld. How this conclusion was arrived at I fail to comprehend. Hyatt's var. *tenuis*, as figured on Plate xiv., is certainly very different in form from Lendenfeld's var. *secunda*, as illustrated on Plate xxvii. in the Monograph. The latter are more or less pyriform in outline, and are described as having a peduncle, which "measures in large specimens at the base about 4 mm." Hyatt states that his figures are all reduced to about one-fourth the original size. The basal diameter of his figured specimen would, therefore, be about 60 mm., and the height about 40 mm. The variety *secunda* is described as having the cup "very shallow," whilst variety *tenuis*, Hyatt, is stated to be "regular and vase shaped."

There are two specimens in the Lendenfeldian collection labelled *Thorecta exemplum*, var. *secunda*. No. 67 is in spirits; the lower portion of the sponge is wanting; the upper part is flabellate, and has a row of oscula on the thick rounded superior border; there is no trace of any central depression at the apex, and the fibres are cored with sand grains, which are described as being "free from foreign bodies." No. 74 is from the Northern Territory of South Australia, the specimen is dry and still retains some of the sand cortex. It is trumpet shaped, and 170 mm. in height; the peduncle is 8 mm. in the lesser and about 19 mm. in the greater

diameter. The cup is 65 mm. across and about the same in depth. A large osculum is present at the base, and numerous smaller oscula are scattered over the inner surface. The outer surface is reticulately ridged, with deep, rounded, or elongated pits between the ridges, especially in the upper portion of the sponge. The main fibres are cored with sand grains and foreign spicules; in some cases the axial core is dense, knotty, and continuous; in others the sand grains are wanting, or are remote from each other. Foreign spicules are often present, and frequently project from the fibres. There is a large example of this form in the exhibited collection from Henley Beach, South Australia. It measures 325 mm. in height, with a peduncle 120 mm. in length, and 20 mm. in thickness; the cup is 200 mm. in diameter across the summit, and 180 mm. in depth. The distal third of the outer surface presents a series of irregular longitudinal ridges, with deep wide valleys between. The lower two-thirds is thickly studded with angular processes 20 mm. high and about 10 mm. in thickness; they are often isolated, but generally they are more or less connected by thin bridges of fibre, which connect the ridges and processes and form the boundaries of the pits. The main fibres are charged with spicule fragments and large sand grains.

Thorecta exemplum, var. *prima*, Lendenfeld, is represented in the exhibited collection by five specimens named by the author (Nos. 66, 70, 71, 72, 73). No. 66 is exactly like No. 67 which is labelled *Thorecta exemplum*, var. *secunda*, neither of which agree with the descriptions. No. 70 to 73 are in accord with the diagnosis, and are undoubtedly young examples of *Spongelia rectilinea*, var. *tenuis*, Hyatt.

In the Fisheries collection there are over a hundred specimens of this form; they exhibit a great range of variation, from flabellate to half or complete cup-shaped, with almost every intermediate stage represented between them, from the simple pedunculate frond 50 mm. high and 55 mm. broad, and 3 mm. in thickness, to the massive vase-shaped kind, such as that illustrated by Hyatt. They all exhibit the same texture, arrangement, and contents of the fibres, their differences being confined to the shape, size, and the aspect of the outer surface: the latter, in immature flabellate or half cup-shaped examples, is often nearly smooth, whilst in some there are slight depressions, such as might be made by pressure from the tips of fingers; the depressions are rarely surrounded by raised ridges; in even the largest examples the depressions are always shallow, never deep and pit-like. Young specimens generally have a distinct peduncle; as growth proceeds this becomes broader, with scarcely any increase in length; this feature is constant, and certainly does not afford any evidence of affinity with the long-stalked form described as var. *secunda*.

The varieties *secunda* and *tertia*, of *Thorecta exemplum*, Lendenfeld, are very soft and elastic, whilst the var. *prima* (*tenuis*), Hyatt, is hard, rigid, and possesses very little elasticity.

THORECTA ERECTA, *Hyatt*.

(Plate xiv., figs. 29, 29a - e).

Spongelia rectilinea, var. *erecta*, Hyatt, Mem. Bost. Soc. Nat. Hist., ii., (4), 1877, p. 537, pl. xvii., figs. 12 - 13.

Thorecta exemplum, var. *secunda*, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 145; *id.*, Mon. Horny Sponges, 1889, p. 359, pl. xxiv., figs. 3 - 5.

Thorecta exemplum, var. *tertia*, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 145; *id.*, Mon. Horny Sponges, 1889, p. 359, pl. xxiv., figs. 3 - 5, pl. xxxiii., figs. 2, 3, 4, 6, 7, 10.

This species is represented by numerous examples, which exhibit great variation in habit. There are also six specimens, named by Dr. Lendenfeld, labelled *Thorecta exemplum*, var. *tertia*, Lendenfeld, and two bearing the name of *Thorecta exemplum*, var. *secunda*, Lendenfeld. The former are numbered as follows:—Nos. 65, 75, 76, 78, 79, 80, and in each case they agree with the diagnosis. Hyatt's description introduces an element of doubt as to whether his examples are identical with the variety *tertia*, Lendenfeld. According to the latter author, "The body of the sponge itself appears massive, conical, irregular, distended above. It attains a largest horizontal transverse diameter of 50 mm." . . . "Each osculum is slightly prominent. In large specimens there is generally one large osculum in the middle which measures 10 - 15 mm. in diameter, and a number of small oscular scattered around it." It will be noted that there is no mention made of a cup-like cavity at the summit, yet Hyatt's account states that "The inside of the cup is very shallow." From the above quotations and the specimens under examination, it appears to my mind that both forms are simply extreme variations of one species. There is a regular graduated series connecting the conical forms with those that are cup-shaped. Certain characters are common to both forms; these are: deep pits on the outer surface, a large central osculum (which may be seated on a conical elevation or at the bottom of a cup-like depression), and either with a series of smaller ones arranged around it, as in the latter, or with one or two occupying the lateral aspect of the ridge in those that are conical. The texture of the sponge is the same, and the contents of the fibres consist of large sand grains and foreign spicules.

The following brief descriptions will convey some idea of the variation exhibited by this species, all of which are more or less distinctly pedunculate:—

(a) Lobose; 130 mm. by 9 mm. across the flattened summit, and with numerous large scattered oscula, sides deeply pitted.

(b) Compressed, with a broad rounded semi-circular margin, bearing three or more oscula in a row, from 8 to 10 mm. in diameter. Sides deeply pitted, with the apertures directed upwards.

(c) Compressed, with one or two conical processes, surmounted by large oscular openings. Sides with distant shallow pits, and low angular ridges.

(d) Elongate, subcylindrical, with a single axial osculum, which extends downwards to the apex of the peduncle; surface with wide angular shallow pits.

(e) Subflabellate, with a narrow apical groove, in which are seated a row of large oscula and a number of small ones, about 2 or 3 mm. in diameter. Surface with few distant shallow depressions.

(f) Compressed, oblong, having a shallow apical cup about as wide as deep, and with or without a large central osculum, but invariably with a number of the smaller kind. External surface deeply pitted.

(g) Trumpet-shaped, with a shallow apical cup, the sides lined with numerous oscula, and with or without a large one in the centre. Surface deeply pitted.

(h) Regularly cup-shaped, with a wide deep cavity, which is evenly rounded at the bottom internally. The inner surface is closely sprinkled with oscula, from 3 to 4 mm. in diameter; the external surface exhibits high ridges, conical elevations, deep grooves, and pits.

In some examples the cup is incomplete, and is accompanied by conical osculiferous processes; in others there are two shallow depressions, each with a central funnel-shaped osculum.

In two specimens there are indications of three or four incipient cups at the summit. Each have a large central osculum, and many small ones on the sides of the depression.

Notwithstanding the great variation in shape and surface, the texture, arrangement, and the nature of the foreign bodies in the fibres are the same, in all the specimens examined.

THORECTA MARGINALIS, *Lendenfeld*.

(Plate xv., figs. 30, 30a - d.)

Thorecta exemplum, var. *marginalis*, Aust. Mus. Cat., xiii., Sponges, 1888, p. 147; *id.*, Mon. Horny Sponges, 1889, p. 361, pl. xxiv., fig. 2, pl. xxxiii., fig. 1.

This species displays considerable variation, and exhibits three marked forms with numerous intermediate stages between them, none of which approach towards *Thorecta tenuis* or *T. erecta*. The texture of the latter is not unlike that of *T. marginalis*, but all its remaining characters are different.

(a) Well developed specimens attain a height of between 200 and 300 mm.; one-fourth of the length consists of a compressed peduncle, twice or thrice as broad as thick; the expanded base usually has a few root-like processes. The upper three-fourths is generally tongue-shaped, widest above the middle, with the broad anterior and posterior surfaces concave, and the sides either flat or slightly convex. The angles bear seriate and somewhat elongate oscula, at fairly even distances apart; their shorter diameter is about 2.5 mm., and the longer about 4 mm. The upper extremity is thin, acute, and may either be truncated or pointed.

(b) This form rarely attains to more than half or two-thirds the height of (a). The peduncle is sharply defined, and is often sub-cylindrical, but usually a little broader than thick. The upper two-thirds of the sponge consists of three or four vertical lamellæ; four is the usual number, and a median transverse section would be more or less cruciform. The oscula are seriate and confined to the margins.

(c) In this form the peduncle is similar to that of the preceding. The lamella is strongly and longitudinally concave; a transverse section through the middle would be semi-circular, with even inner and sinuous outer margins. The inner surface is smooth; the outer often bears two or more low longitudinal ridges, and sometimes it is evenly convex. The oscula are confined to the convex surface, and are irregularly scattered. The position of the oscula are exactly the reverse of what obtains in *Thorecta tenuis* and *T. erecta*, in which they are confined to the concave surface. Another character which tends to show the distinctness of *T. erecta* is the frequent presence of large oscula; these are wanting in *T. marginalis*, and also in *T. tenuis*.

The main fibres contain very large sand grains, and near the surface a few spicule fragments. The sand grains are often isolated, and frequently about 0.5 mm. in diameter, whilst the fibre on each side of the grain is only about 0.15 mm. in width. Another peculiarity which is noticed in the original description is the tendency of the secondary fibres to form "trellis-like closer reticulations in the vicinity of the main fibres." The latter feature is not evident in *T. erecta* or *T. tenuis*.

THE following Table is a brief summary of the principal characters of *Thorecta tenuis*, *T. erecta*, and *T. marginalis*:—

Species.	Habit varying from	Peduncle.	Oscula.	Arrangement of Fibres.	Contents of the Fibres.
<i>Thorecta tenuis</i> .	Flabellate to deep vase-shape.	Short and broad.	Small, usually between 1 and 2 mm., confined to the inner surface	With an eccentric axial column, and short terminals on the inner, and long ones on the outer side of the column.	An interrupted axial column of sand grains.
<i>Thorecta erecta</i> .	Conical to shallow cup-shape.	Narrow and elongate.	Of two kinds— (a) Large, seated on conical elevations or at the base of the cups, 5 to 10 mm. (b) Small, 3 to 4 mm., confined to the inner surface of the cup.		Sand grains and spicule fragments
<i>Thorecta marginalis</i>	Ligulate to very deep half cup-shape.	Narrow and elongate.	Marginal or scattered on the outer surface.	Secondaries forming trellis-like bundles around the main fibres.	Large, isolated, sand grains and spicule fragments

THORECTA LOBOSA, *Lendenfeld*.

Thorecta lobosa, Lendenfeld, Mon. Horny Sponges, 1889, p. 365, pl. xxiii., fig. 4.

This species is represented by a single specimen from Tuggerah Beach.

THORECTA BYSSOIDES, (*Lam.*), *Lendenfeld*.

Thorecta byssoides, Lendenfeld, Mon. Horny Sponges, 1889, p. 365, pl. xxxiii., fig. 3.

This species is represented by three examples. One is pyriform, pedunculate, and has a single central osculum; the other two are flabellate, with indistinct oscula on the upper semi-circular margin. The texture is very open, and the fibres are densely charged with small sand grains, which occupy three-fourths of the fibres.

Three specimens from Port Stephens.

THORECTA PALMATA, *Hyatt*.

(Plate xiii., figs. 25 - 25a).

Spongelia palmata, Hyatt, Mem. Bost. Soc. Nat. Hist., ii, (4), 1877, p. 537, pl. xvii., fig. 15.

Thorecta jarlovii, Lendenfeld, Mon. Horny Sponges, 1889, p. 353, pl. xxiii., fig. 7, pl. xxiv., fig. 4.

This species is usually flabellate and much wider than high; the lamina arises from a compressed and often compound peduncle; in some examples the latter is simple, in others it is made up of several strands, which, although united in part or wholly, still retain their individuality. The frondose portion is mostly semi-circular in outline, with oblique lower borders; the latter are generally about equal to two-thirds of the height of the sponge. Both surfaces are marked with depressions arranged in concentric zones, their width and depth varying in different parts, and often they are almost imperceptible in some specimens; the depth of the wave-like depressions is generally proportionate to the thickness of the frond. In a specimen 16 mm. in thickness the depressions are not more than 3 or 4 mm. in depth; it agrees very closely with the specimen figured by Hyatt (pl. xvii., fig. 15). In another example 30 mm. in thickness, the depressions are from 6 to 10 mm. in depth, and in several larger and thicker specimens they are deeper in proportion. In some smaller specimens the frondose portion of the sponge is very thick, and the peduncle rather long. This form is well depicted by Lendenfeld's figure (pl. xxiv., fig. 4), in which the depressions are very deep. The oscula form a continuous row along the margin; they measure between 3 and 6 mm. in diameter, and are rarely more than their own width apart. The inhalent pores in the skeleton are not plainly visible, except on the lower central regions; they are from

1·5 to 2 mm. in diameter. Texture open, firm, and elastic. Colour, dark or reddish-brown.

Skeleton—Reticulate, with usually square mesh, but often oblong or angular; main fibres 0·5 to 0·15 mm. in diameter, and from 0·6 to 0·8 mm. apart; they are cored with foreign spicule fragments, and with a few large and many small sand grains, the diameter of the core being about half that of the fibre. The connecting fibres are free from foreign bodies; their diameter varies from 0·04 to 0·06, and they are generally about 0·3 mm. apart.

There are three specimens from the Hawkesbury River and three from Lake Illawarra.

SUB-FAMILY STELOSPONGINÆ.

STELOSPONGIA, *Schmidt*.

STELOSPONGIA LEVIS, *Hyatt*.

(Plate xv., figs. 32, 32a - b).

Stelospongia levis, Hyatt, Mem. Bost. Soc. Nat. Hist., ii., (4), 1877, p. 531, pl. xv., fig. 16.

Stelospongia levis, var. *rotunda*, Hyatt, *loc. cit.*, p. 531, pl. xvii., figs. 23-24.

Stelospongia levis (Hyatt), Carter, Ann. Mag. Nat. Hist., (5), xv., 1885, p. 303.

Stelospongia australis, var. *conulata*, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 168; *id.*, Mon. Horny Sponges, 1889, p. 516, pl. xxv., fig. 3.

Stelospongia australis, var. *jovea*, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 170, pl. xi.; *id.*, Mon. Horny Sponges, 1889, p. 518, pl. xxiv., fig. 8.

Stelospongia levis, as figured by Hyatt on plate xv. is strikingly like *Stelospongia australis* var. *jovea*, as figured by Lendenfeld on plate xi. in the Catalogue of Sponges. They are very similar in shape and in the terminations of the fibres at the surface. If the various descriptions are compared it is difficult to see where the differences come in, except in outward form, which is extremely variable, and ranges from broadly fusiform to globose, with a large central or excentric oscula; others again are lobose, or appear to be composed of several individuals having a common peduncle and numerous oscula which may be seriate or scattered. There are over 60 examples in the Fisheries collection, and scarcely any two are alike in habit. The surface is equally variable, the height and disposition of the conuli differing in the same

example. Lendenfeld objects to Hyatt's varieties on the ground that "the conuli vary in one and the same individual as much as in Hyatt's varieties." The latter remarks apply with equal force to the numerous examples under notice. The ends of the trellised columns of fibres project from the general surface from 3 to 5 mm.; they often consist of subcylindric bundles of from two to four fibres, which gives the surface a pilose aspect. In other cases the bundles are compressed, and form flat tufts from 1 to 3 mm. broad, and in very many examples there is a complete reticulation of narrow ridges spread over the whole body; frequently this reticulation is confined to the upper surface, the lower portion being covered with isolated tufts. There is a single flabellate specimen with a series of six marginal oscula; the surface does not differ from some of the globose examples. This is probably *Stelospongia levis*, Poléjaeff.

STELOSPONGIA CANALIS, Lendenfeld.

(Plate xv., fig. 31).

Stelospongia canalis, Lendenfeld, Aust. Mus. Cat., xiii., Sponges, 1888, p. 164; *id.*, Mon. Horny Sponges, 1889, p. 495, pl. xxiv., fig. 10.

Four examples of this are present in the Fisheries collection. There are also two named by Dr. Lendenfeld (Nos. 94 and 319). The specimen bearing the No. 319 was dredged by the writer, and recognised by the author of the species as *Cacospongia canalis*. When alive the colour was bright terra cotta. The main fibres of this species are described as being free from foreign bodies. In both the specimens No. 94 and 319 the main fibres contain a thin axial string of spicule fragments and very small sand grains. Similar foreign bodies are present in all the examples examined. This sponge exhibits considerable variation in habit. In many examples the habit is flabellate, without any distinct digitations; both surfaces are regularly and radiately grooved. The latter are usually opposite to each other, and terminate at the wavy semi-circular margin. Laterally, and here and there on the surface generally, there are numerous small branching grooves from 1 to 1.5 in diameter. The whole surface, including the grooves, are thickly covered with inhalent pores about 1 mm. in diameter. The flabellate forms usually have a short broad peduncle, and frequently possess one or more narrow vertical lamellæ. Other specimens are irregularly lobose, with fully formed or incipient digitations, with broad wavy grooves running up from the base to the summit; on the digitate processes there is as a rule only one groove, which is deeper and wider than those occurring in the flabellate examples. No. 319 yields the following measurements:—Height, 240 mm.; breadth, 150 mm.; thickness, from 20 to 30 mm.; digitations, from 30 to 90 mm. in length and

20 mm. in diameter at their origin, narrowing to about 10 mm. at the summits; grooves, about 8 mm. in diameter. A flabellate specimen measures 190 mm. in height, 250 mm. in breadth, and about 25 mm. in thickness; the grooves are from 3 to 4 mm. in diameter.

STELOSPONGIA FLABELLIFORMIS, *Carter*.

Stelospongia flabelliformis, Carter, Ann. Mag. Nat. Hist., (5), xv., 1885, p. 305.

Stelospongia flabellum, Lendenfeld, Mon. Horny Sponges, 1889, p. 501, pl. xxxix., fig. 6.

A single worn example is here doubtfully referred to this species. The specimen agrees with Lendenfeld's figure, and has been compared microscopically with two slides prepared from specimens named by Carter, one of which presents characters identical with the Lake Illawarra example. The main fibres consist of trellised columns, cored with sand grains; the diameter of the fibres is about 0.2 mm. The connecting fibres consist of a few stout kinds about 0.8 in thickness; these branch and give rise to a dense, close, felt-like network of extremely thin fibres, which fill up the interstices between the main and the stouter secondaries. The denser parts of the sponge, on the cut surface, appears like chamois leather in texture, the density being due to the abundance and fineness of the fibres. In appearance the specimen presents characters such as would be evident in half of the example figured by Lendenfeld without the peduncle. The colour is like that of a light-coloured bath sponge; the texture is hard, tough, and scarcely compressible; the surface is minutely conulose, and bears abundant inhalent pores from 0.5 to 1.5 in diameter. The central grooves are continuous and axially parallel; the lateral grooves are oblique and occasionally branched; their diameter is between 3 and 5 mm., and their depth is about 4 mm.

Locality, Lake Illawarra.

HIRCINIA, *Nardo*.

HIRCINIA VARIABILIS, *Lendenfeld*.

Hircinia variabilis, Lendenfeld, Mon. Horny Sponges, 1889, p. 557, pl. xxxvi., figs. 11 to 14.

Two specimens from Tuggerah Beach.

HIRCINIA AUSTRALIS, *Lendenfeld*.

Hircinia australis, Lendenfeld, Mon. Horny Sponges, 1889, p. 573, pl. xxxvi., figs. 7-9.

One example from Tuggerah Beach.

HIRCINIA CALICULATA, *Lendenfeld*.

Hircinia caliculata, Lendenfeld, Mon. Horny Sponges, 1889, p. 572.

Two specimens of this well marked species are present in the collection from Tuggerah Beach.

ORDER HEXACERATINA.

FAMILY APLYSILLIDÆ.

IANTHELLA, *Gray*.IANTHELLA FLABELLIFORMIS, *Pallas*.

Ianthella flabelliformis, Lendenfeld, Mon. Horny Sponges, 1889, p. 696, pl. xlvii., figs. 1, 4, 6, pl. xlvii., figs. 1-4, pl. xlix., figs. 1-3.

A single fragment of this species was obtained at the Hawkesbury River.

ADDENDUM.

During the heavy gales which swept our coast towards the end of June with such disastrous results to life and shipping, immense seas cast on the harbour and ocean beaches an enormous amount of marine products. Seaweed was piled up to a depth of three or four feet, and with it a vast quantity of animal life. Some of the heaps, composed of the smaller organisms, were simply large, brilliantly variegated mounds, containing representatives of a great proportion of our marine fauna and flora. In addition to the large and varied accumulation of seaweeds, the beaches were strewn with Fish, Ascidiæ, Molluscs, Crustacea, Worms, Alcyonarians, Echinoderms, Zoophytes, and Sponges; of these the Sponges and Ascidiæ were the most abundant, and also the most varied in their tints. The beaches in some places were carpeted with organisms resplendent with all the colours of the rainbow.

After the storm I visited several of the inner and outer beaches with a view of ascertaining the colour of the Sponges dealt with in the foregoing pages. I succeeded in obtaining living specimens

of some of the species, and others, although dead, were in good condition. The following remarks are based on the fresh material obtained :—

PACHYCHALINA AURANTIACA, *Lendenfeld*, sp.

The colour in life is reddish-orange ; when dried yellowish-white.

CHALINA GLOBOSA, *Lendenfeld*, sp.

A very large example of this form was found stranded at Shell Beach ; it measures 300 mm. in length, 225 mm. in breadth, and 150 mm. in height. The dermal membrane is more or less intact ; it is thin in texture, and the surface is pretty even ; the oscula are much smaller than in the dried examples. The dermal skeleton consists of ill arranged oxete spicules, which are somewhat renieroid in their disposition, with generally a triangular mesh.

PSEUDOHALICHONDRIA FIBROSA, *Whitelegge*.

In life this species is covered with a thick gelatinous membrane, with an even, smooth surface ; the oscula are very minute, and confined to the tips of the branches. The dermal membrane is easily separable from the body, when denuded the sponge presents an appearance like that of the figured type.²³

CLATHRIA TYPICA, *Carter*.

Colour in life, dark terra cotta.

CLATHRIA DURA, *Whitelegge*.

Several living examples of this species were obtained at Balmoral Beach. One measures 400 mm. in length, and 260 mm. in height. The colour is dark orange-buff when alive. The dermal membrane is extremely thin, and charged with numerous spined styli.

ECHINOCLATHRIA MACROPORA, *Lendenfeld*, sp.

Some examples of this species were of a bright madder brown, and others dark yellowish-stone.

EUSPONGIA IRREGULARIS, var. *SILICATA*, *Lendenfeld*.

Many specimens of the species were collected. The colour of the ground substance in life is canary yellow, after death it changes to a bright purple.

EUSPONGIA OFFICINALIS, var. *SPINOSA*, *Lendenfeld*.

This variety occurs at low tide line at Maroubra Bay. The colour when alive is dark grayish-brown.

²³ See Plate x., fig. 8.

EUSPONGIA OFFICINALIS, var. DURA, *Lendenfeld*.

The dermal membrane is yellowish-cream, and the ground substance of a yellowish tint.

EUSPONGIA PIKEI, *Hyatt, sp.*

This species does not present any distinctive colouration.

HIPPOSPONGIA EQUINA, var. ELASTICA, *Lendenfeld*.

The dermal membrane is of a pale cream colour, and the ground substance light cinnamon-brown.

AULENA GIGANTEA, var. MICROPORA, *Lendenfeld*.

A single branch of this species was obtained at Maroubra Bay. It is nearly 600 mm. in length and 50 mm. in diameter.

CORRECTIONS.

See p. 60, line 11—for “planking” read “planting.”

„ 69—after “PACHYCHALINA, *Schmidt*,” insert subheading:

PACHYCHALINA AURANTIACA, *Lendenfeld*.

(Plate x., fig. 3).

„ 82, line 9—for “conulæ” read “conuli.”

„ 83, line 30—for “Size—0.13 to 1.3 mm.” read “Size—0.13 to 0.16 mm.”

„ 85, line 7—for “osculæ” read “oscula.”

„ 95, line 14—for “fig. 1,” read “fig. 2.”

„ 99, line 13—for “pl. xii.” read “pl. xiii.”

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,, 8. *Pseudohalichondria fibrosa*, Whitelegge.
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All the figures are reduced to about one-fourth the natural size.



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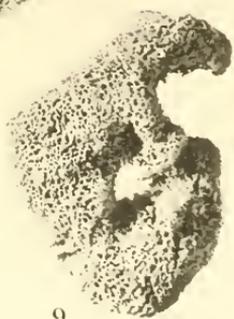
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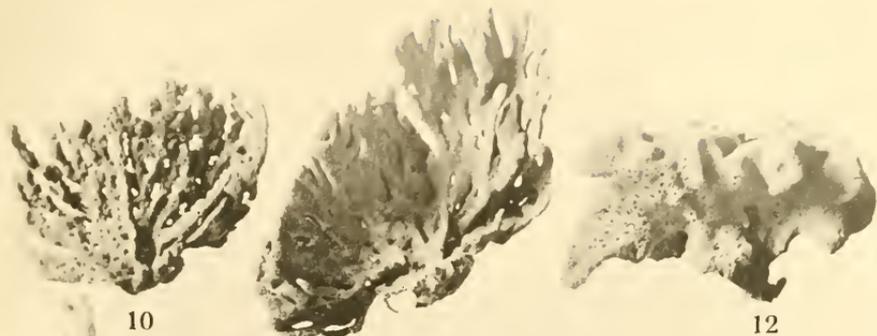


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All the figures are reduced to about one-fourth the natural size.



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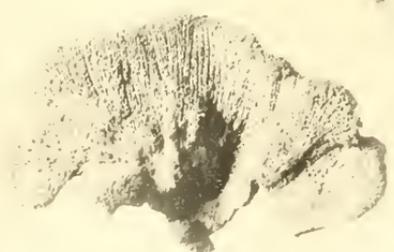
14a



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15a



14b



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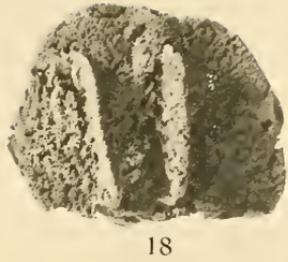
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All the figures are reduced to about one-fourth the natural size.



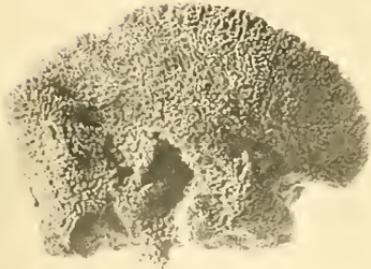
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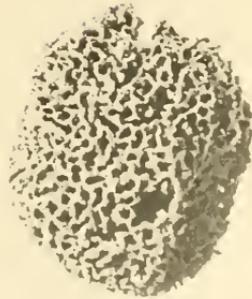
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21



21a



22

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,, 25a. " " "
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All the figures are reduced to about one-fourth the natural size.



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24a



23



25



26



25a



27

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All the figures are reduced to about one-fourth the natural size.



28



28a



28b



29



29a



29b



29c



28d



29e

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„ 30b. „ „ „
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„ 32a. „ „ „
„ 32b. „ „ „

All the figures are reduced to about one-fourth the natural size.



30



30a



30b



30c



31



30d



32



32a



32b