GORGONACEA

BY

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WITH TWENTY TEXT-FIGURES

CONTENTS

1. INTRODUCTION.

The naturalists of the expedition have reported that Gorgonids are rare on the Barrier Reef (Yonge, 1930, p. 133), and that only two species, a *Juncella* and a *Melitodes*, could be found at Low Isles, and that these were apparently confined to shaded or overhanging surfaces on the seaward slope and formed no part of the ordinary surface fauna (Stephenson, 1931, p. 71). The collection sent to me confirms these reports as a general statement of fact, but there is one locality investigated which bears a very rich fauna of Gorgonacea.

In the Penguin Channel no less than 42 specimens were obtained from two stations, and these may be referred to 9 genera and 15 species. The short and narrow "Penguin" Channel lies between Snapper Island and the mainland. It is about 7 miles N.W. of Low Isles, and is 13–14 fathoms deep, with a rocky bottom. An important feature of this channel, which may account for the fact that it is two or three fathoms deeper than the

sea between Snapper Island and Low Isles and for its clean-swept bottom, is that the flood tide flows from south to north directly through the channel and that the ebb tide creates an eddy round the island, so that there is a flow of water in the same direction during the ebb.

A flow of water therefore in one direction over a rocky bottom seems to be favourable to the growth of Gorgonacean corals.*

A strange contrast to this is to be found in Panama Bay, where the Gorgonacea flourish abundantly in an open and very muddy sea (Hickson, 1928, p. 326).

There are no species common to the two regions, but in both there are Gorgonians with lax ramification, and with flabellate ramifications with anastomoses and without anastomoses. The bushy form of ramification which is very common among the Gorgonacea of Panama Bay is not represented in any of the specimens collected in the Penguin Channel.

Our knowledge of the Gorgonacean fauna of the Barrier Reef is very scanty. Ridley (1884) described 22 species collected between Torres Straits and Port Curtis, and of these 14 were Holaxonia and 8 Scleraxonia.

In this report I have recorded 19 species, of which 17 are Holaxonia and only 2 Scleraxonia. Six of these species are probably identical with species described by Ridley. All the others, with the exception of *Isis hippuris* and *Melitodes ochracea* previously described by Saville Kent, have not been recorded from this region.

Owing to the great difficulty of identifying the species of some of the genera of Gorgonacea, to be discussed later, these figures represent opinions rather than facts. The most interesting point in the statement is that Ridley recorded 8 species of Scleraxonia, and that there are only two in this report. It was a surprise to find in the collection no representatives of such genera as *Siphonogorgia*, *Solenocaulon*, *Alertigorgia*, *Mopsella* and *Acabaria*. The species described by Ridley as *Leptogorgia australiensis* (since referred by Kükenthal [1919, p. 854] to the genus *Pseudopterogorgia*) seems to be very common on some parts of the reef, but is not represented in the collection.

Some of the species presented no difficulty in determination. *Isis hippuris* and *Melitodes ochracea* can be recognized at once by several distinguishing characters and seem to show little variation. Most of the others in the collection, however, could be given generic and specific names only with some doubt, and after long and tedious research in the vast literature of the subject. These difficulties have arisen in consequence of the overlapping in characters of the families and the genera into which the Holaxonia have been artificially separated, and to the description of many new species on quite insufficient grounds.

In a previous paper (1930, p. 248) I have pointed out that, apart from the family Isididae, which stands by itself, the families of the Holaxonia, which are generally recognized cannot be separated from one another by any one clearly defined character nor by two or more characters in combination. Some species referred to the Plexauridae, for example, have characters which are almost identical with those of the Gorgoniiade (Hickson, 1928, pp. 339, 340), and others have characters almost identical with those of

* There were only two dredging stations in Penguin Channel, Station IX, 22.ii.29, 12–14 fathoms, in a clean pit and on mud at sides ; six dredges about 20 mins. each : and Station XII, 24.ii.29, 10–15½ fathoms, rock and shell gravel, mud on edges of the pit ; five dredges of about 20 mins. each. To avoid repetition the numbers only of these stations are referred to in the text.

the Muriceidae. Some of the species of the genus *Plexauroides*, usually included in the family Plexauridae, appear to be identical with species of the Muriceid genus *Echinogorgia* (see p. 498), and there are no characters which have yet been described to distinguish *Euplexaura robusta* from the Muriceid genus *Discogorgia* (see p. 474).

The result has been that some species of a genus have been redescribed as " new species " of a different genus and attributed to a different family.

The rapid multiplication of generic names which has taken place of recent years, based, in many cases, on some slight variation in one character (*e. g.* the spicules), has led to unnecessary confusion and difficulty.

The number of supposed new species, many of which have been very inadequately described, has increased to such an extent that the task of attempting to determine a specimen from a new locality is almost overwhelming. The pronounced tendency to increase the number of genera and species in this group of families is due, in no small measure, to faith in the size and detailed characters of the spicules as a guide to generic and specific diagnosis.

There can be no doubt that in some cases the spicules of Alcyonaria (*e. g.* the club-shaped spicules of *Juncella*, the " torches " of *Eunicella*, the scales of many Primnoidae, etc.) are very valuable guides for the distinction of genera or species ; but in others they are so variable, both in the individual and the species, that great discretion is needed in the use of them for systematic purposes. An investigation of the specimens of the genera *Plexauroides* and *Echinogorgia* in this collection lends support to the view that the spicules are far more variable than is usually supposed.

There are 14 specimens of these closely related genera from the Penguin Channel. They all possess a superficial layer of spicules of the type known as " Blattkeulen " (see p. 481). An examination of preparations of all these specimens shows that no two of them were exactly alike as regards the spicules of the coenenchym, and not one of them is exactly in agreement with the description of the spicules of any of the numerous species of the genera hitherto described.

If the principles of classification used by many previous writers on the subject had been adopted, I should have had to propose 14 new species based on the examination of one specimen of each species. To suppose that the naturalists of the Expedition in the course of two days collected only one specimen of each of 15 distinct species in this very small channel is, however, absurd.

Kükenthal (1910) and Broch (1916) have described 8 new species of the genus *Plexauroides* from Sharks Bay and Cape Jaubert in W. Australia at approximately the same depth. These two localities are less than 200 miles apart. There were 3 specimens of one species, but only one specimen of each of the others. Here, again, it seems very remarkable that only one specimen of each of 7 species, which are supposed to be distinct, was obtained in such a limited geographical and bathymetrical range.

Other examples could be given similar to the above, all of which indicate that many of the new species must be only local varieties of a much smaller number. In some Gorgoniidae the spicules are of the same general form and maximum size throughout the whole colony, but when spicules of different specimens of the same species are examined, small but quite appreciable differences are found (Hickson, 1928, pp. 374, 377, 387). The case of *Gorgonia stenobrochis* was of particular interest, because it is quite distinct from the other species of this genus and 7 specimens from the same pool were examined. If these

specimens had been found in different localities, and reliance had been placed on small differences in the spicules without consideration of other characters, several new species might have been proposed.

It is the same with the Muriceids. Many of the genera have spicules of a definite type, such as the " Blattkeulen " of *Echinogorgia*, the dagger-shaped spicules of *Acanthogorgia*, the disc-shaped spicules of *Bebryce*, etc., but the exact size, the details of structure, the tuberculation and other characters vary in every species, and to some extent in every individual.

There are two main influences that determine the size and appearance of the fully-formed spicule. The force of heredity which gives the spicule the generalized type of the genus or species, *i. e.* the club, the spindle, the capstan, the " Blattkeule," etc., and the external forces which determine the exact size and the final detailed form of such processes as tubercles, spine, foliate expansions, etc.

Woodland (1905, pp. 16, 17), in his valuable study of the development of the spicules of *Alcyonium*, laid down two principles: (1) That the growing spicules are subject to an aggregate of tendencies which tend to produce irregularities of form. (2) That the extension of a growing body into a surrounding resistant body is most easily effected by the protrusion of more or less acute processes which, in virtue of their acuteness, are best able to cleave a passage.

That the form of the spicules of certain sponges is also influenced by external forces was shown in an interesting paper by Dendy and Nicholson (1917, p. 573). On these principles the ultimate structure of an individual spicule in such a position as the surface of the verrucae or coenenchym of the Muriceidae, where the spicules are crowded together, depends upon its site and its relation to neighbouring spicules.

The spicules round the aperture of a verruca, for example, may bear a spine, *e. g.* *Acanthogorgia*, which is much more prominent than it is on the spicules at the base of the verruca, and it is very tempting to assume that the latter correspond with a developmental stage of the former. The study of the spicules of young verrucae suggests that they are (Gordon, 1926), in some cases, but there can be no doubt that the development of any spicule is influenced to some extent from the earliest stages by the position it occupies in relation to other spicules and environmental forces.

The process of development of a spicule cannot be studied in prepared material in the same way as the development of a frog can be observed from the live egg to the live tadpole stage; it is only an inference, which may be misleading, that the smaller spicules in a preparation represent earlier stages in the development of the larger ones.

But even if we cannot trace the development of a particular type of spicule in detail, the study of smaller spicules of the type often affords valuable evidence of the value of the full-grown spicule for the determination of specific characters (*cf.* p. 481), as they may correspond with a developmental stage in the growth of the spicule.

If there is some modification of the details of the structure of spicules due to the influence of immediate surroundings, it should be particularly noticeable in those parts of the spicules of the Muriceidae which project from the surface of the coenenchym. Such processes have not to force their way through the dense coenenchym, but are subject to the varied influences of the currents of water and its contents which pass over the surface of the Alcyonarian and other conditions of their site.

When a large number of the spicules of a genus bearing such spicules is examined, a

very remarkable range of variation is seen as regards the detailed structure of the processes, such as the arrangement of the leaves, the number of tubercles, the length of the spines, etc. It is, indeed, difficult to find two spicules that are exactly alike.

This variability of the spicules in the Gorgonacea does not seem to have been usually recognized in systematic work, with the result that several new species have been described, based on the minor and variable characters of one specimen.

In the key plan of the species of *Echinogorgia*, for example, given by Kükenthal (1924, p. 198), the difference between three species of the genus is that in *E. complexa* the leaves of the Blattkeulen are in rows, in *E. furfuracea* they are radial, and in *E. ridleyi* in concentric circles.

On an examination of a large number of spicules from a single specimen referred to the species *E. furfuracea* in the collection, all three of these arrangements of the leaves can be found, as well as many others that are more irregular.

The value of the mode of ramification, as a character of the species, is difficult to determine, and particularly so as regards small specimens 100 mm. or less in height.

There can be no doubt that external influences, such as the strength and direction of the sea current, neighbouring corals and other zoophytes, etc., must influence the detailed growth of the branches ; but, in my experience, the general forms of unbranched, or lax, or flabellate or reticulate ramifications are good characters for systematic determinations. The two small forms of *Ctenocella* described later (p. 509) afford an interesting confirmation of this view.

The entire lack of knowledge of the development of the colonies of these Alcyonaria renders the correct identification of small colonies very difficult. An unbranched specimen 50 mm. high might have remained unbranched like a *Juncella juncea*, or it might have given rise to a flabellum with or without anastomoses.

There are two specimens referred to the species *Echinogorgia furfuracea* in the collection, which are alike in other respects, but the larger one (160 mm. high) has anastomosing branches, and the smaller (100 mm. high) has no anastomoses between the branches. The larger specimen of *Plexauroides rigida* (180 mm. high) has a lax method of branching ; the smaller one (70 mm. high) is unbranched. An investigation, which could only be carried out when a large number of specimens of the same species from the same locality are available, to determine the size or age at which the young forms assume the characteristic form of branching of the adult, would be of great value, and would probably lead to a considerable reduction in the number of redundant species.

In this collection ten stems 2·5–40 mm high arising from a common base of *Euplexaura robusta* (Spec. D) are unbranched, but a stem 65 mm. in length has branches in the same plane (see p. 471 and Text-fig. 1).

Colour.—The investigation of the colour of the specimens in this collection confirms the opinion I expressed (1928, pp. 360 and 399) in the description of the species of *Muricea* and *Leptogorgia* from Panama, that colour may be a fixed character and of considerable value in systematic work.

There are various shades of red, passing from pale pink to coral red, and to orange and yellow, which may be interchangeable, but the distinction between coloured and white or colourless seems to be fixed. The pigment which colours the spicules is either present or absent. When present it may be confined to the spicules at the surface of the coenenchym which are fully exposed to the light, or it may be present in all the spicules

of the colony, but the species without any colour in any of the spicules seem to be distinct from those with colour in some or all of the spicules.

The colour of living Alcyonaria is often different to the colour of preserved specimens of the same species. This is due to the presence of soluble pigments in the coenenchym, and of these we have very little knowledge at present.

The evidence seems to be conclusive that in several of the genera of the Gorgonacea there is considerable variation in the characters which are used for systematic purposes, and the difficulty of distinguishing true species from mere varieties is almost insuperable. The number of specimens from any locality collected by the research expeditions is usually quite insufficient to throw any light on the matter. Moreover a complete account of the characters of the fully expanded polyps is impossible when the specimens sent home for examination are completely contracted. A study of the size, structure and armature of the anthocodiae would probably yield very valuable results.

The time and resources of these expeditions are not usually sufficient to provide expanded material of the kind required on a large scale, but an intensive study of one species or group of varieties in one locality would give us a very welcome addition to our knowledge of this group.

The possibility of hybridization must always be borne in mind, and therefore a record of the gonads should always be made, and the date on which the specimens were collected. The few facts that have been collected seem to indicate that most of the Gorgonacea of the Penguin Channel spawn at the same time of the year, and that therefore hybridization is not impossible. If it can be shown that two closely related forms breed at different times of the year and hybridization is thus rendered impossible, there would be one good reason for regarding them as distinct species.

Gonads.—Most of the specimens in the collections were examined by means of whole mounts decalcified and cleared in oil, to determine the size and sex of the gonads if they were present.

By this method gonads 0·05 mm. in diameter can be easily seen and their size and sex determined. Series of sections show in some cases gonads of still smaller size, but it seemed to me unnecessary, for my purpose, to devote so much time to cutting sections of all the specimens as this would have involved. In the Alcyonarian colonies the sex and stage in oogenesis or spermagenesis is usually the same throughout, so that a sample taken from any part or branch except the growing tips gives the sex and state of maturity of the colony as a whole. I have not discovered any case in which different parts of a colony were not of the same sex, and in these Gorgonians from the Barrier Reef there were no examples of hermaphroditism nor of viviparity. It is possible that some branches of a colony that bears gonads elsewhere may be barren, and that some of the specimens in which no gonads were observed may not be barren throughout. That is a possibility which should not be lost sight of in the following discussion of results.

The specimens collected in the Penguin Channel on 22nd and 24th February, 1929, are 42 in number, and they are referred to 14 species in this report. Of these, 33 were examined for gonads; 6 duplicates of *Euplexaura robusta* and 3 duplicates of *Muricella tenera* were not examined. In 13 out of the 33 specimens examined no gonads were observed.

Of the 20 specimens with gonads, 14 are male and 6 female. In only one specimen (*Plexauroides praelonga*) is the gonad nearly mature; in all the others they are immature,

varying from 0·1 to 0·3 mm. in diameter. There are 8 specimens referred to 6 species which were dredged outside the Penguin Channel. *Suberogorgia appressa* from the Pasco Reef collected in March, *Acanthogorgia studeri* from the Papuan passage also in March, *Melitodes ocharcea* and *Isis hippuris* from the Low Isles in February and May, were apparently all barren. The specimen of *Muricella perramosa* from the Linden Bank collected in November had small male gonads, and *Isis hippuris* from Lizard Island in July, ripe male gonads. A male specimen of *Ctenocella pectinata* taken in February on the Wentworth Reef had the gonads nearly ripe, and 0·5 mm. in diameter. As a small female specimen of the same species collected on the following day in the Penguin Channel had relatively large ova (0·4 mm.), it may be that this species spawns earlier than the other species of this part of the reef.

As the number of observations is very small, no definite conclusions can be drawn from these facts, but they seem to indicate that most of the Gorgonians of the Penguin Channel are in approximately the same sexual stage in the month of February, and that therefore they spawn at some later time. There is no evidence at present as to the time when they do spawn ; but if I were asked my opinion, I should say probably June or July.

Our knowledge of sexual questions in the Alcyonaria is very meagre, but in some species several months (six months in the case of *Alcyonium digitatum*) elapse from the time when the gonads are first visible to the naked eye until they are mature. In this connection it is of some interest to note that one specimen of *Isis hippuris* collected off Lizard Island on 3rd July was sexually mature with gonads 0·45 mm. in diameter.

There is no evidence as to the size or age at which these Alcyonarians reach sexual maturity. The smallest specimen in the collection of *Euplexaura robusta* (specimen x), was a male with testes only a little smaller than those of other specimens of the same species.

Of the two small specimens of *Ctenocella pectinata* from Penguin Channel, one was a female with comparatively large ova (0·4 mm.). The very small (55 mm. high) specimen of *Echinogorgia sasappo* has male gonads as large as those of the larger specimen.

My thanks are due to Prof. Stanley Gardiner for giving me facilities to work in the Zoological Department in the University of Cambridge, to Capt. Totton, Dr. A. Hastings and Mr. Robson for assistance in identifying specimens in the British Museum, to Dr. S. Manton for information concerning the localities on the reef, and to Miss J. Gardiner for drawing many of the illustrations.

2. LIST OF SPECIES.

The following is a complete list of the species in the collection :

Sub-Order Scleraxonia.

Family *Suberogorgiidae.*

Suberogorgia appressa, Nutting. 1 specimen.

Family *Melitodidae.*

Melitodes ochracea, L. 2 specimens ; P.

Sub-Order Holaxonia.

Family *Isididae.*

Isis hippuris, L. 3 specimens.

Family *Plexauridae.*

Euplexaura robusta, Kükth. 13 specimens ; P.

Family *Muriceidae.*

Muricella perramosa, Ridley. 1 specimen.
Muricella tenera, Ridley. 8 specimens ; P.
Echinogorgia sasappo, Esper. 2 specimens ; P.
Echinogorgia furfuracea, Esper. 2 specimens ; P.
Echinogorgia sphaerophora, Kükth. 1 specimen ; P
Echinogorgia reticulata, Esper. 2 specimens ; P.
Echinogorgia umbratica, Esper. 1 specimen ; P.
Plexauroides rigida, Kükth. 2 specimens ; P.
Plexauroides praelonga var. *typica*, Ridley. 2 specimens ; P.
Plexauroides praelonga var. *cinerea*, Ridley. 2 specimens ; P
Echinomuricea indo-malaccensis, Ridley. 1 specimen ; P.
Paramuricea (?). 1 specimen ; juv. ; P.

Family *Acanthogorgiidae.*

Acanthogorgia studeri, Nutting. 1 specimen.

Family *Gorgonellidae.*

Juncella gemmacea, Val. 2 branches ; P.
Scirpearia elongata, Pall. 1 specimen ; P.
Ctenocella pectinata, Pall. 3 specimens ; P.

Note.—The letter "P." at the end of the line signifies that the species was dredged in the Penguin Channel.

3. EPIZOITES.

Most of the Alcyonaria in the collection are quite clean, but on some there is a rich fauna and flora of epizoic organisms. None of these seem to be destructive in nature, but in most cases are confined to the dead or dying stems and branches, taking advantage of the firm support of the exposed axis.

In a few specimens there is a small growth of sponge over the coenenchym that looks normal, but these are the only cases in which the epizoites appeared to have a smothering effect.

Attached to an *Echinogorgia reticulata* (F) were two specimens of the Pelecypod *Pteria marmorata*, each about 65 mm. in length. Another specimen of the same size was attached to a specimen of *Muricella tenera* (G), and two small ones (16 and 18 mm. in length) were

attached to another specimen of the same species of *Muricella* (Q). These molluscs modified to some extent the normal ramification, but did not affect to any serious degree the general well-being of the colony (Text-fig. 4). Attached to the bare axis at the base of the stem and branches of the *Echinogorgia reticulata* (F) there are growths of Zoanthids, Sponges, Polyzoa, Hydrozoa, and a few small specimens of the interesting Tunicate *Didemnum grande* of Herdman, whose minute, densely crowded calcareous spicules give it the superficial appearance of an encrusting Foraminifer. A small simple Ascidian (15 mm. in height) was found on some of the branches.

Mixed with this varied fauna on the stem are some long filaments which I believe are algae. Among a similar fauna attached to the stem of the specimen of *Echinomuricea*, I found some small colonies of *Rhabdopleura* with the zooids beautifully preserved. The *Pteria* shells attached to these Gorgonians also bear a rich epizoic fauna, including two species of special interest. One is a fine specimen of the encrusting Polyzoon *Petralia vultur* var. *serrata*, Livingstone, and the other a diminutive Alcyonarian without spicules which I think should be referred to the species *Clavularia margaretiferae* of Thomson and Henderson.

4. DESCRIPTION OF SPECIES.

Sub-Order SCLERAXONIA.

Family Suberogorgiidae.

Suberogorgia appressa, Nutting.

An incomplete specimen from Station XXIV, 16½ fathoms, ¾ mile N.W. of Pasco Reef (13.iii.29) has close agreement with Nutting's (1911, p. 28) species founded on specimens from Makassar (32 metres) and Aru Island (13 metres). It has no base of attachment, and may be only a part of a much larger specimen. There is a main branch about 150 mm. in length giving off, from one side only, six long secondary branches, of which one is 100 mm. in length. From these characters it is probable that the whole colony was a flabellum with very long terminal branches.

All the branches are slightly flattened and there is a well-defined groove running along the middle line of the flatter surfaces on both sides. The greater diameter of the main branch is 4 mm., and of the terminal branches about 2·5 mm. The verrucae are low mounds where the polyps are completely retracted, but scarcely visible where the polyps are fully expanded. The polyps are very small. The expanded anthocodiae have a body 1 mm. in length and 0·45 mm. in diameter. The tentacles are difficult to measure, but when fully expanded are about 0·65 in length.

The colour of the coenenchym is brownish red, approximately chestnut colour; the anthocodiae are quite colourless.

The spicules of the coenenchym are stout girdled spindles showing very little variation in size or form. They are approximately 0·15 mm. in length by 0·06 mm. in greatest breadth, including the tubercles. There are usually six whorls of tubercles on each spicule, but exceptionally eight whorls may be counted. A few spicules in a preparation are 0·18 mm. in length.

Their colour is orange-yellow by transmitted light, but decidedly pinkish by reflected light. The armature of the anthocodiae agrees so closely with that of the type that

Nutting's description may be quoted : " The entire dorsal surface of the infolded tentacles is covered with a complete armour of flattened longitudinal spicules or bar-like forms, there being numerous longitudinal series in each tentacle." All these spicules are quite colourless.

Gonads were not observed in this specimen.

A section of the axis shows a large number of spicules of the same size, form and colour as the spicules of the coenenchym embedded in a mass of colourless smooth branching fibres or rods. There is no central core, and no canals passing longitudinally through the substance of the axis.

When the axis is decalcified the girdled spindles have disappeared, and there is left a spongy mass of branching and anastomosing fibres. These fibres are about 0·03 mm. in diameter and do not differ in that respect from the fibres of the undecalcified axis, but they differ materially from them in appearance, having a much less sharp outline, and seem to be hollow tubes rather than solid fibres. In the undecalcified axis they are obviously very brittle, breaking into sharp angled blocks as the razor passes through them. For these reasons it seems certain that the horny substance of which they are composed is heavily calcified.

The axis agrees in general characters with the axis of *Sclerogorgia* described by Kölliker (1865, p. 144), and of *Suberogorgia appressa*, described by Kükenthal (1919, p. 685), but differs from them in the character that the girdled spindles in the axis are coloured. No mention is made by previous authors concerning the calcification of the horny matrix of the axis.

The type species of this genus is *Gorgonia suberosa*, Pallas, from the " Indian Ocean." Kölliker (1865) gave figures of the spicules of this species under the name *Sclerogorgia suberosa*, and a description of the axis of his new genus. Ridley correctly transferred the species to Gray's genus *Suberogorgia*. It was said to inhabit the coast of Africa and the Indian seas.

Studer (1878, p. 666) attributed a specimen from the N.W. coast of Australia, and Ridley (1884, p. 349) specimens from Torres Straits and Alert Island to this species. There is, however, no good description of the characters of the type, and there may be some doubt whether the W. Australian specimens are really identical with the type from the Indian seas.

If we can trust Kölliker's identification of the type-species, its spicules are of the same size and character as those of our specimen, but of a paler yellow colour, and the axis differs in so far as the included spicules are colourless. Nutting's species, *S. appressa*, is better known, and although it is difficult to distinguish it from the type-species by any very pronounced characters, it is probably, on the ground of distribution and on the general appearance, as shown in the illustrations in Nutting's Plate V as compared with Esper's Plate 49, a distinct species.

In Kükenthal's key plan of the species the difference between the two species is said to be that the branching of *S. suberosa* is dichotomous and of *S. appressa* lateral. A glance at the two illustrations of the types of these species referred to above shows that no distinction can be drawn between them in this respect. The terminal branching of *S. appressa* has exactly the same appearance of dichotomy as *S. suberosa*. Ridley's specimen of *S. suberosa* from Torres Straits, in the British Museum, has a pale orange-yellow colour and the terminal branches are relatively thicker than those of the specimen described above.

Family Melitodidae.

Melitodes ochracea, L.

Two specimens of this common and well-known species were obtained, one from Station 1 of the general survey of Low Isle (19.v.29), and the other from Penguin Channel, Station XII (24.ii.29). They are both irregularly fan-shaped in growth, and measure 100 mm. by 90 mm. and 180 mm. by 90 mm. respectively.

They exhibit the characteristic features of the species, a thick stem (13 mm. in diam.) with moderately thick secondary branches shading off into numerous very slender (1·5 mm.) terminal twigs. In the secondary branches the swollen nodes are almost spherical in shape (6 mm. in diameter), and the internodes, very variable in length, are 3 mm. in diameter. The maximum length of an internode is about 6 mm., but most of them are much shorter.

There are a few anastomoses in the middle and basal regions of the flabellum.

The only character by which the specimens do not fully agree with the definition of the species given by Kükenthal (1924, p. 62) is that the stem and main branches are almost cylindrical, not oval in section (abgeplattet). The verrucae are small (*ca.* 0·75 mm. in diameter), and in most of them the aperture is wide open, showing the infolded tentacles. They are very conspicuous owing to their bright orange colour.

Most of the verrucae are on one side of the flabellum, and on many of the branches they are arranged in two lateral rows, with a few scattered verrucae between them on a median bare track. On the opposite surface of the flabellum there are only a few scattered verrucae.

The colour of the coenenchym is a dark purplish-red. The nodes and internodes of the axis have the same colour. The anthocodiae are yellow.

The spicules of the coenenchym are spindles and clubs with coarse, blunt tubercles irregularly scattered over their surfaces, and between the typical spindle and the typical club there are many intermediate forms. The largest of these spicules are 0·12 mm., but the majority are only 0·1 mm. in length. The armature of the anthocodiae agrees with the description given by Kükenthal; the thin long yellow spicules of the crown that surrounds the base of the tentacles reach a length of 0·15 mm.

There were no gonads in either of them.

There can be little doubt that these specimens belong to the same species as the *Isis ochracea* of Linnaeus and the older writers. Kölliker (1872) described the spicules of the species under the name *Melithaea ochracea*. The generic name of the genus was changed to *Melitodes* by Verrill in 1864. Since that time many new species of the genus have been described.

M. ochracea was recorded from the Barrier Reef by Saville Kent. *M. esperi* from Torres Straits by Wright and Studer (1889, p. 179), and *M. albitincta* by Ridley (1884, p. 359) from Queensland.

There seems to be very little difference between *M. esperi* and *M. ochracea* except in the size of the spicules of the coenenchym. According to Wright and Studer, they are nearly twice as large (0·24 mm.) in *M. esperi* as they are in *M. ochracea*.

According to Kükenthal's key plan (1924, p. 55), *M. ochracea* differs from *M. squamosa* of Nutting from the Malay Archipelago in having flattened branches. The flattening of

the branches of these Alcyonaria is probably caused by special external conditions of the locality in which they grow, and as a character has no value for the diagnosis of species.

In this case it is very striking how closely the specimens from the Barrier Reef agree with the description of the species by previous authors in all the principal characters except this one, and if the flattening of the branches is sound as a specific character, the new species it would be necessary to make for them would differ from *M. ochracea* in this character alone.

Kükenthal (1919, pt. 2, p. 150) considers that Nutting's (1911, p. 38) *Birotularia splendens* from the Kei Islands is identical with *M. ochracea*. The coenenchym spicules of this species are not only much smaller, but of quite a different type to any I have seen in *M. ochracea*, and, moreover, the characters of the ramification seem to be different in the two species. It may be a matter of opinion whether Nutting was justified in making a new genus for his species, but it certainly differs very distinctly from *Melitodes ochracea*.

Sub-Order HOLAXONIA.

Family Isididae.

Isis hippuris, L.

Two complete specimens and some fragments of this well-known and widely distributed species are in the collection :

One from Lizard Island, Reef A (3.vi.29), is 200 mm. high, the other from Three Isles (1–15.v.29) is 150 mm. high, and the fragments are from Low Isles A 2 (date ?).

The Three Isles are about 75 miles north of Low Isles and Lizard Island about 30 miles further north, in latitude 14° 40′ S.

The species is said to be common at the anchorage in Low Island (Stephenson, 1931, p. 82). Its very beautiful jointed axis and very thick coenenchym distinguish it at once from any other kind of Gorgonian on the Reef.

There is an excellent account of the history and anatomy of the species by Simpson (1909, p. 180), and, as my own observations on its structure agree very closely with his description, there is no need for me to describe those specimens in detail.

The specimen from Lizard Island collected in July bears numerous ova (0·45 mm. in diam.), which have the appearance of being nearly mature. The specimen from Three Isles collected in May is barren, and I found no gonads in the fragments from Low Island.

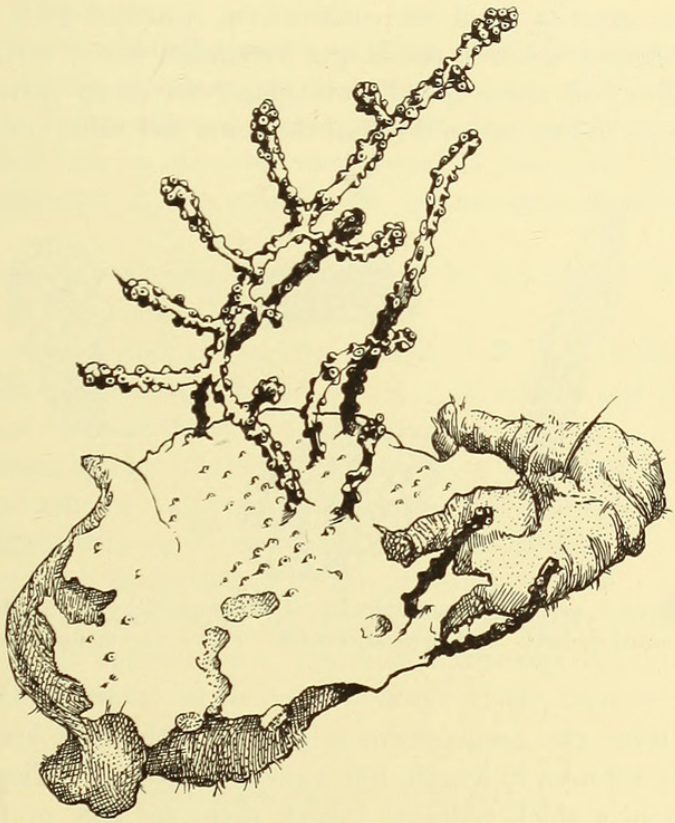
Family Plexauridae.

Euplexaura robusta, Kükenthal.

There are twelve specimens of this species from the Penguin Channel (8 from Station IX and 4 from Station XII). Of the specimens from Station IX, 6 consist of a single stem springing from a relatively small base of attachment ; 2 consist of a wide base of attachment giving rise to several stems. The former range from 42–120 mm. high, and the branches, when present, are almost exactly in one plane. The smallest is unbranched ; the largest has ten branches, some of which give off secondary twigs. There are no anastomoses. The branches in all the specimens are rather thick, the terminal

ones being in many cases 3–4 mm. in diameter. Most of the branches have a knobbed extremity. In one specimen (102 mm. high) there are no verrucae on the base of attachment, nor on the proximal part of the stem, for a distance of 30 mm. from the base. On all the others the base bears a few small verrucae.

The other two specimens from this station are of special interest. One of them (D) consists of a large base spreading over a considerable area of an oyster shell (Text-fig. 1). It is irregularly circular in outline and about 40 mm. in diameter. On this base there are numerous irregularly scattered verrucae. It supports one branched stem (65 mm. high) and ten unbranched stems (2·5–40 mm. high). The other one (A) is also attached to an



TEXT-FIG. 1.—*Euplexaura robusta.* Specimen D, showing a very large spreading base of attachment bearing verrucae. From the base arise one branched and several unbranched stems. Nat. size.

oyster shell and has a spreading base 30 mm. in diameter, which bears two stems about 15 mm. apart, one 30 mm. high, the other, which is bifurcated, 40 mm. high.

The four specimens from Station XII are 50–80 mm. high, and all bear branches, but in three of them the branching is decidedly not in one plane, but quite irregular and in all directions. In the fourth specimen (70 mm. high) the branching is as clearly in one plane as in the specimens from Station IX.

At first sight the verrucae seem to be smaller and rather wider apart than in the larger specimens from Station IX, but in these respects they do not differ from the smaller specimens from that station, nor from some of the branches of the larger specimen.

More detailed examinations of structure leave no doubt that the specimens from the two stations belong to the same species.

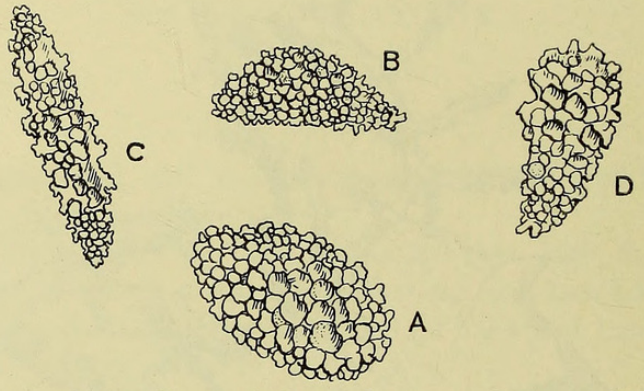
The verrucae are prominent dome-shaped structures, with eight triangular lobes, bent inwards at the upper end, and when fully grown are 1 mm. in diameter at the base and about 0·75 mm. in height. The whole surface of the verrucae, including the lobes, is heavily armed with spindle-shaped spicules.

In most of the specimens from both localities there are several smaller verrucae, with an aperture in the centre of the dome, which are not lobed as in the full-grown verrucae, and many forms of intermediate size with small lobes can be found.

The coenenchym between the verrucae is protected by a layer of close-set spicules, ovals, discs and other forms fitting close together to form a continuous shield.

The colour of all the specimens is a dull grey.

Spicules.—The outer layer of the coenenchym is armed with a continuous coat of thick discs or oval-shaped spicules, reaching a maximum size of 0·4 mm. in diameter and 0·45 × 0·2 mm. Many of these spicules are plano-convex in optical section, the outer convex surface having longer tubercles than the inner flat side (Text-fig. 2).



Text-fig. 2.—*Euplexaura robusta.* Four spicules of the coenenchym. A, Surface view of a disc. B, Side view of another disc. C, A typical spindle. D, An intermediate form. × 100 diam.

Beneath this layer the coenenchym is packed with thick spindle-shaped spicules, most of them about 0·2 mm. in length, but some much larger. They are not arranged in definite layers, but in a thick terminal branch there are four or five of these spindles between the axis and the outer layer. In many species of this genus the spindles have an equatorial band free from tubercles. I have not seen one of this type in my preparations.

The armature of the anthocodiae agrees exactly with the description and figures of the type by Kükenthal (1909, p. 18). There is a crown of two or three rows of bent spindles on which stand eight groups of three or four pairs of converging spicules to form the points. These spicules have the same size and form as those of the type.

Neither in the original description nor in the definition of the species in ' Das Thierreich ' does Kükenthal refer to any further armature of the polyps.

In the description of *Euplexaura flabellata* from W. Australia, Broch (1916, p. 42) states that the tentacles are richly encrusted with small, feebly tuberculated rod-shaped spicules. This species was considered by Kükenthal to be identical with *E. robusta*, and Thomson and Dean (1931, p. 198), agreeing with this identification, refer to the well-armoured tentacles of their specimen from the coast of Ceram.

The tentacles of the specimens from the Penguin Channnel are densely pigmented, and

it is difficult to clear them in oil, but dissections of the retracted anthocodiae have not revealed any trace of these small spicules in the tentacles.

The axis is brown and flexible in the terminal branches, but almost black in the main stem near the base. On treatment with acid the axis gives off a slow effervescence of very small bubbles, proving the presence of some calcareous deposit. In a main stem where the axis is 1·5 mm. in diameter, the central chambered core is 0·45 mm. in diameter, and the cortex about 0·5 mm. thick. The cortex is not loculated (gefächert), but solid throughout. At the proximal end of one of the branches, where the axis is 1·05 mm. in diameter, the core is 0·95 mm. in diameter and the cortex about 0·1 mm. thick. In this region the fibres composing the cortex are more loosely attached and small spaces between them are seen at the periphery.

A transverse section of a branch close to its origin shows that the polyps are connected with twelve large longitudinal canals running close to the axis. The polyps and the longitudinal canals are also connected with a network of smaller canals.

Female gonads 0·2 mm. in diameter were found in one of the specimens, and male gonads 0·2 mm. in diameter in two others. No gonads were observed in two, and six were not examined.

The species *E. robusta* was originally described by Kükenthal (1909, p. 18) from a specimen from Japan in the Vienna Museum.

According to the same author the species described as *E. flabellata* by Broch (1916, p. 42) from N.W. Australia belongs to this species. Thomson and Dean (1931, p. 198) record the species from the east coast of Ceram.

Although three other species of the genus have been described by Nutting from the Malay archipelago and four by various authors from N.W. Australia, *E. robusta* has not previously been recorded from the Barrier Reef or Torres Straits.

The species seems to be distinguished by the prominence of the verrucae, by the large disc-shaped spicules of the coenenchym, by the absence of double clubs or double spindles and its dull grey colour. In appearance it resembles *E. aruensis* (Kükth.), but the verrucae are not prominent in this species, double spindles occur in the coenenchym and the colour is brown (" hellbraun ").

? *Euplexaura robusta*, Kükenthal.

There is a small specimen (x) from the Penguin Channel Station IX which is of some special interest, as it called my attention to the very close relationship of certain species of the Plexaurid genus *Euplexaura* and the Muriceid genus *Discogorgia*.

It consists of a stem 35 mm. high with a disc of attachment (*ca.* 7 mm. in diameter), and a long branch 45 mm. in length arising about 10 mm. from the base.

The diameter of the stem and branch is about 2 mm. The verrucae are scattered all round both stem and branch, are crowded above and separated by small spaces below. They seem to be rather smaller than in the other specimens of *E. robusta*, but the larger ones are almost 1 mm. in height and the same in breadth at the base.

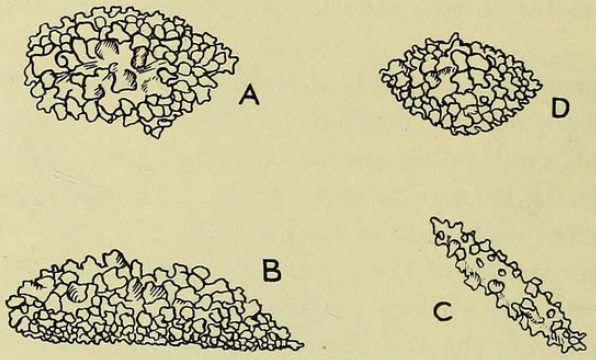
Nearly all of them are tightly contracted.

Examination of the surface shows that the verrucae are protected by overlapping spicules that are spindle-shaped above, and oval or disc-shaped at the base. The surface of the coenenchym is covered with disc-shaped or oval spicules, which also overlap in some places.

Spicules.—There are two distinct layers of the coenenchym—an outer layer bearing thick plano-convex discs or ovals, and an inner layer bearing nothing but spindle-shaped spicules. This inner layer comes to the surface at the top of the verrucae. The spicules agree very closely with those of the other specimens referred to this species.

The discs at the surface are from 0·2–0·25 mm. in diameter, and the larger ovals 0·3–0·45 mm. in length by 0·2 mm. in breadth. There is a complete range from discs, through ovals to thick blunt spindles (Text-fig. 3). The tubercles on the outer convex side of these spicules are longer and thicker than those on the flat side, and in character resemble those of the spicules of the *Placogorgia bebrycoides* of Nutting (1910 (A), pl. xxii, fig. 11).

The inner layer of the coenenchym is thin as compared with that of most of the other specimens in the collection referred to this species. There are not more than two spicules between the axis and the outer layer. These are spindle-shaped, pointed at the extremities, and have a maximum size of about 0·2 × 0·05 mm. The rough tubercles are densely crowded and are not arranged in whorls.



Text-fig. 3.—*Euplexaura robusta*. Specimen x (the " Discogorgia " form). Four spicules of the coenenchym. A, Surface view of a disc. B, Side view of another disc. C, A spindle. D, An intermediate form. × 100 diam.

The operculum in this specimen consists of a crown of two or three rings of spindles with low tubercles about 0·25 mm. in length, and eight points. In many of these points there are only two bent spindles meeting above, which, together with a spindle of the crown, form an acute angle triangle ; but in others a third and sometimes a fourth spicule are interposed in the triangle.

Very small male gonads (0·15 mm. diameter) were observed in this specimen.

The colour is the same as that of the other specimens, and all the spicules are colourless.

The specimen agrees so closely with the description of *Placogorgia bebrycoides* by Nutting (1910*a*, p. 83) that at first I referred it to this species, but on further investigation I found that it cannot be separated from *Euplexaura robusta*. The genus *Placogorgia* was founded by Wright and Studer (1889, p. 113) for a species from 80 fathoms in the Atlantic Ocean. Nutting (1910*a*) added ten more species to this genus, but Kükenthal (1919, and 1924, p. 212) separated six of Nutting's species from the Malay Archipelago into a new genus *Discogorgia*, and thus *Placogorgia bebrycoides*, for example, became *D. bebrycoides*. Thomson and Dean accepted this transfer and gave a good figure of the species (1931, pl. xv, fig. 12), which, however, resembles very closely some of our smaller specimens of *Euplexaura robusta* (*cf.* also Kükenthal's figure, 1928, p. 95, fig. 67).

The specimen agrees in so many respects with the original description of *Euplexaura robusta* and with the other specimens of that species from the same locality in the collection that it must be referred to that species.

But it differs from the other specimens in two respects—the greater simplicity of the points of the operculum, and the more slender terminal branches due to a very thin coenenchym. In these respects it seems to agree better with *Discogorgia bebrycoides*. Nutting says that the most prominent feature of the operculum of that species is the three spicules forming an acute-angled triangle. This is, however, a variable character in *Euplexaura robusta*. I have examined a large number of verrucae of this species, and although the larger ones show points of the operculum with two or three pairs of spicules as shown in Kükenthal's figure (1909, p. 19, fig. 13), some of the smaller ones have only one pair, as in *Discogorgia bebrycoides*.

The slenderness of the branches gives the specimen described above a Muriceid appearance. In that respect it resembles Nutting's figure of *Discogorgia bebrycoides*, but as no measurements of the diameter of the terminal branches of this genus have been given, and no statement of the spiculation of the inner layer of coenenchym, it is difficult to determine whether this appearance is of essential importance.

But what are the differences between the Muriceid genus *Discogorgia* and the Plexaurid genus *Euplexaura* ? They agree in having a flabelliform ramification ; the spicules of the outer layer of the coenenchym are almost identical in size and shape. They both have an operculum of the same type, and the verrucae are of approximately the same size and arrangement.

With these remarkable agreements, and in the absence of any knowledge of the characters of the coenenchym and axis of the type-species of *Discogorgia*, the only conclusion there can be is that this genus is identical with *Euplexaura*. The separation of the two genera in different families is only misleading, and leads to the establishment of many redundant species.

Family Muriceidae.

Muricella perramosa, Ridley.

One small specimen which seems to belong to this species was found on the Linden bank at a depth of 28 fathoms on 24th November, 1928. Linden Bank is off the line of the outer barrier reef about 25 miles E. of Low Isles. The specimen is perfect except that a part of the basal disc has been torn away.

It is 65 mm. high and the branching is almost in one plane, with a spread of about 55 mm. The main stem bears eight branches and some of these subdivide two or three times. The branching is not strictly dichotomous, although in some places it has the appearance of dichotomy. The main stem is 2 mm. and the terminal twigs 1 mm. in diameter. Most of the twigs terminate in swollen extremities about 1·5 mm. in diameter.

The verrucae are low mounds of a maximum height of 0·75 mm. They are not very crowded except on the terminal twigs, where they occur all round the axis without any definite arrangement. On the main stem most of the verrucae are lateral.

The colour is a dark purplish red.

Spicules.—The outer layer of the coenenchym is armed with large red straight or curved spindles. They vary so much that it is difficult to form an estimate of their average size, but many of them are 2·5 mm. in length by about 0·16 mm. in greatest

thickness. Here and there larger spindles may be seen, the largest in my preparations being a little over 3 mm. in length (Text-fig. 5).

Below the surface the coenenchym is crowded with spindles of the same type, only much smaller.

The polyps are all contracted and the details of their armature are not easy to determine accurately, but there are certainly eight groups of flat, spindle-shaped spicules, which are much more definitely arranged " en chevron " than in *M. tenera*. The spicules of the coenenchym agree in form with those described by Ridley for the type. I have examined two preparations of the type spicules, and the largest I can find are only a trifle over 1 mm. in length. The colour of the spicules, also, is a pale orange red as compared with the dark purplish red of those of the Linden Bank specimen.

Although the spicules of our specimen differ from those of the type in these two respects, they agree with the spicules of the specimens of this species collected by the " Siboga " Expedition very closely both as regards size and colour.

The axis of this specimen seems to be purely horn: not the slightest effervescence occurred when a fragment was immersed in strong HCl. In the terminal twigs the axis has a very thin cortex and the core is divided in compartments by thin septa, of which there are about 26 to 1 mm. of length.

In the larger branches the cortex of the axis is much thicker and composed of longitudinal fibres. So far as I could judge from one observation, it is not loculated.

The specimen is a male with gonads 0·2–0·3 mm. in diameter.

The type-specimen of this species described by Ridley (1882, p. 128) is in the British Museum (registered number 82.4.6.1). " It has a broad, fan-like outline," and is 500 mm. high by 175 mm. in extreme breadth. It was found in 90 fathoms of water off the coast of Mauritius.

I have examined spicule preparations and the terminal twigs of the type-specimen, and find that the largest of the spindles of the coenenchym is about 1 × 0·16 mm., in close agreement with Ridley's figures, but the statement that the diameter of the main branches is about 0·18 mm. and of the terminal twigs 0·018 mm. is quite erroneous. The diameter of the main branches of the type-specimen is roughly 5 mm., and of the terminal twigs 1 mm.

The specimen attributed to this species by Wright and Studer (1889, p. 126) was found off Japan in 345 fathoms of water. The largest spindles of this specimen were 1·7 × 0·145 mm.

Nutting's specimens were found in the Kei Archipelago, off New Guinea and other localities in 32–90 metres of water, and the largest spindles are 2·5 mm. in length.

If it be assumed that the identifications of these authors are correct, it is evident that this species has a wide geographical distribution, and a range in depth from 30 metres to 345 fathoms.

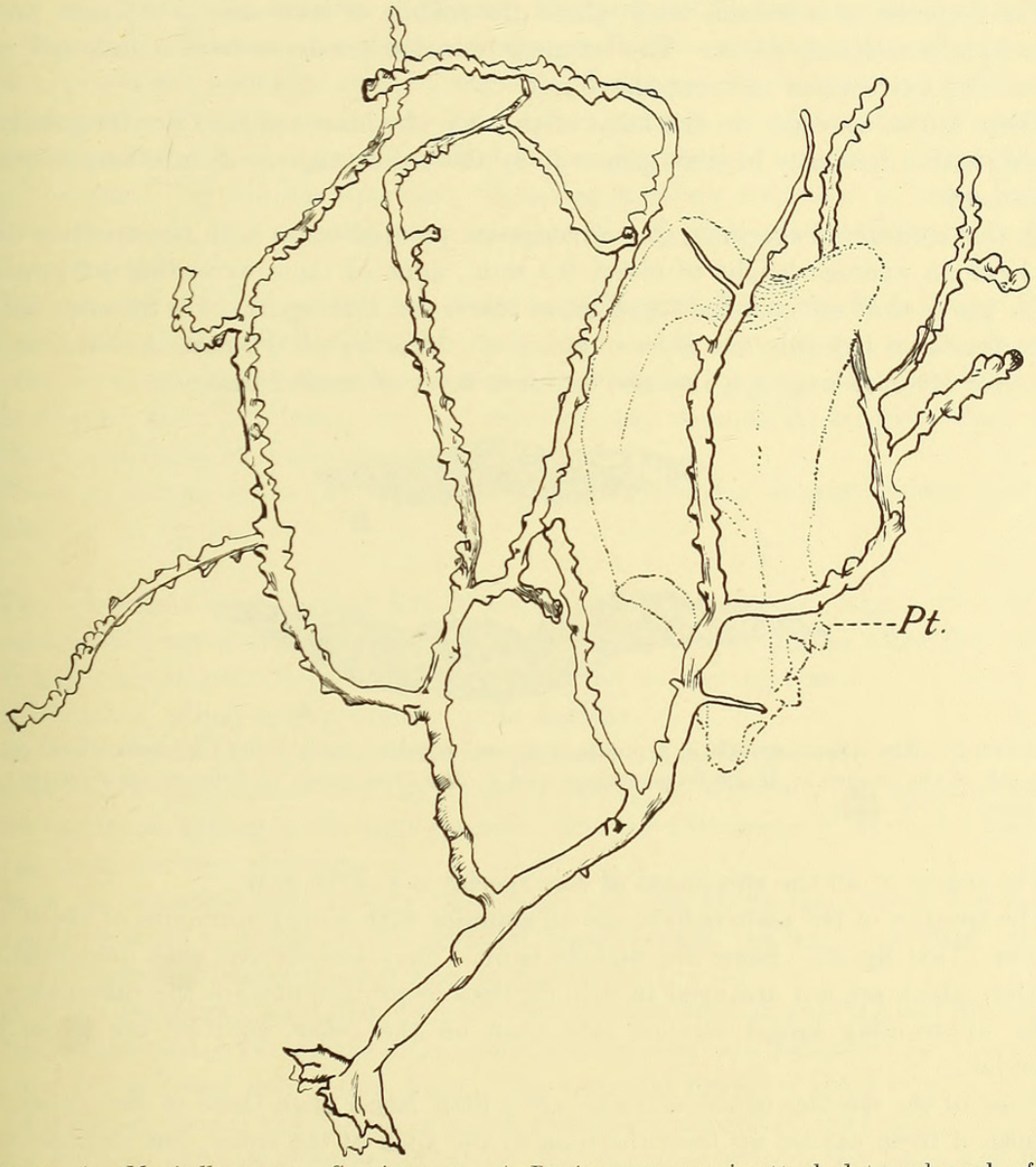
There seems no reason to doubt the validity of these identifications. The only prominent character in which they differ is in the size of the largest spindles of the cortex.

Muricella tenera, Ridley.

There are eight specimens in the collection which may be referred to this species. They were all dredged in the Penguin Channel, five at Station IX (Q) and three at Station XII (E and G).

Every specimen has been carefully examined, and notwithstanding certain differences in minor variable characters I am convinced that they all belong to the same species.

They afford a very interesting study in the variation of ramification and, as some specimens are less contracted than others, the variation in the size and form of the verrucae in the several phases of the contraction of the polyps.



Text-fig. 4.—*Muricella tenera*. Specimen G. A *Pteria marmorata* is attached to a branch of the colony (*Pt.*), and has modified the growth and number of verrucae. Nat. size.

The largest specimen (G) has the general form of a half flabellum (Text-fig. 4). Two branches arise on one side only of the main stem; the lower one subdivides into a number of secondary branches, the upper one is undivided. Above these branches the main stem appears to bifurcate, but both divisions bend over towards the same side as the lower branches. Attached to the colony at the point of bifurcation there is a bivalve (*Pteria marmorata*) 60 × 30 mm. in size, which may have influenced the growth from this point upwards.

This specimen is unfortunately very tightly contracted.

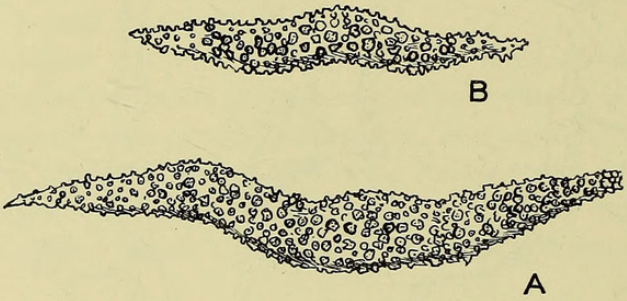
The colony is 130 mm. high and about 80 mm. broad. The disc of attachment is 15 mm. in diameter.

The main stem, consisting of the axis and a very thin covering of coenenchym, is 4 mm. in diameter.

The diameter of a branch taken about the middle of its course is 2·5 mm. and the coenenchym is relatively thick. The terminal branches are up to 60 mm. in length; some have swollen extremities and some have not.

There are no verrucae on the main stem. On the branches they are irregularly distributed, with a tendency in some places to a bilateral arrangement, in others to a spiral arrangement.

In this contracted specimen the verrucae are pointed cones with the aperture closed. They have an average height of about 0·5 mm., none of them exceeding 1·0 mm. high. In some places they are crowded together, in others 2–5 mm. apart. On the stem the very thin coenenchym has only one layer of spicules. In a branch 0·9 mm. in diameter there is an outer layer of large spicules and an inner layer of smaller ones.



Text-fig. 5.—The largest spicule in a group of several hundred taken from the coenenchym of each of the species A, *Muricella perramosa* and B, *Muricella tenera* to indicate their relative sizes. × 35 diam.

The colour of all the specimens of this species is a dirty grey.

The spicules of the coenenchym are all spindles with a maximum size of about 1·5 × 0·15 mm. (Text-fig. 5). Some are slightly bent. They are covered with numerous small tubercles, which are not arranged in definite lines or girdles, nor are the tubercles in any spicules appreciably longer on one side than on the other, as they are in so many Muriceidae.

Some of the spicules of the verrucae are a little larger than those of the coenenchym, and most of them extend up from the base to the apex of the cones, but in many of the verrucae smaller spindles are inserted between the larger ones towards the apex.

The arrangement of the spicules of the anthocodiae cannot be easily determined in this contracted specimen, but so far as I can judge from dissections it does not differ from that in specimen Q1, which is described later.

The specimens from Station IX (Q) are not so tightly contracted, and in many cases a part of the body-wall of the anthocodiae and the tentacles protrude from the aperture of the verruca. They are respectively 140, 80, 80, 75 and 60 mm. high. Each one has a small base of attachment and is apparently perfect.

The largest one has five branches arising in one plane right and left of the main stem at

irregular intervals. Another specimen has four branches, which are not in the same plane. The others have only two or three branches which are in the same plane.

The verrucae vary considerably in size. In one specimen they are 2–2·5 mm. high on some of the branches and densely crowded together. On other branches of the same colony they are much smaller and separated by intervals of 2–5 mm. The aperture of many of the verrucae is wide open, showing clearly a well-defined operculum protecting the anthocodiae. The spicules of the verrucae in these cases do not converge as in the contracted ones, but stand up at right angles to the coenenchym, forming a paling round the anthocodia. The spicules of the true calix, forming, in the contracted condition, the operculum, consist of eight triangular groups of spindles ("points"), surrounded by a ring ("crown") of similar spicules. This ring is rarely composed of more than one spicule in thickness, and in some cases consists of only one or two transversely placed spicules altogether.

The spicules of the "points" are very variable in size, but rarely exceed 0·45 mm. in length; the spicules of the "crown" are larger, and in some cases 0·9 mm. in length. They can be distinguished from the coenenchym spicules by their smaller tubercles, but in this respect, as in size, the "crown" spicules are intermediate between those of the operculum and those of the coenenchym.

There are no spicules in the upper part of the body-wall of the anthocodiae, nor in the tentacles.

Two specimens from Station XII (E and E[1]) are about 85 mm. high. One of them (E) has a small base of attachment and is apparently perfect. In the other the proximal end of the main stem is broken and covered by an encrusting sponge. It bears three lateral branches, which are apparently quite healthy.

As the verrucae of both specimens are partially expanded, the structure of the operculum as well as other characters can be easily examined, and there can be no doubt that the two specimens belong to the same species. But the differences in external appearances between them are very striking.

In E the branches arise in one plane right and left of the main stem, the verrucae are closely crowded together on the terminal branches, and the larger ones are 1·25 mm. high. The terminal branches are 2 mm. in diameter.

In E[1] the branches are not in one plane; the verrucae even on the terminal branches are situated at intervals of 2·0 mm. or more apart, and are very much smaller than the verrucae of E, the largest being only 1 mm. high. The terminal branches are 1 mm. in diameter.

All the specimens of this species in which gonads were observed were males. Specimen G from Station XII was apparently barren, but specimen E from the same station bore testes from 0·1–0·2 mm. in diameter, and specimen E[1] testes up to 0·45 mm. in diameter. The specimens from Station IX were with one exception males with testes 0·08–0·1 mm. in diameter.

The variations observed in this species may be summarized as follows:

The ramification is usually in one plane, but in two small specimens (*ca.* 85 mm. high) it is not in one plane.

There are great variations in the thickness of the coenenchym. In one specimen, E, the terminal branches between the verrucae are twice as thick as they are in another specimen from the same locality.

The verrucae vary in size according to the state of contraction. In a large contracted specimen they do not exceed 1 mm. high; in a smaller partially expanded specimen they are 2–2·5 mm. high, but they also vary independently in size, as seen in specimens E and E[1].

There is also great variation in the degree of crowding or dispersal of the verrucae.

The characters in which there is agreement are :

1. The ramification of the larger forms is in one plane.

2. The spicules of the coenenchym are spindles provided with numerous scattered tubercles which do not exceed a maximum length of 1·0–1·5 mm. (Hiles, 1899, p. 50, referred a specimen from Funafuti to this species with spicules over 4 mm. in length).

3. There is a well-developed operculum, consisting of eight triangular points and a crown of single spicules.

4. The colour is dull grey and all the spicules are colourless.

The type of this species is in the British Museum. It is a small specimen, and was named *Muricella tenera* by Ridley (1884, p. 335). It was dredged in 14–20 fathoms of water off Port Molle on the coast of Queensland.

A large specimen of the same genus (300 mm. high) found in 49 fathoms in the neighbouring Arafura sea was referred to the new species *M. crassa* by Wright and Studer (1889, p. 131).

Some of the specimens in this collection are intermediate in size between the types of these two species, and as their characters are, in some respects, intermediate between them they link the two species together.

An examination of the type of *M. tenera* shows that they cannot be satisfactorily distinguished from that species, but they afford some evidence that *M. tenera* is identical with *M. crassa*.

The two species agree in having a flabellate form of growth, in colour and in the general form, size and detailed structure of the spicules. The differences are that in *M. tenera* the coenenchym is said to be thin and in *M. crassa* very thick. According to Ridley the spicules of the verrucae are either 1·5 mm. or 0·9 mm. in length in *M. tenera*, and according to Wright and Studer the spicules of the " calix " of *M. crassa* are 0·9 mm. in length.

The vague statement that the coenenchym is very thick in *M. crassa* does not help in the determination of the species. In most of our specimens the coenenchym is very thin on the main stem and the proximal end of the primary branches, becoming gradually thicker towards the terminal ends, where it is relatively very thick. At a distance of about 20 mm. from the distal end in one specimen the axis is 0·9 mm. in diameter and the coenenchym 0·3 mm. in thickness. The difference in size of the coenenchym spicules is not material. The largest spicules in the specimens in the collections are pretty uniformly 1·2 mm.; in the fragment of the type-specimen of *M. tenera* that I examined there are none over 1 mm. in length. It is not quite clear what Wright and Studer meant by the " calix " in their account of *M. crassa*. It is probably not the same thing as the " verruca " of Ridley, but the group of spicules at the base of the anthocodia forming the true calix or operculum. Ridley gives the size of the spicules of the " polype " of *M. tenera* as about 0·35 mm. in length, but there is no good account of the constitution of the operculum in this species.

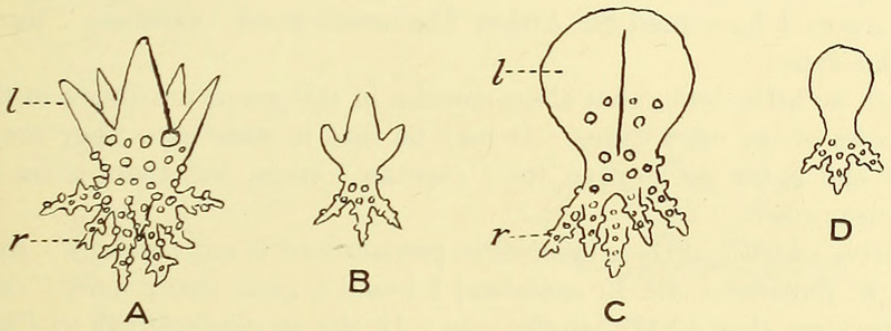
In our specimens the spicules of the triangular groups (" points ") of the operculum

are very variable in size and rarely exceed 0·4 mm. in length. The spicules of the surrounding ring " crown " are larger, and in some cases are 0·9 mm. in length.

The identity of *M. crassa* and *M. tenera*, however, cannot be firmly established, as the type-specimen of the former was not returned to the British Museum with the rest of the " Challenger " Collection, and it is not known where it has been deposited.

Genus *Echinogorgia*, Kölliker.

This genus was founded by Kölliker in 1865 (p. 136) for certain species formerly referred to *Gorgonia* by Esper. His definition of the genus simply stated that the species has a horny axis with small superficial spiny spicules of a peculiar form, and small or slightly developed calices. These peculiar spicules received different names. The forms with a single flat leaf as in *E. sasappo* he called " Schuppenkeulen " ; the forms with triangular leaves, as in *E. furfuracea*, he called " Stachelkeulen " (Text-fig. 6). The name " Blattkeulen " in this paper was confined to the spicules of certain species of *Eunicea*.



Text-fig. 6.—Diagrams to illustrate the structure of the Blattkeulen. A, The variety called " Stachelkeule " by Kölliker. B, Small form of the same variety. C, The variety called " Schuppenkeule " by Kölliker. D, Small form of the same variety. *l*, the leaves ; *r*, the roots. In C the single leaf has a median keel and bears some tubercles.

Kükenthal (1919, p. 5) defined the " Blattkeulen " thus : " Die Stacheln der Anschwellung verbreitern sich blattförmig ; bei plattenartiger Ausbreitung einzelner Blätter entstehen sie Schuppenkeulen."

In recent times the term " Blattkeulen " has been used in a more general way for the spicules belonging to several genera in which leaf-like processes project from the surface of the coenenchym and verrucae, and are supported by root-like processes which penetrate into the mesogloea. Kükenthal himself, in 1924, calls the spicules of *Echinogorgia sasappo* and *Plexauroides praelonga* " Blattkeulen," which, according to Kölliker's definition, are typical " Schuppenkeulen."

Several authors writing in the English language have called these spicules " foliaceous clubs." In my opinion it is better to retain Kölliker's original name " Blattkeulen," but to use it in a more general sense.

In many of the species of the genus large tuberculated spindles are also found, usually situated in the coenenchym close to the axis. In *E. sphaerophora* some of these spicules occur at the surface and can be seen without dissection in dry or preserved specimens. They vary from 0·5–1·0 mm. or more in length. In *E. furfuracea* there are no spindles as large as this.

In some species a few large spicules may be found which seem to be a combination of these two types, *i. e.* a spindle- or half-spindle-shaped base with foliaceous expansions at one end or on one side. Such a spicule is figured by Kölliker (1865, pl. xviii, fig. 9, 1) for *E. sasappo* and is termed a " halbseitige Blattkeule " (Text-fig. 8). These spicules, which may be formed by a fusion of two or more scleroblasts in development, are not common in any of my preparations, and in some cases I have found only one on searching through a heap of several hundred dried spicules.

It would not be wise to use the presence or absence of these spicules as a guide for the determination of species.

A third type of spicule is very common in preparations of the spicules of the species of this genus. It consists of a short, smooth, median bar, terminating in a knob at each end. They are always very much smaller than spicules of the other two types. They have received various names according to the size and arrangement of the tubercles on the knobs, *e. g.* dumbbells, capstans, double wheels, double stars, etc. (Text-fig. 10).

Woodland (1905, p. 300) described a form of this type in the development of the spicule of *Alcyonium* under the name " caudal vertebra."

In this report I have used Sir Arthur Thomson's word " capstans " throughout for spicules of this type.

There can be little doubt that these spicules in this genus are stages in the development of spicules of the other types. It may be that in some cases they are arrested in development and never get beyond the " capstan " stage, but there is no evidence to prove or to disprove it.

The relative number of these spicules in preparations is not constant. In the case of two species (*E. furfuracea* and *E. reticulata*) I found a great many more " capstans " in the larger specimen than in the smaller one. In the species referred to *Plexauroides* I found no " capstans " in my first preparations, but on searching through a heap of dried spicules a few typical capstans in three out of six specimens.

The only conclusion that can be drawn from these observations is that the presence or absence of "capstans" cannot be safely used for the determination of specific characters.

The method adopted in this report for the determination of the species of this genus is to take Esper's description and figures of the species referred by Kölliker to the genus *Echinogorgia*, and the figures given by Kölliker of the spicules of the original types in the Erlanger Museum, which he investigated. The specimens in the collection which agreed in ramification and colour with Esper's plates and in the general character of the spicules with Kölliker's figures were referred to Esper's species. In this way four out of the five species were identified. One species (*E. sphaerophora*) was quite distinct from the others in having large spindle-shaped spicules at the surface of the coenenchym, and this has been referred with some hesitation, as the only specimen is a very small one, to the species proposed by Kükenthal.

Of the five species in the collection, *E. sasappo* is distinguished from the others by having " Blattkeulen " of the variety known as " Schuppenkeulen." The others have typical Blattkeulen. *E. sphaerophora* is distinguished from the others by having large spindles at the surface of the coenenchym.

E. furfuracea and *E. reticulata* have, when full grown, profuse ramification in one plane with anastomosing branches.

E. furfuracea has colourless spicules and no large spindle-shaped spicules in the coenenchym.

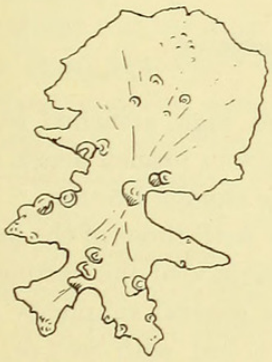
E. reticulata has red spicules and many large spindles in the coenenchym.

E. umbratica has a loose flabelliform ramification without anastomoses and colourless spicules.

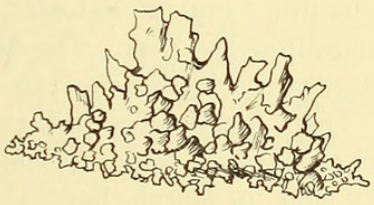
Echinogorgia sasappo, Esper.

There are two specimens dredged in Penguin Channel (Station XII).

The larger of these (specimen L) consists of a main stem, without a base of attachment, 100 mm. high. From this stem spring three branches, not in the same plane, at intervals of about 30 mm. The longest of these branches is 25 mm. The stem and branches are about 2·5 mm. in diameter.



Text-fig. 7.



Text-fig. 8.

Text-fig. 7.—*Echinogorgia sasappo.* One of the larger Blattkeulen without a keel on the leaf.
Text-fig. 8.—*Echinogorgia sasappo.* One of the spicules called "halbseitige Blattkeulen" by Kölliker.

The verrucae are prominent, some dome-shaped, others, more fully expanded, conical. The height of the conical verrucae is 0·75 mm. They are densely crowded on all sides of the stem and branches, but are smaller and more scattered on the lower third of the stem.

The colour is salmon-red.

Spicules.—The surface of the coenenchym and verrucae is protected by a layer of "Blattkeulen" of the variety "Schuppenkeulen," the leaves of which project irregularly on the coenenchym, but overlap like imbricated scales on the verrucae. These spicules are extremely variegated in form and size, but the maximum size appears to be about 0·3 mm. in length.

The smaller forms, 0·18 mm. in length, consist of a single smooth leaf and three tuberculated rootlets (Text-fig. 6, D).

In the largest forms there is a single leaf with a crenated edge and a single keel, or in addition to the keel two or four lateral ridges, in which case the keel and ridges project from the edge of the leaf, giving it a palmate outline ; and in the more complicated forms the keel and ridges are expanded vertically to form secondary plates at right angles to the leaf. There are some "Blattkeulen," however, without keels on the plates (Text-fig. 7).

All the Blattkeulen are pale pink in colour.

There are no spindle-shaped spicules at the surface of the coenenchym, but lying close to the axis and parallel with it there are some large profusely tuberculated spindles reaching a size of 0·75 mm. × 0·15 mm. In addition to the typical spindles there is a great variety of irregular shaped spicules, bearing, in many cases, triangular tubercles on one side only. The largest of these are of the type called by Kölliker " halbseitige Blattkeulen " (Text-fig. 8). Most of these spicules are colourless, but a few have a faint pink colour.

There are some pink capstans in my preparations 0·1 mm. in length.

A few of the polyps of this specimen are partially expanded. There is a thick collar of spicules below the tentacles, composed of straight or slightly bent spindles with small pointed tubercles, and a few forked spicules. The largest spindles in one of these anthocodiae are about 0·2 × 0·03 mm., but there are longer spindles of this type in the spicule preparations. There are no spicules in the tentacles nor, apparently, at the base of the anthocodia.

There is some calcareous matter in the axis.

The specimen is a male with gonads 0·3 mm. in diameter.

The smaller specimen (Dd) consists of a stem 55 mm. high, attached to a worm tube by a small circular disc 7 mm. in diameter. A small broken branch arises at right angles to the stem 38 mm. from the base. The diameter of the stem is 1·5 mm.

The characters of the verrucae and the colour agree with those of the larger specimen.

Spicules.—The " Blattkeulen " which cover the surface of the verrucae and coenenchym differ from those of the larger specimen in a more general simplicity of form. The smaller ones, 0·2 mm. in length, have a single smooth leaf with two or three rootlets. The larger ones have two or three tubercles on the upper side of the leaf, but no keel; the largest, 0·3 mm. in length, occasionally show a median keel, but never lateral ridges, and in only a few forms is the leaf lobed or divided.

There are some pink tuberculated spindles in the coenenchym, of which the largest I have measured is 0·5 × 0·16 mm.

There are some capstans (0·1 mm.), and numerous small (0·1–0·2 mm.), very irregular spicules, crosses, rods, etc., which may be younger stages of the other types.

From the examination of two partially expanded polyps it seems certain that the spiculation of the anthocodiae is similar to that of the larger specimen.

The specimen is a male, with gonads 0·3 mm. in diameter.

The differences observed between the spicules of these two specimens might be regarded as of sufficient importance to separate them into two distinct species.

I am convinced, however, that these differences are correlated with the size or age of the two specimens. In both specimens numerous small " Blattkeulen " (about 0·18 mm.) can be found which are identical in shape; between these and the elaborate " Blattkeulen," with 3- or 5-fid leaves armed with prominent keels, there are many intermediate stages in both specimens, but in specimen L the later stages are dominant, in specimen Dd the earlier stages are dominant.

The spindles of the cortex, which are mainly colourless in L, but coloured in Dd, offer another point of difference which may be correlated with the size of the branches. These spicules are found only in the lower layer of the cortex, and if the development of the colour is determined by light, the specimen with the thinner cortex and less elaborate

" Blattkeulen," which would be more penetrable by light, would be more likely to have coloured spindles.

The illustration of *Gorgonia sasappo* given by Esper (1797, pl. ix) shows a number of red gorgonians, each with a few branches as in our larger specimen. The coenenchym is rather thick, and the low verrucae are densely crowded all round the branches.

Kölliker (1865, pl. xviii, fig. 9) gives three figures of the spicules of *Echinogorgia sasappo*; one of these (No. 3) with a single leaf and a complex root is similar to many spicules of the larger specimen L, but does not show the prominent keels which most of the " Blattkeulen " of this specimen possess. I have found a few spicules in my preparations corresponding with Kölliker's (No. 1) of a " halbseitige Blattkeule " and there are several spicules in the smaller specimen similar to his (No. 2) of a " Warzenkeule."

The spicules of *E. mertoni* (Kükenthal, 1919, p. 282) are similar to those of our smaller specimen, but the colour of this species is grey.

The species described by Nutting (1910, p. 66) as *E. flora* agrees with our specimens in the lax ramification, and the only type of " Blattkeule " that is shown in his pl. xxi, fig. 10, is similar to many that occur in my preparations. The colour of *E. flora*, however, is " very light brown and the spicules colourless." This species, however, is also closely related to *Plexauroides praelonga* (see p. 498, *infra*).

The name *Gorgonia sasappo* was given by Pallas to a species which he identified with the Accarbaar Sasappo of Rumphius (' Herbarium Amboinense,' vol. vi, p. 223, t. 83). A comparison of the figure given by Rumphius with the figure given by Esper of *Gorgonia sasappo* suggests very strongly that the gorgonian called by the Malays Accarbaar Sasappo is not identical with Esper's species.

However, if the specific name stands, as it should do, it should be spelt as Rumphius spelt it, and not in the form sassapo, as used by Kükenthal and other writers.

Echinogorgia furfuracea, Esper.

There is one large specimen (B) belonging to this species and a small one (P) which may be a juvenile form of the same species. They were both dredged in the Penguin Channel, the former at Station XII and the latter at Station IX.

The larger specimen (B) is definitely flabellate in form and the branches anastomose in several places. The frond, as it is preserved—the base is missing—is 200 mm. high and 150 mm. broad—the largest specimen in the collection.

The stem divides close to its origin and is lost in the general ramification. There is no pronounced midrib.

The main branches are almost uniformly 3 mm. in diameter. The terminal branches are very short and slightly swollen at the extremity.

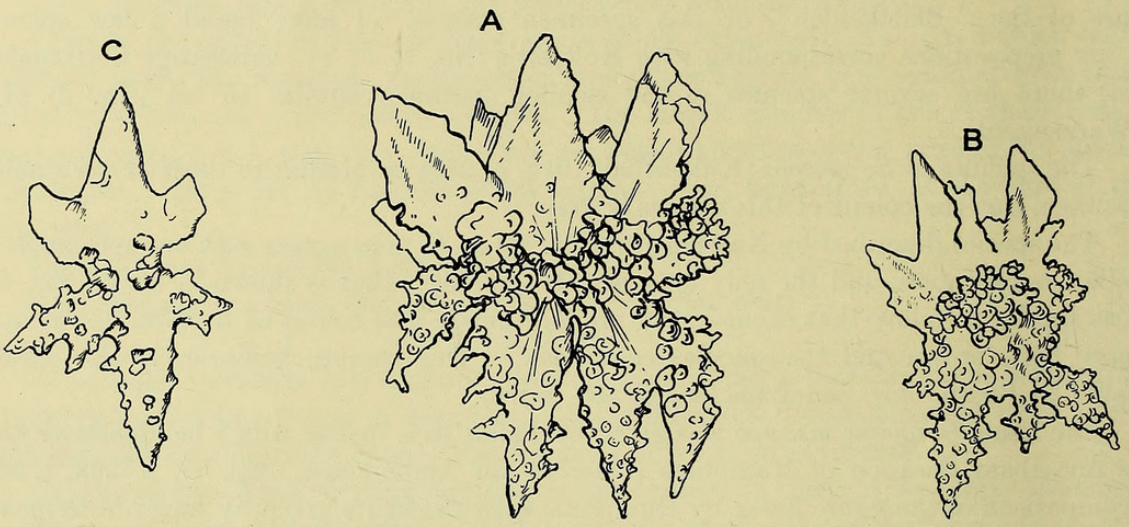
The verrucae are low mounds about 1 mm. in diameter at the base. They are irregularly distributed, and rather crowded on the terminal and secondary branches.

The colour of the specimen in spirit is dark grey, almost black on the older branches, but there is a note on the label—" yellow in colour."

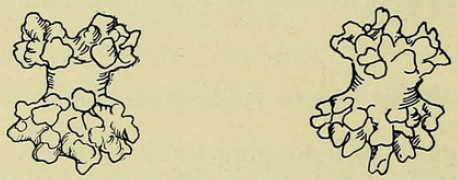
Spicules.—The " Blattkeulen " cover the coenenchym and verrucae. When full grown they are a little over 0·3 mm. in length and 0·3 mm. in breadth. They exhibit three to eight or more triangular leaves and have three to four tuberculate roots

(Text-fig. 9). The arrangement of the leaves is very variable. In some cases they have a roughly radial arrangement; in others the outer leaves are arranged in an irregular circle round a group of three or four central leaves. In many others there is a very prominent central leaf with an irregular group of smaller leaves around it.

The leaves are usually smooth and triangular in section, but some of them bear a few scattered tubercles. The smallest " Blattkeulen," 0·2 mm. in length, have three pointed leaves in a row and usually three short roots (Text-fig. 9, C).



TEXT-FIG. 9.—*Echinogorgia furfuracea.* A and B, Two forms of the larger Blattkeulen. × 200 diam. C, A smaller form. × 300 diam.



TEXT-FIG. 10.—*Echinogorgia furfuracea.* Two examples of the " capstan " spicules. × 300 diam.

There are numerous small " capstans " and stellate spicules (*ca.* 0·06 mm. in length) in the coenenchym (Text-fig. 10).

An important feature in the spiculation of this specimen is the absence of any very large spindle-shaped spicules in the coenenchym. A few straight tuberculated spindles occur in the older branches, but the largest of these is not more than 0·3 mm. in length.

The polyps are so tightly contracted in the specimen that the spiculation of the anthocodiae cannot be very satisfactorily determined, but the spicules which form the operculum have the usual form of slender straight or bent spindles with low tubercles and about 0·3 mm. in maximum length.

All the spicules are quite colourless.

The axis at the base is 3 mm. in diameter, and consists of an excentric core about 0·2 mm. in diameter, bearing crowded crystals of calcium carbonate, and a very thick dense cortex without a trace of loculi.

The axis of the terminal branches is similar to that of the other species, with its chambered core and a cortex of loosely bound horny fibres.

The specimen is male, with gonads 0·2 mm. in maximum diameter.

The small specimen, P, is 50 mm. high × 30 mm. broad. It is flabellate in form, and divides into twelve terminal branches without anastomoses. It springs from a disc-shaped base of attachment about 8 mm. in diameter.

The verrucae are a little smaller than in the larger specimen, but in form and distribution they agree with the verrucae of the larger specimen.

The colour is dark grey.

Spicules.—The "Blattkeulen" are similar to those of B, but smaller and simpler in form. The largest in my preparation is 0·24 mm. in length and has four leaves and three roots.

The smaller forms have three leaves in a row and three roots.

There are a few small capstans and, in my preparation, one tuberculated spindle 0·4 × 0·07 mm.

No gonads were observed in this specimen.

The illustration given by Esper (1797, pl. xli) of *Gorgonia furfuracea* agrees very closely in form and colour with the larger specimen (B) in this collection.

The spicules figured by Kölliker (1865, pl. xviii, fig. 18) are similar to many of the spicules in my preparations, although the "Blattkeulen" as drawn by him are smaller (0·2 mm.).

Kükenthal (1924, p. 201) says that in this species the walls of the verrucae bear peculiar "Blattkeulen," in which the leaves form a collar round a narrow central space.

There are no spicules answering to this description in the verrucae of either of our specimens, and there is no such spicule in Kölliker's illustration of Esper's type-specimen.

Kükenthal's description of the species was based on an investigation of the specimen referred to this species by Studer (1878, p. 652) from W. Australia.

Nutting (1910*a*, p. 63) described a specimen from the Flores Sea under the name *E. furfuracea* with "Blattkeulen" on the verrucae, bearing leaves similar in arrangement to that described by Kükenthal and others, in which the leaves are heavily keeled. In Kölliker's drawings of the type the leaves of the "Blattkeulen" are not keeled. The "Siboga" specimen also differs from the type in colour, being light pinkish brown.

The specimens described as *Echinogorgia furfuracea* by Studer and Nutting seem to differ in some important respects from the two specimens described under the same name in this paper and from Esper's type-specimen.

There can be no doubt that the specimens described by Ridley (1884, p. 337) from Port Denison and Port Curtis on the coast of Queensland as *Echinogorgia flabellum* belong to the same species as those referred in this report to the species *E. furfuracea*. I have examined the specimens* and preparations of their spicules in the British Museum, and find them in almost complete agreement with the specimens from the Penguin Channel.

There is no evidence, however, that Esper's *Antipathes flabellum* was an *Echinogorgia*. Only the bare axis is shown in the illustration, and this is more suggestive of a *Plexaurid* than of a Muriceid. Kölliker does not give any notes on this type. The species should therefore disappear from our lists and Ridley's specimens referred to *E. furfuracea*.

* There are two or three specimens on the sheet with the same name, which may not belong to this species. The specimens referred to here are registered as follows: 81.10.21.165 and 177.

Echinogorgia sphaerophora, Kükenthal.

There is a very small specimen in the collection from the Penguin Channel (Station IX) which, with some hesitation, may be referred to this species.

It consists of a single stem 55 mm. high, with two short branches and a rudimentary one, attached to a stone by a circular disc of attachment 5 mm. in diameter. The stem and branches are not more than 1 mm. in diameter.

The verrucae are crowded on all sides, rather prominent and almost hemispherical in shape.

The colour is pale red.

Spicules.—The " Blattkeulen " are very irregular in form, but, as in the type-specimen, they are smaller (0·2 mm.) than in most of the species of the genus.

In many there is a single trifid leaf, in some cases with a definite keel, in others densely tuberculated at the base. In other " Blattkeulen " there are several pointed leaves quite irregularly arranged. They bear three or four thick, short, and densely tuberculated rootlets. The smallest " Blattkeulen " have three pointed leaves in a row and three or four short thick tuberculated roots.

These spicules are all colourless.

The most characteristic feature of the species, however, is the presence of large spindle-shaped spicules at the surface of the coenenchym. They are pink in colour and from 0·6 to 0·9 mm. in length.

The larger ones are plano-convex in optical section and are densely covered with large tubercles, those on the outer convex surface being the most prominent.

There are a few small " capstans," but owing to the very small size of the specimen only one preparation of spicules has been examined.

The verrucae are fortunately not very tightly contracted, and the operculum can be clearly seen. It agrees very closely with Kükenthal's description and figure of the type-specimen (1919, p. 287).

Gonads were not observed in this specimen.

The original description by Kükenthal (1919, p. 286) of this species was based on the examination of two specimens in the Münich Museum with the rather vague locality " Ostindien." The two specimens were respectively 195 mm. and 87 mm. high, and therefore much larger than the specimen from the Penguin Channel.

The smaller of the two original specimens differs in some respects from the larger one, and Kükenthal had some hesitation in placing it in the same species.

Both specimens, however, form fan-shaped colonies, with some anastomoses of the branches and a similar armature of the polyps.

The large spindle-shaped spicules of the cortex are, however, very much larger (0·5 mm.) in the smaller specimen than in the larger. In the very small Penguin Channel specimen they are apparently larger still (0·9 mm.). Neither of the type-specimens had a red colour; they were both " hellgrau."

The very large spindle-shaped spicules call to mind the large spicules of *E. macrospiculata* (Thomson and Simpson, 1909, p. 219), but in this species they are not stated to be at the surface of the coenenchym as in *E. sphaerophora*, and in other respects the two species are not in agreement.

Echinogorgia reticulata, Esper.

There are two specimens in the collection from the Penguin Channel belonging to this species, one (H) from Station XII and the other (F) from Station IX.

Specimen H consists of a main stem arising from a spreading base of attachment 20 mm. in diameter, giving off branches sparsely in approximately the same plane to form a loose flabellum. It is 100 mm. high × 70 mm. broad. There are no anastomoses.

The branches are comparatively slender—*ca.* 2 mm. in diameter. The main stem at the base is 3 mm. in diameter.

The verrucae are rather more prominent than in the specimens of *E. furfuracea*, densely crowded and without any definite arrangement.

The colour of the colony is a dark purplish red.

Spicules.—The larger " Blattkeulen " are about 0·36 mm. in length × 0·3 mm. in breadth. Their leaves are triangular in shape and the root bears three or four pronounced rootlets. At the margin of the calix the " Blattkeulen " usually bear five pointed leaves in a row, the middle leaf being very prominent.

The leaves of these spicules in the coenenchym bear numerous blunt tubercles and in others the margin is dentated.

There seems to be no definite arrangement of the leaves. In many there is a prominent leaf in the centre, surrounded by a circlet of smaller leaves, but in the large ones there is no regular arrangement. Some of the larger spicules have a blunt, tuberculated keel.

All these spicules are pink in colour.

There are very few capstans in this specimen. They have a very faint pink colour.

There are numerous profusely tuberculated pink spindles in the coenenchym, varying in size to a maximum of 0·9 × 0·13 mm., but none of these are visible at the surface.

The spicules of the anthocodiae are bent spindles, *ca.* 0·3 mm. in length, with a maximum thickness of 0·03 mm. They are thicker than the corresponding spicules of *E. furfuracea*. In the retracted verrucae they form an operculum. These spicules are colourless.

This specimen is a female with ova up to 0·1 mm. in diameter.

Specimen F is also fan-shaped in growth, but differs from H in the presence of several anastomoses. It is 160 mm. high × 70 mm. broad, and springs from a spreading base 40 mm. in expanse.

The branches are more slender than in H, most of them being not more than 1 mm. in diameter.

The main stem is soon lost in the general ramification; the axis, which is bare near the base, is 2 mm. in diameter.

The verrucae are similar to those of specimen H, and the shade of red colour is almost the same.

Spicules.—The " Blattkeulen " of F and H are alike, but there is a difference between the two specimens in the relative numbers of the " Blattkeulen " and the spindles.

In an ordinary slide preparation of the spicules of F the number of spindles (up to 0·9 mm. in length) is about equal to the number of " Blattkeulen "; in H the " Blattkeulen " greatly exceed the spindles in number.

Moreover, in F there are many more capstans than in H, where they are very scarce. They are from 0·06–0·07 mm. in length.

This specimen is also female, the eggs being rather more advanced than in H. One egg was 0·3 mm. in diameter, but the largest eggs in most of the polyp cavities were only 0·2 mm. in diameter.

The general appearance of these specimens agrees fairly well with Esper's pl. IXA of *Gorgonia sasappo* var. *reticulata*, although the branches seem to be more slender. Kölliker (1872, pl. xviii, fig. 10) gives an illustration of a large red, irregular spindle of *Echinogorgia pseudosassapo* 0·9 mm. in length, which is an abnormal form of the large red spicule of our specimens. The name of the species was changed to *E. reticulata* by Kükenthal (1924, p. 202).

Our specimens agree with Kükenthal's definition of the species except in one particular. The branches and twigs are not greatly flattened. In one colony described by Nutting from the Malay Archipelago (1910A, p. 64) the branches are said to be flattened, but this is not mentioned as a character of the species either by Wright and Studer (1889, p. 119) in their specimen from Torres Straits, or by Thomson and Dean (1931, p. 205) in a specimen from N. New Guinea.

Echinogorgia umbratica, Esper.

The specimen was obtained in Penguin Channel (Station IX).

It is in the form of a loose flabellum without any anastomoses, 90 mm. high by 70 mm. broad.

A thick stem, 5 mm. in diameter, rises from a thin band of attachment, 9 mm. in length, to any oyster shell.

The branches arise laterally from the main stem, which does not bifurcate, but can be traced right through the colony to the margin of the flabellum. The branches are from 2–3 mm. in diameter and end in slightly swollen knobs. The verrucae are small (1 mm. in diameter), close set and distributed all round the stem and branches. An unusual feature of this specimen is that the verrucae extend the whole way down the stem and there are a few verrucae on the base itself.

The colour is a light brown.

Spicules.—The " Blattkeulen " are very similar in shape to those of *E. furfuracea*, but on the whole rather smaller in size. The larger " Blattkeulen " of *E. furfuracea* are a little over 0·3 mm. long; those of this specimen are a little less than 0·3 mm.

When fully developed they have four or five thick, pointed leaves, which very rarely show any trace of a keel, and four or five heavily tuberculated rootlets.

The smaller " Blattkeulen " (0·2 mm.) have usually three small triangular leaves and three rootlets.

There are several capstans (0·1 mm.) in the preparations.

There are more spindle-shaped spicules in the coenenchym in this specimen than in the specimens of *E. furfuracea*. An exceptionally large one is 0·75 × 0·15 mm., but most of them do not exceed 0·6 × 0·12 mm. in size.

All the spicules are colourless.

There are no gonads in this specimen.

The general form and colour of this specimen resemble the illustration given by

Esper, pl. xx, of *Gorgonia umbratica*, and the spicules agree in form with the figures given by Kölliker (1865, pl. xviii, fig. 495) of *Echinogorgia umbratica*. It is noteworthy that the " Blattkeulen " of this species are much smaller (0·11 mm.) than those of *E. furfuracea* (0·22 mm.) according to Kölliker's measurements.

Echinogorgia umbratica is included in Kükenthal's (1924, p. 204) " uncertain species," and no specimens have been referred to it since the publication of Kölliker's memoir.

This specimen from the Penguin Channel has several characters in common with those of *E. furfuracea* from the same locality (p. 487), and it is possible that it is only a variety of this species. The principal points of difference are that (1) the ramification is less profuse and there are no anastomoses, (2) the " Blattkeulen " are smaller, and (3) the number of large spindle spicules in the coenenchym is greater.

The specimen is much smaller than the larger specimen of *E. furfuracea* in the collection, and it occurred to me that the smaller " Blattkeulen " might be correlated with size, but a careful examination of the " Blattkeulen " of the smaller specimen of *E. furfuracea*, which is not so large as that of *E. umbratica*, has shown that they are approximately as large as those of the larger specimen of *E. furfuracea*.

As regards the size and number of spindle-shaped spicules in the coenenchym, the smaller specimen of *E. furfuracea* is intermediate between the two species. They are more numerous and some of them larger than in the older specimen of that species, but not so numerous, and apparently do not reach the same size as in this specimen of *E. umbratica*.

These statements are based on the examination of a large number of dried spicules from branches of approximately the same size. It is possible that if the investigation had been carried further, so as to include many different parts of each colony (*i. e.* base, stem, terminal twigs, etc.) they might have to be modified.

Genus *Plexauroides*.

No one who has had experience of systematic work in the Gorgonacea can doubt that the genera *Plexauroides* and *Echinogorgia* have many very similar features, and are difficult to distinguish from one another. But according to modern classifications, *Plexauroides* belongs to the family Plexauridae and *Echinogorgia* to the Muriceidae.

In 1884 (p. 338) Ridley said " *Echinogorgia* of Kölliker is nearly allied to *Plexaura*," but since his paper was published the species he described under the name *Plexaura praelonga* has been transferred to the genus *Plexauroides*. With even greater emphasis it may now be said that *Echinogorgia* is nearly related to *Plexauroides*.

If we consider the characters of the Plexauridae and Muriceidae given by Kükenthal (1924), there is found to be no sound reason for placing the two genera in separate families. According to his key plan of the families the Muriceidae have polyps with an operculum (Deckel) ; in the Plexauridae the polyps have no such operculum. In the more detailed definitions of the families (pp. 89 and 139) the polyps of the Plexauridae are said to be completely retractile or retractile into calices or apparent calices (Scheinkelche). In the Muriceidae the calices are usually higher than they are broad.

In the coenenchym of the Plexauridae there are two layers bearing different kinds of spicules, but no statement is made on this point in the definition of the Muriceidae. There is no clear distinction made between the axes of the two families.

The only clearly defined characters, therefore, which separate the families according to these distinctions is the presence or absence of an operculum or cover to the retracted polyps.

If we compare the definitions of the two genera, *Plexauroides* and *Echinogorgia*, (pp. 124, 198) the differences between are also very slight.

Both genera form fan-shaped colonies, but the branches anastomose in *Echinogorgia* but do not anastomose in *Plexauroides*. The calices, *i. e.* the verrucae, are pronounced in *Echinogorgia*, feebly developed in *Plexauroides*. In both genera the inner layer of the coenenchym bears spindles which are said to be small in *Plexauroides*. In *Echinogorgia* no mention is made of the size of the spindles, but they are said to be accompanied by crosses and other forms.

In the definition of *Echinogorgia* (p. 198), however, the important statements are made that the axis has the typical structure of the Plexauridae and that there are longitudinal canals arranged round the axis.

It may be seen that according to these definitions the two genera are alike in forming fan-shaped colonies, in showing two layers of the coenenchym, of which the outer layer bears " Blattkeulen," and, in some cases at least, the inner layer has longitudinal canals grouped round the axis. The structure of the axis itself is the same in the two genera.

The supposed difference between them as regards the presence or absence of an operculum is found on analysis to be of very uncertain value.

It may be said that Kükenthal (1924) did not make any clear distinction between his terms " Deckel " and " Operculum." They appear to be synonymous.

In the typical species of *Echinogorgia* the retracted polyps are covered and protected by an outer ring of spindle-shaped spicules (the crown), and eight triangular groups of bent spindles meeting by their apices in the centre (the points).

It is true that in *Plexauroides rigida* there are no spicules in the polyps and therefore no operculum, but in *Plexauroides praelonga* and *P. simplex* (Kükenthal, 1910, p. 95, fig. xlix) this armature of spicules shows no difference from that of a typical species of *Echinogorgia*. The verrucae of *Echinogorgia* are usually more pronounced than in *Plexauroides*; but low mound-like verrucae, not to be distinguished from the verrucae of some species of *Echinogorgia*, occur in *P. simplex* (Kükenthal, 1910, pl. i, fig. 3) and in other species of the same genus.

There is also a very well-defined operculum in species of *Euplexaura* (see p. 472).

The axis of these specimens affords no support for the separation of the genera in different families. The axis of every specimen in this collection of both genera has been examined and I can find no distinction of any importance between them.

Nutting (1910*a*, p. 67), in his description of *Echinogorgia flora*, says: "Were it not for the fact that the axis cylinder is devoid of calcareous matter the writer would be much tempted to place this species in the genus *Plexaurella* of the family Plexauridae." This species seems to be identical with Ridley's *Plexauroides praelonga* var. *typica*.

The axis of the smaller specimens and of the branches of the larger ones in both genera is free from calcareous inclusions, but in the stem or larger branches of *E. sasappo*, *E. furfuracea* as well as *Plexauroides rigida* and *P. prælonga* there is sufficient calcareous matter in the axis to give a distinct reaction with an acid.

The genus *Paraplexaura* (Kükth.) is evidently closely related to *Plexauroides* and to *Echinogorgia*. In discussing its relationship Kükenthal (1919, p. 252) says it is

closely related to *Plexauroides*, and differs only from *Echinogorgia* in the absence of an operculum.

The separation of these two genera into different families is obviously very inconvenient and has no scientific foundation. It has probably led to many mistakes in the past and, if retained, will lead to more in the future.

The occurrence in *Plexauroides* of spicules of the type of " Blattkeulen " seems to indicate that the affinities of the genus are closer with the Muriceidae than with the Plexauridae, and the general resemblances as regards the characters of the axis, the canal system and indeed the operculum (when present) of the species of *Plexauroides* and *Echinogorgia* support this conclusion.

For these reasons the genus *Plexauroides* is transferred to the family Muriceidae in this Report.

It is still an open question whether the species of *Plexauroides* should not also be transferred to the genus *Echinogorgia*. If the former generic name is retained there is only one very unsatisfactory character to distinguish the genus from *Echinogorgia*, namely, that the coenenchym is relatively thick and smooth.

In *Echinogorgia* the verrucae are prominent; in fully contracted specimens of *Plexauroides* the verrucae are almost flush with the general surface of the coenenchym. It is this character which gives the species of the latter genus a superficial appearance similar to that of many of the Plexauridae.

Plexauroides rigida, Kükenthal.

The specimen described below (R) was dredged in Penguin Channel (Station XII). It is 180 mm. high, and gives off dichotomously four branches about 30 mm. in length. The diameter of the main stem and branches is approximately 4 mm. The branches are not in the same plane and there are no anastomoses. In a branch 4 mm. in diameter the axis is 1 mm. in diameter.

The surface is covered with verrucae, showing no definite arrangement in lines of spirals. The verrucae are low mounds and measure about 1 mm. at the base.

The colour in spirit is orange red.

Spicules.—The majority of the typical " Blattkeulen " are 0·3 mm. in length and approximately the same in breadth, the breadth varying a good deal more than the length. The leaves are narrow triangular plates quite irregularly arranged and the root is characteristically a convex mass covered with tubercles, that is to say, there are usually no prominent rootlets as in the other species.

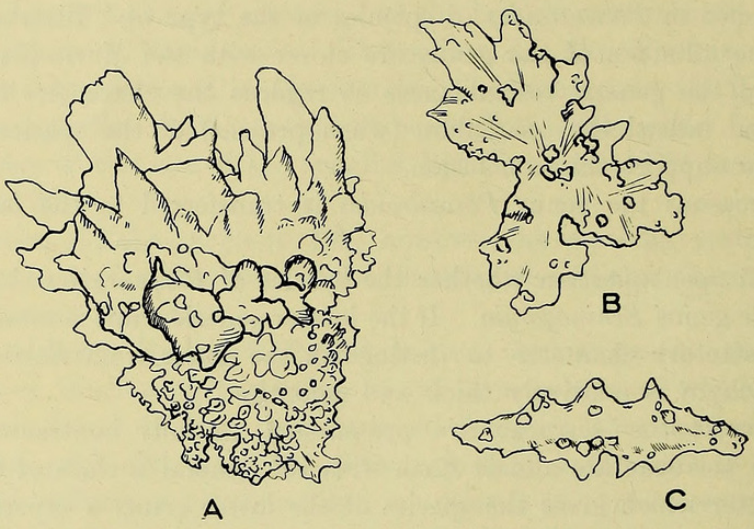
Among the full-grown " Blattkeulen " in a preparation smaller forms may be found 0·2 mm. in length, with three triangular leaves in a row and three pronounced rootlets, and it appears that as this type of spicule grows, the rootlets increase in thickness to form the convex mass without increasing relatively in length (Text-fig. 11).

There are a few capstans (0·1 mm.) in this specimen.

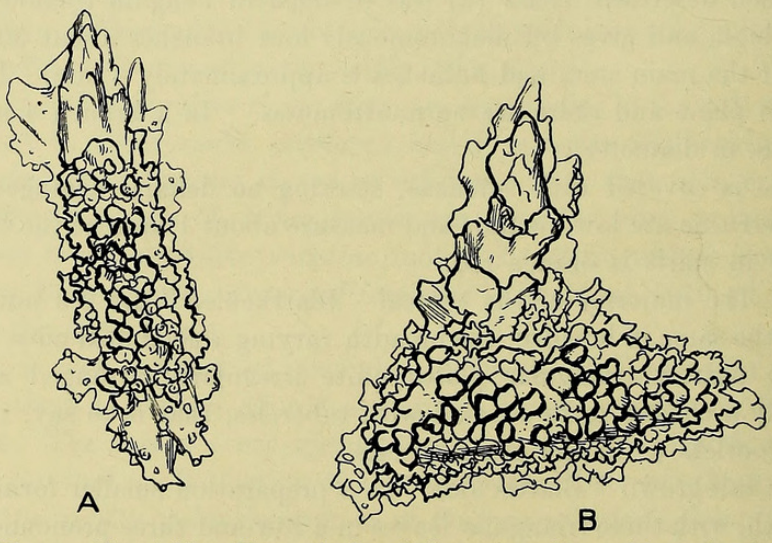
The spindles lie beneath the surface of the coenenchym, and attain to a size of 0·5 mm. in length by 0·15 mm. in maximum thickness. They are not all of a simple spindle shape, as some are forked at one end and some larger at one end than the other. One spicule in my preparation is of almost the exact shape, size and colour as the spicule figured for *E. pseudosassapo* by Kölliker in his pl. xviii, fig. 10.

The intermediates are of immense variety but of great interest. In several of them

one half is like the leaf cluster of a " Blattkeule " and the other half a spindle. The leaf cluster may be terminal so that the spicule is like a torch, or it may arise on one side only of a spindle-shaped base. Several of these are much larger than the typical " Blattkeulen," attaining a size of over 0·45 mm. in breadth × 0·5 mm. in length (Text-fig. 12).



TEXT-FIG. 11.—*Plexauroides rigida.* A, A very large Blattkeule with the roots fused into a dense convex mass. B, A smaller form with two thick irregular roots. C, One of the spindles from the lower layer of the coenenchym. × 200 diam.



TEXT-FIG. 12.—*Plexauroides rigida.* Two spicules of the coenenchym of irregular form. A, A torch. B, A halbseitige Blattkeule. × 100 diam.

All the larger spicules have a faint pink colour, the spindles being usually more darkly stained than the " Blattkeulen."

The polyps are contracted in the specimen, but the apertures of the verrucae are in many cases sufficiently wide to enable a good view to be obtained of the retracted anthocodiae. No group of spicules forming an operculum can be observed in any polyp, nor can any spicules corresponding in form with the polyp spicules of the species of *Echinogorgia*

be seen in the spicule preparations. Dissection of the retracted anthocodiae confirms these observations, and it can be definitely stated that there are no spicules in the anthocodiae and therefore no operculum.

No gonads were found in this specimen.

A smaller specimen (w) from the Penguin Channel, Station IX, consists of a single unbranched stem 70 mm. high springing from a very small disc-shaped base attached to an oyster shell.

The diameter does not exceed 2 mm.

The verrucae are low mounds.

The colour is orange red—almost the same shade as that of the specimen from Station XII.

Spicules.—The " Blattkeulen " agree in form and size with those of the other specimen, and there are several large spindles up to 0·3 mm. in length in the coenenchym. There is no operculum in the polyps.

There can be no doubt that this is a younger colony of the same species as the specimen described above from Station XII.

No gonads were observed.

The type of this species was obtained in 11–12½ metres of water in Shark's Bay, N.W. Australia, and was described by Kükenthal (1910, p. 92).

It was 230 mm. high, was branched in one plane without anastomoses and had an expanse of 110 mm.

The type was therefore much larger than the larger specimen from the Penguin Channel and the ramification much more profuse. Another important point of difference between them is that in the type-specimen the largest spindle-shaped spicules in the coenenchym were only 0·15 mm. in length, whereas in the Penguin Channel specimen there are some 0·5 mm. in length. The colour of the type-specimen was blood red, of our specimen orange red.

On the other hand, they agree in the absence of an operculum and in the form of the " Blattkeulen." The branches in both are circular in section and the diameter of the stem and branches is approximately the same.

Plexauroides praelonga var. *typica*, Ridley.

There are two small specimens dredged in the Penguin Channel, Station XII, which are probably young forms of this variety.

The larger one (z) consists of a stem 95 mm. high with two lateral branches, the longer of which is 50 mm. in length. The diameter of the stem is 3 mm. There is a small base of attachment 9 mm. in diameter without a covering of coenenchym.

The verrucae of the expanded polyps are in the form of low collars. In the contracted polyps these collars are almost flush with the general coenenchym. They are evenly distributed all round the stem and branches but not crowded together.

The colour is orange brown.

Spicules.—The " Blattkeulen " in this species are of the variety called " Schuppenkeulen " by Kölliker, that is to say, they consist of a single broad flat leaf and a root (Text-fig. 13).

In this specimen the prevailing type bears some large tubercles on one side of the leaf

and the root has two or three rootlets. The largest are about 0·4 mm. long × 0·3 mm. broad across the leaf.

Variations from this type show a leaf divided into two or three lobes with or without a crenate margin. In some of these there is a definite keel on the leaf, in others several radiating ridges as shown in Ridley's figure (1884, pl. xviii, *g'*).

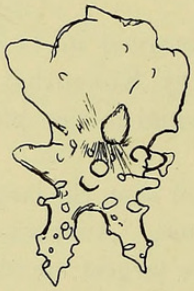
The small " Blattkeulen " have a single smooth leaf with two or three rootlets.

There were no capstans in my preparations of this specimen.

There are several large spindle-shaped spicules visible at the surface. They are variable in size up to a maximum of about 0·75 × 0·3 mm. The side of these spicules exposed at the surface bears longer tubercles than the underside, and some of these tubercles are expanded into triangular or more irregular leaf-like processes.

Some of these surface spicules are oval or disc-shaped, approaching the type of spicules of *Euplexaura robusta*.

In the lower layer of the coenenchym and in close contact with the axis there are numerous small white spicules 0·15–0·3 mm. in length of very varied shapes. Some are simple tuberculate spindles, some spindles with one or more long lateral spines, some crosses, some shaped like knuckle-bones.



Text-fig. 13.—*Plexauroides praelonga*. One of the " Blattkeulen " of the coenenchym. × 100 diam.

The retracted anthocodiae are protected by an operculum of bent spindles similar in arrangement to those of the operculum of the smaller specimen.

All the spicules except those of the anthocodiae are yellow, or, when seen in a heap, orange.

In a piece of the axis 0·75 mm. in diameter there is a chambered core 0·45 mm. in diameter with close-set concave septa, and a thin cortex consisting of tightly compressed fibres. It is not loculated. There is a little calcium carbonate in the axis.

The specimen is female, with ova 0·1 mm. in diameter.

A smaller specimen (Cc) has a base of attachment 15 × 7 mm., and consists of a stem 74 mm. high with one short branch.

The base and part of the stem bears no coenenchym. Where the latter is complete the stem is 2·5 mm. in diameter. The verrucae are similar in form and distribution to those of the other specimen (z).

The colour is orange red—a much brighter red colour than the other specimen.

Spicules.—Most of the " Blattkeulen " consist of a very thin leaf with a smooth outline. The larger ones bear a few tubercles on the outer side of the leaf but they are not keeled. They usually have three short tuberculated rootlets. The largest " Blattkeulen " are 0·3 mm. in length.

There are no capstans.

There are a few pink spindle-shaped spicules in the coenenchym with a maximum length of 0·4 mm., and in my first preparation there are no large spindles or plates similar to those of specimen z, but on examining a little heap of dried spicules I discovered one large sausage-shaped spicule (1·2 × 0·3 mm. in size) with large tubercles, expanding in some cases to small triangular plates on one side and small tubercles on the other.

The retracted anthocodiae are protected by an operculum consisting of slender bent spindles with a maximum length of 0·15 mm. They have the usual arrangement of a crown of two or three circles of spicules, and eight points of two or three spicules which meet more or less " en chevron."

All the spicules of this specimen, except those of the anthocodiae, are pink. When seen in a little heap they are red.

The specimen is male with testes up to 0·3 mm. in diameter. Some of the testes seem to be almost ripe.

Plexauroides praelonga var. *cinerea*, Ridley.

A specimen (v) from the Penguin Channel (Station XII) agrees very closely with Ridley's description of *P. praelonga* var. *cinerea* from 5–10 fathoms at Port Curtis, Queensland.

It is in two pieces; one with the base is 55 mm. high, and the other, without a base, is 120 mm. high. The diameter in the middle of the latter is 4 mm.

Many of the polyps in this specimen are expanded and the surface of the coenenchym round them is smooth—that is to say, there are no verrucae. The polyps are quite irregularly scattered on all sides of the stem.

The colour might be described in Ridley's words as " dirty grey," but " light dirty grey " in this well-preserved spirit specimen rather than dark dirty grey.

Spicules.—The " Blattkeulen " are variable in form, but the prevailing type has a single thin leaf without keel or ribs, but usually some tubercles on the proximal half, and a root with three rootlets, of which the middle one is frequently longer than the two lateral ones.

There are no " capstans."

There are some spindles in the coenenchym which are very variable in size up to a maximum of about 0·6 mm. These have usually longer tubercles on one side than the other.

In this specimen all the spicules are colourless.

The polyps are expanded but probably somewhat contracted by the reagent. The body measures 0·75 mm. × 0·45 mm. and the tentacles 0·45 mm. in length. The body exhibits two regions—a proximal region about 0·45 mm. in length with a thick wall and a distal thin-walled region about 0·3 mm. in length. The thick-walled region is almost unarmed, only a few scattered spindles being observed; at the junction of the thick and thin-walled regions there are a few spindles arranged transversely, forming a crown; in the thin-walled region there are several spindles arranged roughly parallel with the body, and some of these project into the bases of the tentacles. There are no spicules in the tentacles.

I have described the polyps as they are seen in the preparations, but I think it is possible that in life they were more heavily armed, as the surface epithelium seems to be slightly macerated, and some of the spicules may have been lost before the specimens reached me.

The axis of this specimen gives a strong effervescence when treated with an acid. Apart from the presence of more calcium carbonate which this reaction indicates, the structure of the axis is the same as that of the specimen z of the other variety.

The specimen is male, with testes up to 0·2 mm. in diameter.

A small specimen (Aa) from the same station probably belongs to this variety of the species.

It has a stem 60 mm. high, with one lateral branch springing at right angles from the stem 50 mm. in length. Near the extremity of the branch it is 2·5 mm. in diameter, but becomes more slender towards the base. None of the polyps are expanded in this specimen, and the verrucae are in consequence more pronounced.

The colour is dirty grey.

Spicules.—The " Blattkeulen " are also very variable in this smaller specimen, but the prevailing type is similar to that of the larger specimen. On comparing a group of spicules of each there are clearly more spicules in the smaller form which are provided with tubercles and ridges on the leaves and have a crenate or dentate leaf margin. Moreover, the rootlets are often more numerous and shorter than in the larger specimen. The smallest " Blattkeulen " have a single broad leaf.

In the smaller specimen also there are some spicules which seem to be a compound of a large spindle with a " Blattkeule " of the general type of Kölliker's " halbseitige Blattkeule."

The spindles of the lower layer of the coenenchym are similar to those of the larger specimen.

Although the majority of the spicules are colourless as in other specimens of this variety, it is of some interest that a few of the spicules in this specimen have a faint pink colour.

The armature of the few contracted polyps examined seemed to be similar to that of the other specimen.

Gonads were not observed.

These specimens agree closely with the description of the two varieties of *Plexaura praelonga* by Ridley (1884, p. 339). The type-specimens of the variety " *typica* " were found in 5–11 fathoms of water, on a bottom of sand and shells at Port Curtis and at Port Denison on a rocky bottom, the variety " *cinerea* " at Port Curtis only.

Wright and Studer (1889, p. 138) transferred the species to the new genus *Plexauroides*, and described a specimen (260 mm. high) from Cape York.

Nutting (1910*b*, p. 10) also described a large red specimen from the Aru Islands.

The new species *Echinogorgia flora* from New Guinea described by Nutting (1910*a*, p. 66) almost undoubtedly belongs to the typical variety of this species of *Plexauroides*. His figure (pl. xi, fig. 2) of *E. flora* shows a Gorgonian very similar to the specimen v of *P. praelonga* from the Penguin Channel, and the spicules of that species, as described by Nutting, agree closely with those of this *Plexauroides*.

The absence of calcareous matter in a specimen is no reason for retaining it in the family Muriceidae, as there is great variation in this respect in the Plexauridae, as shown in the axis of the specimens described above (see also Thomson and Dean, 1931, p. 198). This point, however, is of some general interest, as it is another indication of the very close relations of *Plexauroides* and *Echinogorgia*.

Echinomuricea indo-malaccensis, Ridley.

There is a specimen of this genus from the Penguin Channel, Station IX.

It is 85 mm. high, and has a base of attachment 12 mm. in expanse. The branching is quite irregular and without anastomoses. The base and the lower part of the branches are devoid of coenenchym, and partly enveloped by a mixed population of Polyzoa, sponges and other encrusting organisms (including a species of *Rhabdopleura*). Some of the terminal branches retain the coenenchym, but even this is partly covered by a milk-white encrustation, which consists of white calcareous sand-grains agglutinated together by a kind of slime.

In a word, the specimen looks unhealthy.

However, there is quite sufficient evidence that it is an *Echinomuricea*, and the only specimen of this genus in the collection.

Text-fig. 14.—*Echinomuricea indo-malaccensis*. One of the dagger-shaped spicules on the margin of the verrucae. × 100 diam.

The verrucae are crowded together in some places, but in others there are small stretches of coenenchym between them. The size of the verrucae varies a good deal, but the maximum breadth at the base is about 1 mm. The height of the verrucae depends on the extent of the contraction. The greatest height I have measured is 0·7 mm., but in some verrucae it is less than 0·3 mm. This measurement in contracted spirit specimens is of no specific value, although it might be of some value in specimens with fully expanded polyps.

The calcareous encrustations make it very difficult to determine the surface characters of the verrucae and coenenchym, but I have observed a few dagger-shaped spicules in the coenenchym.

The colour under the encrustations is red.

Spicules.—The characteristic spicules of this genus are the dagger-shaped spicules, which are found on the edge of the verrucae and more rarely on the coenenchym (Text-fig. 14).

A typical dagger is 0·6 mm. in total length; the blade has smooth edges and is 0·45 mm. in length. At the base of the blade there are a few small pointed tubercles. The hilt consists of 4 or 5 branched, root-like processes.

Other dagger-like spicules have a relatively longer blade or a more complicated hilt, and there is some variation as to the presence of tubercles on the blade. On the whole the blades are remarkably free from such tubercles and have smooth, sharp edges.

Other spicules found in a preparation are the thin bent spindles having a length of about 0·45 mm. and a maximum thickness of 0·03 mm., a number of quite irregular forms and a few crosses.

Nearly all these spicules have a pale pink to a darker orange-pink colour.

The axis is brown, and contains very little calcium carbonate.

The specimen bears male gonads up to 0·27 mm. diameter.

I have examined the type-specimen and its spicules, and there seems to be no reason to separate this specimen from Ridley's (1884, p. 336) *E. indo-malaccensis*, which was found in 5–20 fathoms off the coast of Queensland and in Torres Straits, although it differs from this species by its more irregular branching.

Nutting (1910, p. 56) describes seven species of the genus from the Malay Archipelago and New Guinea. Of his new species, *E. pulchra* from Banda (9–45 metres) has some resemblance to the specimen described above, but I do not consider that there is sufficient reason to separate this species from *E. indo-malaccensis*.

The species was also recorded by Wright and Studer (1889, p. 112) from the Philippines, but according to Hedlund (1890, p. 14), this specimen should be referred to a distinct species, *E. philippinensis*.

Thomson and Henderson (1905, p. 291) recorded the species from the Gulf of Manaar, but the verrucae in their specimens were higher (0·8 mm.) than those of the type (0·3 mm.) and the dagger-shaped spicules rather larger. These differences, however, should not be regarded as of any specific importance. There is a specimen in the collection made by Mr. Bedford at Singapore, of which Mr. Shann made a number of preparations, now in my cabinet. This specimen is undoubtedly identical with that from the Penguin Channel described above as *Echinomuricea indo-malaccensis*.

Genus *Paramuricea* ?

In the collection from the Penguin Channel, Station IX, there is a small Gorgonian which with great hesitation I have assigned to the genus *Paramuricea*. It consists of a single stem 58 mm. high and 1 mm. broad in its greatest diameter, rising from a horny disc of attachment (2·5 mm. diam.) to an oyster shell.

The verrucae are scarcely raised above the surface of the coenenchym, are oval in shape (0·75 × 0·6 mm.), separated by intervals of about 1 mm. but arranged irregularly all round the stem. The coenenchym is very thinly covered with a dense aggregation of spicules.

These spicules are of very variable shape, but some may be seen to be spindles up to 0·3 mm. in length, with large and sometimes branched tubercles. Others are forked, and there are some crosses. They are very difficult to separate in boiling potash, but it seems to be certain that there are some masses of spicules of irregular shape.

The anthocodiae have an armature of narrow, almost smooth spindles about 0·15 mm.

in length, and in retraction they form an operculum very similar to that of some of the species of *Paramuricea*.

The spicules are colourless and the specimen itself light grey.

It is impossible to determine with certainty the generic position of a single specimen of such small size, and a more elaborate study of its structure could not be made without serious mutilation, which did not seem to be justified.

The main point to be emphasized is that it is not a juvenile form of any of the other species described in this paper.

Most of the species attributed to the genus *Paramuricea* are found in European or Atlantic seas. No species have hitherto been described from the Malay Archipelago or from the coasts of Australia.

Family Acanthogorgiidae.

The genus *Acanthogorgia* was formerly included in the family Muriceidae, but was referred to a separate family, together with the genus *Acalycigorgia*, by Kükenthal (1908, p. 37). This rearrangement of the genus was not accepted by Nutting (1910), but the new family name has been more recently adopted by Thomson and Dean (1931). I have already expressed the opinion (1930, p. 250) that the reasons for the separation of the genus from the Muriceidae are not very satisfactory, but may be accepted temporarily until our knowledge of the two families is further extended.

The statement, however, that the species of the family have a purely horny axis (Kükenthal, 1924, p. 237) is subject to some exceptions, as the specimen from the Maldive Archipelago which I described as *Acanthogorgia flabellum* (1905, p. 812) has an axis with a core filled with large calcareous beads. The presence or absence of small calcareous granules in the axis is a character which is too variable for use in the diagnosis of families.

Acanthogorgia studeri, Nutting.

The single small specimen which I attribute to this species was dredged in 20–25 fathoms in the Papuan Pass (Station XXV, 17.iii.29).

It is only 32 mm. high, and consists of a main stem giving off five branches in one plane. It is attached by a small expanded base to a barnacle shell. There are no anastomoses of the branches.

The stem and main branches are of approximately the same thickness. The axis is 0·15 mm. in diameter, and this is covered by a thin transparent coenenchym 0·075 mm. in thickness.

The verrucae stand up from the coenenchym and are quite irregularly arranged, crowded at the distal ends of the branches, scattered on the main stem. They are cylindrical or hemispherical in shape according to their age or degree of contraction. The largest cylindrical form I have measured is 0·65 mm. in height and 0·45 mm. in diameter; the hemispherical or knob-shaped verrucae are about 0·45 mm. in diameter. The spines forming a crown round the top of the verrucae, which are a characteristic feature of the genus, are shorter than in most species.

The colour is pale brown, but the dark gold axis can be seen through the almost transparent coenenchym.

The spicules of the coenenchym are straight or bent spindles of various sizes, up to a maximum of about 0·35 mm. in length by 0·07 mm. in thickness; some of them have very prominent tubercles, as shown in Nutting's figure (1910, pl. xix, fig. 3). In others the tubercles are short convex projections. There are also a few crosses and irregular shaped spicules.

The spicules of the walls of the verrucae are similar to the spindles of the coenenchym. In the cylindrical verrucae they are arranged transversely to the axis of the polyp, in the hemispherical and knob-shaped verrucae more irregularly, with an approach to chevron arrangement in some cases.

The characteristic spicules of the margin of the verrucae consist of a spine 0·3 mm. in length, and a root usually bent at a wide angle to the spine 0·2 mm. in length. Both spine and root bear more tubercles than in this type of spicule of most of the species of this genus.

There are no gonads in this specimen.

The identification of this specimen may be open to some doubt, as it is very small and possibly only a juvenile form of another species.

According to Nutting (1910, p. 20), the type shows anastomoses of the branches to a limited degree, and the verrucae are 2 mm. in height, or more than twice as large as they are in this small specimen, but in the characters of the spicules the specimen agrees more closely with *A. studeri* than with any other species.

A study of the growth stages in a number of specimens of a single species from one locality seems to be necessary before specific determination in this genus can be satisfactorily made. It is probable in this case that the specimen described above is a young growth stage of *A. studeri*, but this species may in its turn be only a growth stage of such a species as *A. laxa*.

The genus has a very wide geographical and bathymetrical distribution and there are 28 species in Kükenthal's list (1924, p. 28). Nutting (1910) describes twelve species from the Malay Archipelago, and to this list Thomson and Dean (1931) add one more. It is rather surprising, therefore, that this is the first record of the occurrence of a species of the genus in Australian waters.

Family Gorgonellidae.

Genus *Juncella*, Val.

The original name given to a species of this genus by Valenciennes in 1855 was *Junceella*. Five years later its form was quite rightly corrected to *Juncella* by Milne Edwards and Haime, and until quite recently the genus has been called *Juncella* in the extensive literature on the subject by subsequent authors. *Juncella* should be retained as a *nomen conservandum*.

The genus can be distinguished from the other genera of the family by the characteristic club-shaped spicules of the outer layer of the coenenchym.

Juncella gemmacea, Valenciennes.

Two pieces of this species were dredged in the Penguin Channel (Station XII). They may be only branches of a large colony, but they are large enough to show the apparently dichotomous branching. The terminal branches of these two specimens have a maximum

length of about 100 mm. They have a diameter of 3·5 mm., including the verrucae, and taper gradually to a blunt point.

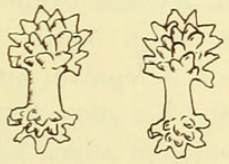
The verrucae are distributed evenly all round the branches, leaving no bare tracks such as are described in many specimens. They are about 2 mm. in length and 0·5 mm. in diameter, and are bent upwards towards the growing point with a slight inward bend. In many places they are so crowded together that they almost overlap.

The colour of these branches is orange red.

The spicules of the outer layer of the coenenchym are of the type, characteristic of the genus, called by Kölliker " unsymmetrische Doppelkeule " and by Simpson " clubs " (Text-fig. 15). They are pale yellow in colour and approximately 0·1 mm. in length. In the inner layer of the coenenchym the spicules are capstans of the type called " Doppelstern " by Kölliker. They are of the same length as the clubs, but colourless.

The figures of these two types of spicules in *Juncella juncea* given by Kölliker (1865, pl. xviii, figs. 45 and 46) resemble very closely the spicules in these specimens.

The specimens are so completely retracted that no parts of the anthocodiae protrude from the mouths of the verrucae, and therefore the only way to study the armature of the anthocodiae is by dissection. The tightly contracted anthocodiae thus released are



Text-fig. 15.—*Juncella gemmacea.* Two of the club-shaped spicules at the surface of the coenenchym. × 200 diam.

colourless and apparently free from spicules. I can find no evidence of the small warted rods which, according to Toeplitz (1929, p. 270), fill the tentacles (erfüllen dicht die Tentakel) in *J. juncea.*

It may be that Simpson and Toeplitz were able to examine the fully expanded anthocodiae of some of the species they described ; but in my experience the description of the armature of the polyps based on the examination of anthocodiae dissected out of tightly contracted verrucae is apt to be very misleading.

The axis has the usual straw colour of the Gorgonellids and gives rapid effervescence in hydrochloric acid. It is deeply grooved for the longitudinal canals. There are twelve grooves in a part of the axis 1 mm. in diameter.

The specimen is male, with testes 0·2 mm. in diameter.

This species was recorded from various localities off the coast of Queensland by Ridley (1884, p. 346), and from the Aru Islands and the Timor Sea by Nutting (1910, p. 20). It was thoroughly investigated by Simpson (1910, p. 294). Toeplitz considered the species to be a variety only of *Juncella juncea*, and this view was accepted by Kükenthal (1924). There can be no doubt that the two species are closely related, but the dichotomous branching of the specimens of *J. gemmacea* forms a sufficiently distinct character to justify their separation for the present.

The specimens from the Penguin Channel differ from most of the descriptions of the species in having no bare tracks between the verrucae. The verrucae are distributed all round the branches.

Genus *Scirpearia*, Studer.

The name *Scirpearia* was first introduced by Cuvier for an Alcyonarian which, by some subsequent authors, was considered to be a Pennatulid and by others a Gorgonian (see Simpson, 1910, p. 307). On the strength of this Nutting declared that the name should be abandoned and most of the species referred to the genus *Scirpearella*. Toeplitz (1929) has, however, expressed the opinion that it should be retained as one of the *nomina conservanda*.

Studer (1878, p. 660) gave a short definition of the genus based on the examination of specimens which were certainly Juncellids.

Simpson (1910, p. 277) after a thorough analysis of the characters of a large number of species, came to the conclusion that *Ctenocella*, *Ellisella* and *Scirpearella* could not be distinguished from one another generically, and united them into the one comprehensive genus *Scirpearia*.

Kükenthal (1924), on the strength of the work of Toeplitz, has resuscitated the genera *Ctenocella* and *Ellisella*.

My own investigations on the materials collected by the Barrier Reef Expedition, and on specimens in my own collection from various localities, lend support to Simpson's view that *Scirpearia*, *Scirpearella* and *Ellisella* cannot be separated, but I would plead for the retention of the genus *Ctenocella* (see p. 509).

The principal differences between *Scirpearia* and *Ellisella* according to Toeplitz are that in *Scirpearia* " die Tentakeln sind bei allen Arten der Gattung bewehrt mit Doppelspindeln, die Uebergange zu Gürtelspindeln zeigen können " (1929, p. 293), but in *Ellisella* "Die Bewehrung der letzteren (*i. e.* the Polyps) geschieht durchweg durch zwei Formen von Spicula, kleine unregelmässig bewartzte Stäbchen in den Tentakeln und stachelige Skleriten in der Polypenbasis " (*loc. cit.*, p. 274).

These statements do not agree with those of Simpson (1910, p. 264), who says that in *Scirpearia* (+ *Ellisella* + *Ctenocella*), " the tentacles bear a number of small flat, scale-like spicules on the aboral surface. These are very easily overlooked in a preparation ; and in fact they are so similar *in all species* as to be of no specific importance, so that their inclusion in each individual description is hardly necessary."

A very careful examination of the armature of the anthocodiae of the only specimen in this collection has been made, with the result that, in my opinion, the distinction between the two genera cannot be maintained.

Scirpearia elongata, Pallas.

Two branches of the Juncellid which I have referred to this species were also dredged in Penguin Channel (Station XII).

They are 240 and 190 mm. respectively in length. At the proximal end of the larger one there is a fork, but one of the branches is broken off near its origin, leaving only a short stump. Just below the fork it is 5 mm. in diameter, the axis is 3·5 mm. in diameter and the coenenchym about 0·75 mm. thick. The terminal branches at a distance of 20 mm. from the distal end have the axis 0·75 mm. in diameter and the coenenchym about 0·25 mm. in thickness.

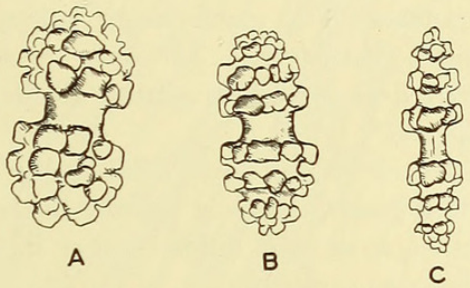
The verrucae are small blunt cones turned slightly upwards, 0·75 mm. in height and about 0·5 mm. in diameter at the base.

They are arranged quite irregularly all round the distal ends of the branches, but in some places near the proximal ends of the branches they are arranged laterally, leaving two broad bare tracks, in one of which there is a shallow groove.

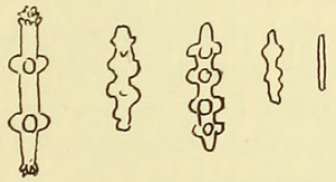
The colour is orange red.

The spicules of the coenenchym consist of "capstans" ("Doppelstern"), and more elongated forms which might be called double clubs. The larger capstans are about 0·058 × 0·054 mm. and the larger double clubs ·07 × ·03 mm. (Text-fig. 16). They agree very closely in form and size with the coenenchym spicules described and figured by Simpson (1910, p. 327, pl. ix, fig. 48) for this species.

It is very difficult to determine the exact arrangement of the spicules of the anthocodiae by dissection of the contracted verrucae. In this specimen there are a few verrucae, from the apertures of which a part of the tentacles protrude, and by the study of these and



Text-fig. 16.—*Scirpearia elongata*. Three spicules of the coenenchym. A, A capstan. B, An intermediate form. C, A double club. × 400 diam.



Text-fig. 17.—*Scirpearia elongata*. Spicules from the aboral side of a single tentacle. × 500 diam.

numerous dissections the following notes have been prepared: (1) The aboral side of the tentacles bears a row of spicules extending from the base to the apex. (2) The pinnules bear no spicules. (3) The thin body-wall of the anthocodia bears a few spicules 0·04 × 0·01 mm. in size, with two girdles of four tubercles and a tuft of small tubercles at each end. (4) Between the base of the body-wall of the anthocodia and the verrucae there is a cluster of small spindle-shaped spicules of various sizes up to a maximum length of about 0·06 mm.

The question whether these spindle-shaped spicules really belong to the anthocodia or the verruca can only be determined by the examination of fully expanded polyps.

The spicules of the tentacles diminish in size from the base to the apex, where they are, as Simpson described them, thin scales (Text-fig. 17). In the basal parts they vary in form, some being double clubs, some with regular girdles, and some with irregularly distributed tubercles; in fact spicules corresponding in form with the spicules of the tentacles figured by Toeplitz for both genera (*Scirpearia* and *Ellisella*) can be seen in one tentacle of this species.

The axis is straw-coloured and highly calcified. In a section of a decalcified branch 1·8 mm. in diameter between the verrucae, the axis is 1·3 mm. in diameter and the coenenchym 0·25 mm. thick and there are twelve longitudinal canals, of which two on opposite sides of the branch are much larger than the others.

The specimen is female with small ovaries. One or two ova 0·2 mm. in diameter were found, but in most cases the ova did not exceed 0·1 mm.

This species is supposed to be identical with the *Gorgonia elongata* of Pallas. The specimens have been referred to it with some hesitation, but after a careful consideration of the extensive literature on the family, I have come to the conclusion that these Juncellids are far more variable than they are generally assumed to be, and that most of the new species that have been proposed are only local variations of one wide-spread species.

Simpson (1910, p. 325) has given a full account of a specimen of this species from the West Indies in the collection of the Royal College of Surgeons, and if the specimens described above are the terminal branches of a much larger colony, they agree closely with this description in all essential characters. The only species of the genus which has been recorded from the Barrier Reef is *Ellisella calamus* (Ridley, 1884, p. 348), referred by Simpson to the genus *Scirpearia*.

The species was referred back to the genus *Ellisella* by Toeplitz, and our specimens agree with his definition of that genus in having spicules in the verrucae of the same kind as those in the general coenenchym, but differ from it in having much more slender branches and a relatively thin coenenchym.

There is apparently no sound specific difference between the specimens from the Penguin Channel and the specimen of *Scirpearia elongata* from the West Indies in the Hunterian Museum described in detail by Simpson (1910, p. 326). It is possible that when fully expanded specimens of the *Scirpearias* from these two widely separated localities can be examined and the armature of the polyps accurately determined, some important differences between them may be discovered.

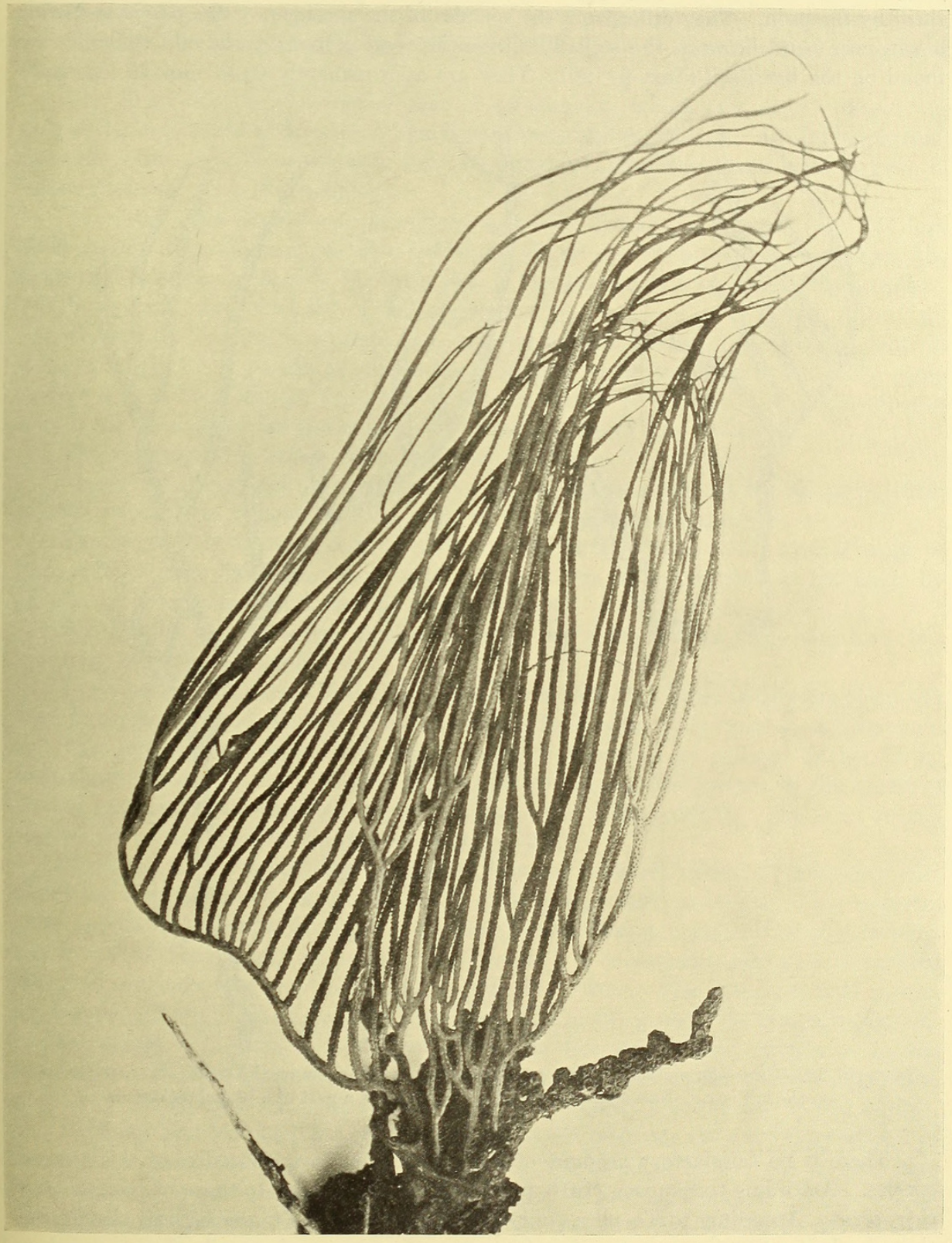
But until this time the species must be considered to have a very wide geographical distribution with only slight local variations.

Ctenocella pectinata, Pallas.

A fine specimen of this well-known species was found in 7 fathoms of water inside the Wentworth Reef (Station XI, 23.ii.29) (Text-fig 18). The Wentworth Reef is a submerged patch of coral near Port Douglas. This is the specimen figured by Dr. Yonge on his pl. xxxix A, opp. p. 133, as a "horny coral or Gorgonid." Two small specimens, probably of the same species, were also obtained from the Penguin Channel (Station XII) on the following day.

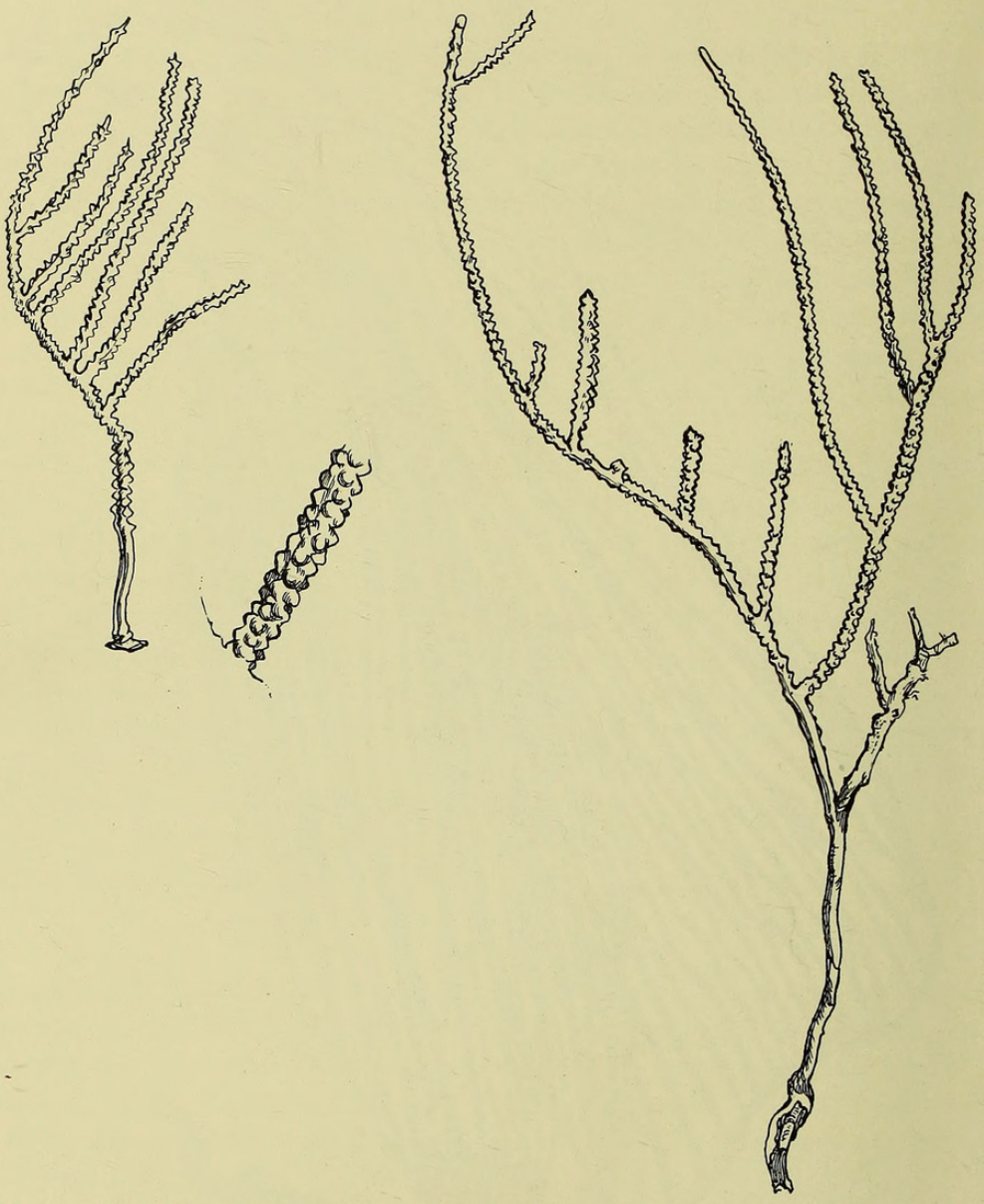
The large specimen is about 600 mm. high and has an expanse across the shoulders of about 250 mm. The thickest part of the stem is 30 mm. in diameter and the branches about 2·5 mm. in diameter. The verrucae are low mounds, and about 1 × 0·75 mm. in size at the base. The arrangement of the verrucae varies in different parts of the same branch. In some places there is a distinct bare track on both sides between two lateral groups of verrucae; in others there is no bare track on one side, and in considerable lengths the verrucae entirely surround the branches. In some places the verrucae are arranged in a spiral manner round the branches but in others the arrangement is quite irregular.

The colour of these specimens is red.



TEXT-FIG. 18.—*Ctenocella pectinata.* From a photograph of the large specimen from Wentworth Reef. × $\frac{1}{3}$.

The spicules of the coenenchym agree very closely with the description given of them by Simpson. They differ from the spicules of the specimen of *Scirpearia* in having a narrower band between the stellate extremities, and in many cases odd tubercles are found on the bar itself (Text-fig. 20). They are approximately 0·057 mm. in length.



TEXT-FIG. 19.—*Ctenocella pectinata*. Two young specimens. The one on the right is T_1, and the one on the left is T_2. Nat. size. At the side of T_2 there is a part of a branch enlarged.

There is no satisfactory account of the spicules of the anthocodiae of this genus or species. According to Simpson (1910, pp. 264), they are similar to those of the species of *Scirpearia*. According to Toeplitz (1929, p. 319 and 327), the tentacles bear slender rod-shaped sclerites 0·046 mm. in length. I have found some spicules similar in size and shape to those described by Toeplitz, but in my dissections of these small, tightly contracted verrucae it was not possible to obtain a clear idea of the armature of the anthocodiae when

expanded. The polyp cavities were filled with nearly ripe testes with a maximum diameter of 0·5 mm.

The two small specimens from Station XII present some features of interest (Text-fig. 19).

The larger one (T_1), having no base of attachment, is 140 mm. high. The lower part of the stem is dead, the coenenchym being brown and degenerate. It divides, 40 mm. from the lower end, dichotomously, but one of the two branches is also dead 30 mm. in length and covered with epizoites.

The other branch, however, is normal, and at a distance of 15 mm. from the fork divides again dichotomously, to give rise to an almost typical bipectinate flabellum, the secondary branches arising on the inner side of the two main divisions of this branch.

No gonads were observed in this specimen.

The smaller one (T_2) is 80 mm. high and has a small base of attachment 3 mm. in diameter. The form of this specimen may be said to be mono-pectinate. The main stem at a distance of 25 mm. from the base bends sharply to one side, and on the opposite side to the bend gives rise to six secondary branches 25–35 mm. in length.

The specimen is a female with ova up to 0·45 mm. in diameter.

These two specimens are smaller than any of those examined by Simpson (1910, p. 320), which were apparently all normal in their bipectinate form.*

The larger form is of interest, as it shows that having failed at the first attempt to form a bipectinate flabellum owing to the death of one of its branches, it has made by another dichotomy a second and successful attempt.

The smaller one, although abnormal, shows the characteristic branching from one side only of a typical flabellum.

These young forms seem to indicate that in this genus the bipectinate form of growth is an important genetic character which manifests itself at an early stage in development.

This well-known species has been previously described by several authors from Australian waters. It is distributed throughout the Malay Archipelago to the coasts of Burma, and has been found in various localities in the Indian Ocean. The same species also occurs in the West Indies (Ridley, 1884, p. 349).

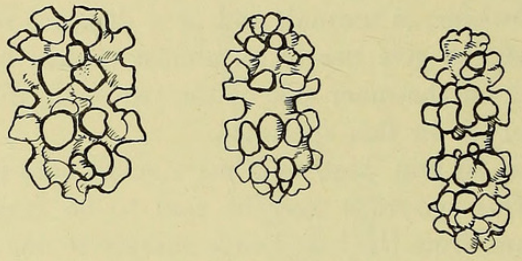
There can be no doubt that the genus *Ctenocella* is closely related to *Scirpearia*, and that there is great force in Simpson's (1910, p. 277) arguments in favour of the inclusion of the species in the genus *Scirpearia*. The unique and characteristic method of branching, usually called "lyre form," or better, "bipectinate," is so definite and easily recognized that it is convenient to keep the species in a distinct genus. This is not the only reason, nor a sufficient one in itself, to justify the retention of the genus. As Simpson (*loc. cit.*, p. 318) points out, there is a difference between this species and *Scirpearia* in the spiculation. This difference might easily be overlooked, because at first sight the spicules of a *Scirpearia* and a *Ctenocella* seem to be exactly alike in size and in outline, but, as Ridley pointed out (1884, p. 349), in *Ctenocella pectinata* the two inner whorls of the verruca spicules almost meet in the middle, "so as to obliterate the median bare zone, which is characteristic of the cortical spicules" (Text-fig. 20).

After a careful examination of several preparations of the *Scirpearia* and of each

* There is some confusion in Simpson's table of measurements, as in the column of the diameter of the main stems *cm.* is probably a misprint for *mm.* A main stem 3 cm. in length by 10·5 cm. in diameter is impossible.

of the three specimens of *Ctenocella* in the collection, I can not only confirm Ridley's observation, but find a further difference in that the bare zone of the ordinary cortical spicules is usually narrower and more frequently partially obliterated by the presence of odd tubercles on it.

In comparing the canal system of these specimens of *Ctenocella* with that of the specimen of *Scirpearia*, I have observed a difference between them which may be of some importance. In a terminal branch of *Ctenocella* there are two very large longitudinal



TEXT-FIG. 20.—*Ctenocella pectinata*. Spicules of the coenenchym. × 400 diam.

vessels connected by a network of capillaries. In a branch of *Scirpearia* of the same diameter there are two large longitudinal vessels, as well as several smaller longitudinal vessels surrounding the axis.

It is possible that further investigation will emphasize the difference between the two genera, as we have very little information concerning many important features of their anatomy. There is no satisfactory account, for example, of the armature of the expanded anthocodiae of *Ctenocella*, and the short statements that have been made on this character are not in agreement (see Toeplitz, 1929, p. 323).

Until the time when fully expanded specimens of the two genera have been examined and described it is better to retain the genus *Ctenocella*, rather than merge this interesting species with those of *Scirpearia*.

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