

GORGONACEA (COELENTERATA: ANTHOZOA: OCTOCORALLIA) OF SOUTHERN TAIWAN¹

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Chung-Chi Chen and Kun-Hsiung Chang (1991) Gorgonacea (Coelenterata: Octocorallia) of southern Taiwan. *Bull. Inst. Zool., Academia Sinica* 30(3): 149-182. A total of 18 species of gorgonians, belonging to 13 genera of 7 families, from the subtidal zone of Kenting National Park in southern Taiwan are described. All of them are new records for Taiwan. A systematic account with a key based on color and sclerites morphologies and descriptions of their habitats and symbionts are presented.

Key words: Gorgonacea, Octocorallia, Systematic accounts, Distribution, Symbionts, Taiwan.

The Order Gorgonacea belongs to Subclass Octocorallia, Class Anthozoa, Phylum Coelenterata. Animals in this Order include sea whips, sea feathers and sea fans which as a whole are known as horny corals. Most horny corals possess graceful forms and bright coloration, hence they are conspicuous in the reef area.

Gorgonians are important ecological components of the coral reefs; they provide shelter and habitats for many marine invertebrates, including polychaetes, bivalves, gastropods, nudibranches, echinoderms and fishes (Kinzie III, 1970; Patton, 1972; Zann, 1980; Hazlett and Bach, 1982; Grygier, 1984); their calcified sclerites and axials contribute in part to reef formation (Opersko, 1973).

Furthermore, prostaglandins, a kind of natural product which is thought to be of medical value, have been found in *Plexaura homomalla* (Bayer and Weinheimer, 1974).

Although gorgonians are known to be widely distributed in the subtidal waters around Taiwan (Yang *et al.*, 1982; Chang, 1983); very little is known about them in this area. The present paper presents the first report on the systematics and ecology of gorgonians in the shallow waters of southern Taiwan based on a comprehensive survey of the fauna which was conducted over a number of years.

MATERIALS AND METHODS

Field work and specimen collection

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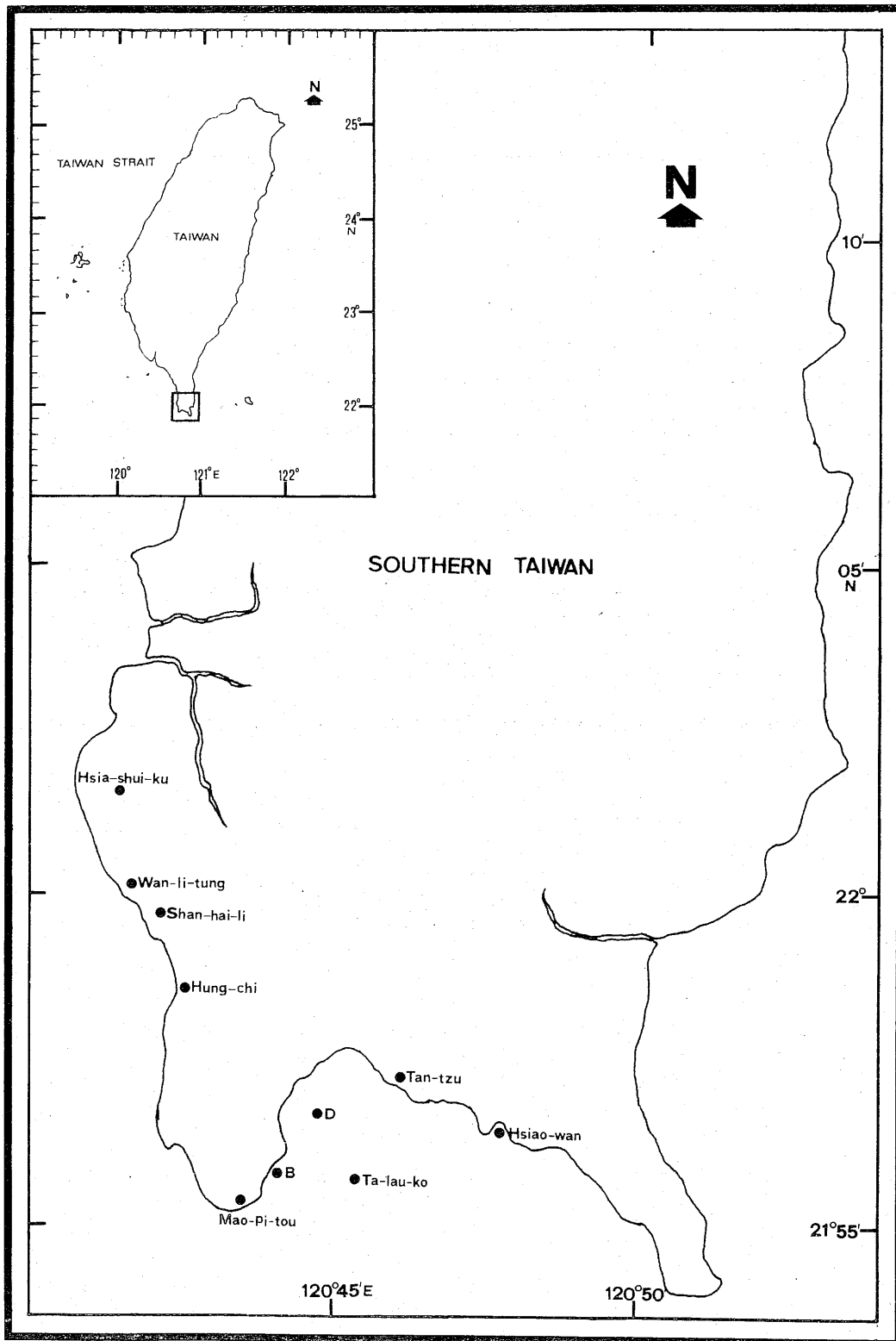


Fig. 1. Map of southern Taiwan showing the study area.

were undertaken along the coast of Kenting National Park in southern Taiwan (Fig. 1) from November 1984 to May 1986. Specimens were collected by scuba diving down to a depth of 30 m. Color and habitat of the gorgonians were observed and underwater photographs were taken to record the colors of the live coral colony.

The specimens were preserved as dry and wet specimens. Dry specimens were first prepared by 10% formalin fixation, and then air-drying. Wet specimens were prepared following the procedures described by Weinberg (1976).

All the specimens described in the present paper are deposited in the Institute of Zoology, Academia Sinica (ASIZ).

The polyps and calyces of the gorgonians were examined and measured with a binocular microscope. The tissues including sclerites of polyps, calyces, superficial and deeper coenenchyme were placed under a binocular microscope and dissolved with 5.25% sodium hyperchlorite solution and 3% hydrogen peroxide to prepare the materials for their identification. Sclerites were examined and measured with an optical microscope. The sclerites, after being dehydrated with absolute alcohol, were studied by using a scanning microscope, Hitachi S-450, and photographs were taken for further examination. The identification of the genera followed Bayer's (1981). General terms, colony shapes, branching patterns and sclerite descriptions mainly followed Bayer *et al.* (1983).

RESULTS

Key to species of Gorgonacea found in southern Taiwan.

1. Central axis not entirely or largely horny, but medulla zone filled with sclerites more or less tightly bound

- together by horny or calcareous matter; if jointed, horny nodes filled with sclerites, and internode contains inseparable spicular sclerodermites. Medulla never with soft and cross chambered central chord (SCLERAXONIA)2
- Central axis either purely horny, or horny with non-sclerite calcareous deposits, or of long calcareous internodes alternating with short and entirely horny nodes; axis having often chambered central chord (HOLAXONIA)7
2. Trunk and/or main branches hollow, tubular (*Solenocaulon*). Colony mostly plumiform, branched in one plane. Stem gutter-like or tubular. Branches moderately thin, flat or groove-shaped, canaliculate or clavate, arising laterally on both sides with a nearly right angle to stem.*Solenocaulon chinense*, Fig. 2, A. Trunk and branches not hollow, tubular3
 3. Medullar sclerites smooth, fusiform, branching, often anastomosing (Fig. 6, D; 7, E; 8, E); colonies arbore-scent, fan shaped or bushy (*Subergorgia*)*Subergorgia*, 4
 - Medullar composed of spongy, horny and spiculiferous nodes alternating with a hard internode of inseparable fused calcareous sclerites. Sclerites of coenenchyme of variable form, sclerites of medulla, smooth rods (Fig. 9, F; 10, F); color red, orange, yellow, rarely white (*Melithaeidae*)6
 4. Colony reticulated (Fig. 2, B). Both front and back of stems sometimes furnished with slightly longitudinal furrow. Live colony color bright orange or grey*Subergorgia mollis*, Fig. 2, B. Colony not reticulated5

5. Colony planar. The stem and branches furnished with incomplete longitudinal furrow. Live colony brick red
 *Subergorgia rubra*, Fig. 2, C.
- Colony nearly planar or in bushy form. Both front and back sides furnished with deep, sharp and longitudinal furrow. Color of live colonies bright red
 *Subergorgia suberosa*, Fig. 2, D.
6. Coenenchyme sclerites include numerous leaf-clubs (*Mopsella*). Colony planar. Nodes of stem globular, but not conspicuously swollen at branches and twigs. Color of colony reddish orange
 *Mopsella aurantia*, Fig. 2, F.
- Sclerites of coenenchyme include capstans more or less strongly modified as double wheels ("birotulated") (*Melithaea*). Colony multipanar, not profusely branching, stem flat. Color of live colony red, orange or sulfur yellow
 *Melithaea ochracea*, Fig. 2, E.
7. Polyps not functionally differentiated into anthocodia and anthostele, contractile (Fig. 11, D) but not retractile within common coenenchyme, tentacles folding over oral disk in contraction (*Acanthogorgiidae*)8
- Polyps functionally differentiated into anthocodia and anthostele, or fully retractile into common coenenchyme; spiculation of tentacular part of polyp not continuous with that of proximal part but separated by neck zone with few or no sclerites, permitting retraction of anthocodia into anthostele or directly into common coenenchyme9
8. Distal ends of sclerites surrounding tentacle bases differentiated as sharp projecting spines forming a conspicuous thorny crown around infolded tentacles (*Acanthogorgia*). Colony flabellate. Calyces irregularly set on all sides of the branches, being more crowded on the terminal twigs
 *Acanthogorgia vegae*, Fig. 2, G.
- Calyces short and verruciform to tall and cylindrical, sclerites arranged more or less distinctly in chevron shape in 8 double rows, the distal ones with small projections or not at all; sclerites of calyces gradually merging with those of tentacle bases, which are not abruptly smaller; inner layer of coenenchyme with more or less abundant radiates. Calyces low, verruciform (*Muricella*). Colony roughly flabellate. Calyces fairly evenly distributed on the sides and front of the colony, but the back is almost completely bare. Colony deep crimson in color
 *Muricella grandis*, Fig. 3, A.
9. Sclerites tuberculate double heads or double clubs sometimes larger at one end (*Ellisellidae*)13
- Sclerites not tuberculate double heads or double clubs10
10. Sclerites in the form of spindles with tubercular sculpture arranged in whorls, of moderate size (up to 0.3 mm, commonly less); when present, anthocodial sclerites are tapered, flat rodlets with scalloped or lobed edges, not usually forming a crown and points; core of axis narrow, cortex dense, with little or no loculation (*Gorgoniidae*)11
- Fully developed sclerites usually longer than 0.3 mm and may be very large (length to 5 mm or more); core of axis wide, cortex soft, loculated (usually abundantly so), the loculi filled with delicate fibrous substance or hard, non-spicular CaCO_3 composed of crystals radially arranged with respect to axis (*Plexauridae*)12

11. Blunt, cylindrical rods scantily distributed among tuberculate spindles and wart-clubs (*Hicksonella*). Colony densely arborescent, forming a profuse branching. Calyces and coenenchyme composed of wart rods, spindles and tuberculate spindles *Hicksonella princeps*, Fig. 3, B.
- No cylindrical rods; wart clubs abundant (*Rumphella*). Colony branching, lateral or irregularly dichotomous, bushy, with branches erect or bent downward. Sclerites composed of warted clubs, warty spindles and belted rods or capstans *Rumphella antipaths*, Fig. 3, C.
12. Stellate forms 5 to many-rayed disks with central boss; outermost layer of coenenchyme filled with rosette-like "collar-button" (*Bebryce*). Colony obscurely flabellate in form. Coenenchyme composed of stellate plate. Surface of plate with bundle of needles..... *Bebryce indica*, Fig. 2, H.
- Projection of thorn-scales consists of several thick, usually pointed lobes; coenenchyme with coarse, irregular bodies with serrated outer surface, sometimes unilaterally spined spindles (*Echinogorgia*). Colony dichotomously branched from nearly the same plane. The sclerites of calyces and coenenchyme rooted leaf *Echinogorgia flora*, Fig. 3, D.
13. Cortical sclerites double heads with both ends roughly equal in size ... 16
- Cortical sclerites clubs with distinctly enlarged heads and smaller handles surrounded by a whorl of tubercles *Junceella* 14
14. Colonies unbranched, whip like or rarely branched.....15
- Colony subflabellate in form and regularly dichotomous in its branching. Sclerites of outer coenenchyme composed of club with one head like a many-rayed star and the other oval or almost equally round, in inner layer club and double star. Color of colony brick red *Junceella gemmacea*, Fig. 4, A.
15. Color of colony white *Junceella fragilis*, Fig. 3, G.
- Color of colony brick red, sclerites of outer layer of coenenchyme composed of club in inner layer dumbbells or symmetrical double head and double star *Junceella juncea*, Fig. 3, H.
16. Sclerites of calyces and coenenchyme of about equal size. Colonies abundantly branched in one plane, terminal branches rather short and numerous (*Verrucella*). Colonies usually anastomosing. Tentacular spicular warty rods. From rind double heads and slightly longer spindles *Verrucella umbraculum*, Fig. 4, B.
- Sclerites of calyces distinctly longer than those of coenenchyme. Colonies unbranched or with few long, whiplike branches *Ellisella*, 17
17. Colonies unbranched, filiform. Coenenchyme composed of double head and tuberculate spindle..... *Ellisella maculata*, Fig. 3, E.
- Colony bushy. Superficial layer of coenenchyme composed of double head and tuberculate spindle. Inner layer of coenenchyme and axial sheath sclerites capstan *Ellisella robusta*, Fig. 3, F.

SYSTEMATIC ACCOUNTS

Suborder Scleraxonia Studer, 1887

Family Anthothelidae Broch, 1916

Solenocaulon chinense Kükenthal, 1919

(Fig. 2A, 5)

Solenocaulon chinense Kükenthal, 1919: 70.

Material: One specimen; ASIZ 51001.

Diagnosis: Colony mostly plumiform, branches in one plane. The main stem solid, cylindrical and holdfast flattened. Stem gutter-like or tubular. Branches moderately thin, flat or groove-shaped, canaliculate or clavate, arising laterally on both sides with nearly right angle to stem. Polyps arranged laterally on stem, branches and front of colony, absent at main stem. Calyces dome-shaped. Color deep red at main stem and orange above the main stem. Polyps colorless or yellowish. Axis colorless.

Anthocodia composed of colorless wart spindles, branch spindles and torches. Sclerites of calyx reddish tuberculate spindles, tuberculate rods and a few wart spindles. Sclerites of branch coenenchyme the same as calyx's, but with more tuberculate rods. Besides the sclerites of branch coenenchyme, stem coenenchyme composed of colorless spheroids or ovoids. Axis filled with long needles with warts on the surface.

Distribution: China Sea, Southern China Sea (Kükenthal, 1919; Stiasny, 1937), southern Taiwan.

Remarks: This species is rare in southern Taiwan. They are anchored along the slope of the reef. No other animals were found associated with this species in southern Taiwan.

Family Subergorgiidae Gray, 1859

***Subergorgia mollis* (Nutting), 1910**

(Fig. 2B, 6)

Euplexaura mollis Nutting, 1910b: 13; Kükenthal, 1919: 124.

Subergorgia verriculata Wright and Studer, 1889: 167; Nutting, 1911: 24-25; Kükenthal, 1919: 112.

Subergorgia mollis Stiasny, 1937: 98-101; Bayer, 1956: 197; Mai-Bao-Thu and Domantay, 1970: 41.

Materials: Three specimens; ASIZ 51002, ASIZ 51003, ASIZ 51004.

Diagnosis: Colony reticulated. Both front and back of stems sometimes furnished with slightly longitudinal furrows. Anthocodia retractile into very low, dome-shaped calyx which scarcely separable from surrounding coenenchyme; aperture with eight distinct lobes. Calyces distributed on all sides of branches, sparsely on stem. Color of living colony bright orange or grey; dirty orange or brown in wet specimens; dirty brown in dry conditions. Sclerites colorless.

Axis composed of smooth, reticulated spindles and horny substance. Sclerites of superficial layer of coenenchyme double wheels. Deep layer of coenenchyme tuberculate spindles, rare wart spindles and crosses. Polyps have straight or curve wart spindles.

Distribution: Northwest coast of Australia, Japan (Wright and Studer, 1889; Nutting, 1911), Malaya Arch. (Stiasny, 1937), Rotti Island (Nutting, 1910b), Marshall Islands (Bayer, 1956), the Philippines (Mai-Bao-Thu and Domantay, 1970), southern Taiwan.

Remarks: The colony is anchored to the lateral side of reef blocks or reef knolls. Colonies are grown with the plane of the fan oriented perpendicular to the direction of the current. The symbionts found on this species were bivalves (*Pteria* spp.), brittle stars (*Ophiothela danae*), sea feathers (Colomertridae) and gobies (*Bryanops* spp.).

***Subergorgia rubra* Thomson & Henderson, 1905**

(Fig. 2C, 7)

Subergorgia rubra, Nutting, 1911, 13b⁵: 27-28; Kükenthal, 1919: 112; Stiasny, 1937: 107.

Materials: Two specimens; ASIZ 51005, ASIZ 51006.

Diagnosis: Colony planar. The stem and branches rounded in sections and show slight, incomplete longitudinal

furrows; branchlet and twig laterally compressed. The individual calyces conical or dome-shaped. The margin bears eight rather definitely marked lobes. The distribution of calyx sparse on the main stem and branches and rather regularly distributed on the lateral side of the branchlet and twig. The anthocodia heavily armed with spindles which are arranged en chevron, anthostole with irregularly arranged spindles. Living colony brick red, and polyps colorless. Dry and wet specimens deep red, and polyps yellow.

Axis composed of smooth, reticulated spindles and horny substance. Most of the sclerites of stem coenenchyme oval and yellow green or pink in color. A few of them spheroid sclerites with deep red color, and tuberculated spindle with yellow-green or pink color. The twig coenenchyme sclerites mostly tuberculated spindles, with a few wart spindles and oval sclerites. The sclerites of calyx mostly tuberculated spindles, yellow-green or pink in color, with a few wart spindles, colorless. Polyps composed of flat spindles with warts and teeth sculpture along the edge, slightly yellow in color, wart spindles, yellowish, and wart rod, colorless.

Distribution: Ceylon (Nutting, 1911), Malaya Arch. (Kükenthal, 1919; Stiasny, 1937), southern Taiwan.

Remarks: Colonies found on the bottom or sheltered areas of the reef block or hard substrate. They usually form patches. Bivalves (*Pteria* spp.) and brittle star (*Ophiothela danae*) are the common animals associated with this species.

***Subergorgia suberosa* (Pallas), 1776**

(Fig. 2D, 8)

Subergorgia appress, Nutting, 1911, 13b⁵: 28; Kinoshita, 1913: 44; Kükenthal, 1916: 114.

Subergorgia suberosa, Nutting, 1911, 13b⁵: 30; Kükenthal, 1919: 116.

Subergorgia suberosa, Wright & Studer, 1889: 166; Kükenthal, 1919: 114; Stiasny, 1937: 87; Mai-Bao-Thu and Domantary, 1970: 37; Muzik and Wainwright, 1977: 314.

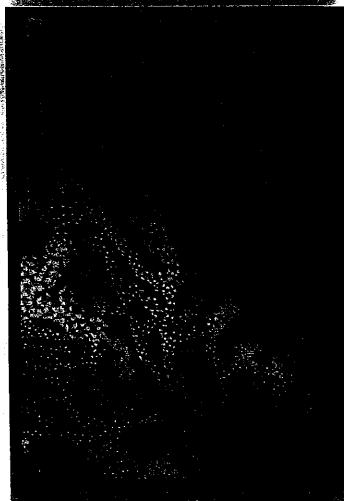
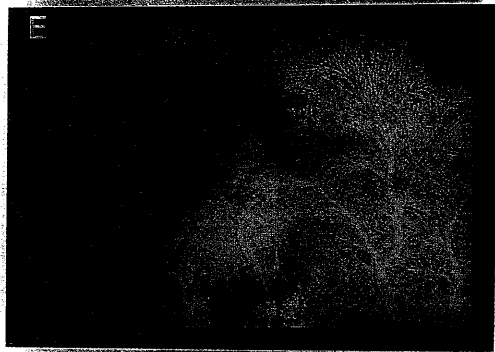
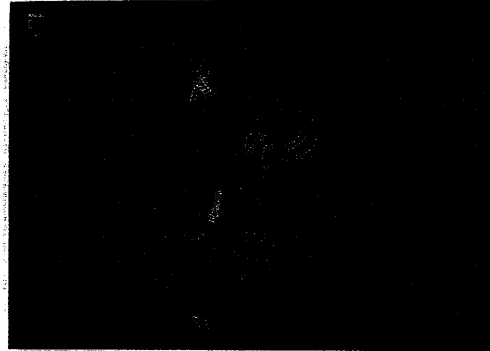
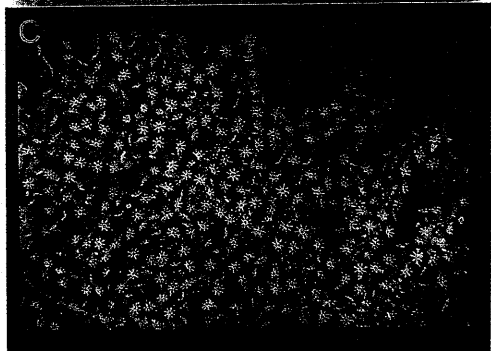
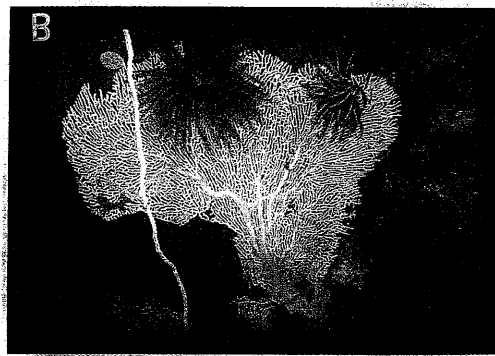
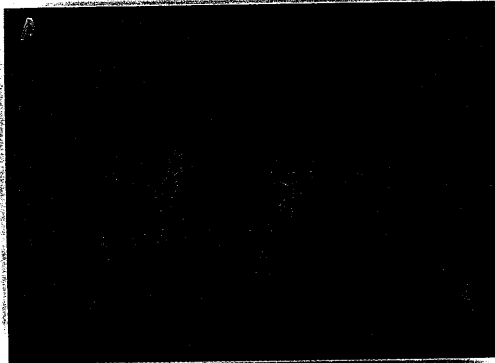
Materials: Three specimens; ASIZ 51007, ASIZ 51008, ASIZ 51009.

Diagnosis: Colony nearly planar or bushy. Stem cylindrical; branches and twigs often laterally compressed. Both front and back sides furnished with deep, sharp and longitudinal furrows. Anthocodia retracted into dome-shaped calyx, with 8 slit-like incisions giving rise to 8 clear lobes. Calyx scattered in two, three or four irregular bands on lateral sides along the furrows. Color of living colonies bright red, red-brown, brownish or orange. Living polyps pink.

Spindles of axis smooth, reticulated in network form. The spindles of anthocodia straight or slightly curved wart spindles, colorless. Calyx composed of yellowish double cones, and yellow spheroids. The coenenchyme of twigs have yellowish tuberculated spindles with 2 to 8 rows of tuberculates regularly arranged. The coenenchyme of stem composed of cylinders, tuberculated spheroids, and a few double headed sclerites; all are yellow in color.

Distribution: Ceylon (Nutting, 1911), Mauritius, Malaya Arch. (Kükenthal, 1919; Stiasny, 1937), Fiji Island (Muzik and Wainwright, 1977), the Philippines (Mai-Bao-Thu and Domantary, 1970), Japan (Kinoshita, 1913), southern Taiwan.

Remarks: The habitat is sand gravel bottom with scattered blocks and boulders. Colony anchored on blocks, boulders, or flat limestone substrates. The plane of the fan is perpendicular to the direction of the currents. Bivalves (*Pteria* spp.) and brittle star (*Ophiothela danae*) usually associated with the colonies.



Family Melithaeidae Gray, 1870

Melithaea ochracea Linnaeus, 1758

(Fig. 2E, 9)

Melitodes ochracea, Wright and Studer, 1889: 292; Nutting, 1911, 13b⁵: 38; Kükenthal, 1919: 148; Bayer, 1956: 200.

Melithaea ochracea, Mai-Bao-Thu and Domantary, 1970: 43; Muzik and Wainwright, 1977: 315.

Material: One specimen; ASIZ 51010.

Diagnosis: Colony multiplanar. Nodes globular, internodes usually short, decrease more and more distally. Branching arises from nodes. Polyps arranged on the lateral surface of the branches and front of colony. Calyx nearly the same height as coenenchyme. Color red, orange or sulfur yellow, calyx orange; polyps yellow; axis red.

Anthocodia composed of colorless wart spindles and needles. The sclerites of calyx clubs, with a few ovals, leaf clubs, wart spindles, yellow, yellow-green or red in color. The superficial coenenchyme sclerites yellow or yellow-green disk-spindles, leaf clubs and unilaterally leaf spheroids. The deep layer of coenenchyme composed of red capstans and tuberculated spindles. Nodes filled with smooth rods. Internodes sculptured with anastomosing grooves.

Distribution: Australia (Bayer, personal communication), Indian Ocean (Nutting, 1911), Fiji Island (Bayer, 1956; Muzik and Wainwright, 1977), Singapore (Wright and Studer, 1889; Kükenthal, 1919), the Philippines (Mao-Bao-Thu and

Domantary, 1970), southern Taiwan.

Remarks: The colonies grow on the lateral side of reef blocks or reef knolls within 3 to 10 meters. They grow with the plane of the fan oriented perpendicular to the direction of the current. There were usually many colonies on the same habitat. The population of this species was low in southern Taiwan.

Mopsella aurantia (Esper), 1798

(Fig. 2F, 10)

Mopsella zimmeri, Kükenthal, 1908: 100, 1919: 163.

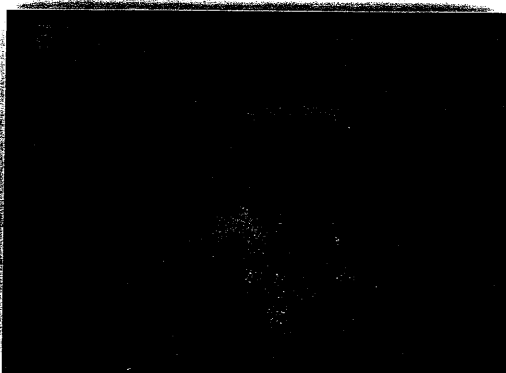
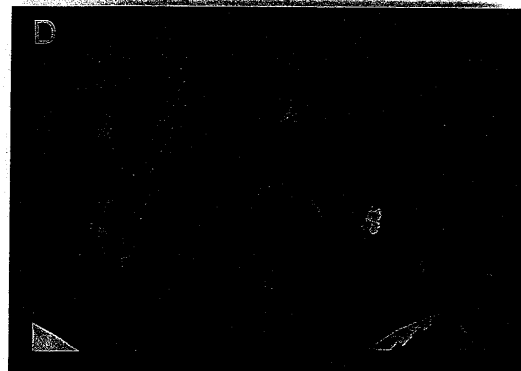
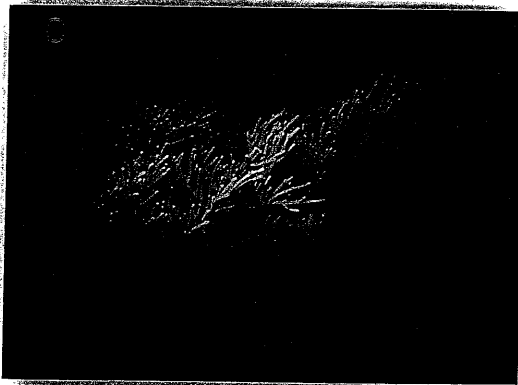
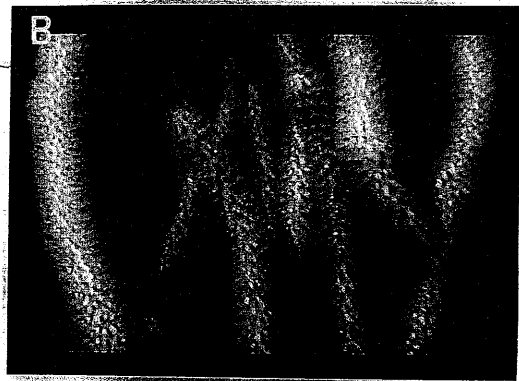
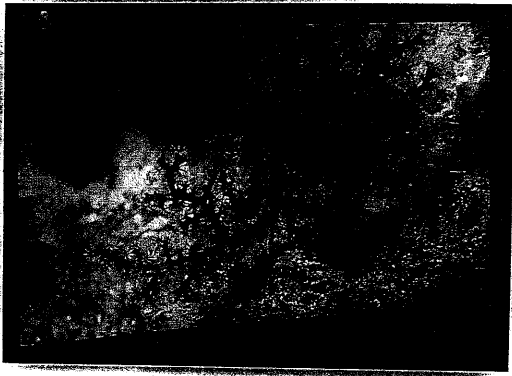
Mopsella aurantia, Kükenthal, 1919: 161; Bayer, 1956: 206; Mai-Bao-Thu and Domantary, 1970: 48.

Material: One specimen; ASIZ 51011.

Diagnosis: Colony planar. Nodes of stem globular, but not conspicuously swollen at branches and twigs. Polyps arranged on the lateral surface of branches and front of colony. Calyx can be clearly seen from the surface of colony, because of the differences in color between calyx and coenenchyme. Color of colony reddish orange, axis red, calyx yellow, polyps colorless.

Sclerites of anthocodia bent wart spindles, colorless. Calyx composed of yellow leaf clubs, a few wart spindles and unilaterally spinose spindles. Coenenchyme sclerites red unilaterally foliated spheroid, tuberculated spindles, unilaterally spiny spheroids and clubs. Nodes filled with smooth rods with a median whorl of projections. Internodes filled

- Fig. 2A. Ecological photograph of *Solenocaulon chinense* taken at Shan-hai-li, depth 12 m.
 Fig. 2B. *Subergorgia mollis* showing crinoids is clinging on to them at Ta-lau-ko, depth 15-20 m.
 Fig. 2C. Ecological photograph of *Subergorgia rubra* taken at Wan-li-tung, depth 10-20 m.
 Fig. 2D. *Subergorgia suberosa* where *Colobometra perspinosa* (Crinods) clinging on the branch, Ta-lau-ko, depth 12-20 m.
 Fig. 2E. Ecological photograph of *Melithaea ochracea*, depth 3-7 m.
 Fig. 2F. Photograph of *Mopsella aurantia* taken when alive where *Prosimnia semperi* (ovulid) slipping on the branch.
 Fig. 2G. Ecological photograph of *Acanthogorgia vegae* taken at Ta-lau-ko, depth 15-25 m.
 Fig. 2H. *Bebryce indica* anchoring on reef block at Wan-li-tung, depth 10-15 m.



with fused rods. Sclerites of nodes and internodes pink.

Distribution: Australia, Singapore (Kükenthal, 1919), the Philippines (Bayer, 1956; Mai-Bao-Thu and Domantary, 1970: 48), southern Taiwan.

Remarks: The habitat of this species is the same as *M. ochracea*. It is not easy to distinguish this species from *M. ochracea* by shape. This species is rare in southern Taiwan. Ovulids (*Prosimnia semperi*) and brittle stars (*Ophiothela danae*) were found on the surface of this species.

Suborder Holaxonia, 1887

Family Acanthogorgiidae Gray, 1859

Acanthogorgia vegae Aurivillus, 1931

(Fig. 2G, 11)

Acanthogorgia vegae, Zou and Scott, 1980: 142.

Material: One specimen; ASIZ 51012.

Diagnosis: Colony flabellated. Calyces columnar, and the margin surrounded by a crown of thorns. They are irregularly set on all sides of the branches, being more crowded on the terminal twigs.

Sclerites of calyces and coenenchyme wart spindles. Besides wart spindles, top of calyces composed of large bent wart spindle, with one end heavily warted and the other loosely warted.

Living colony yellow-brown with yellow axis, and with colorless sclerites.

Distribution: Hongkong (Zou and Scott, 1980), southern Taiwan.

Remarks: The colony is anchored along the lateral side of the reef block. This species is easily decolorized by formalin.

Muricella grandis Nutting, 1910

(Fig. 3A, 12)

Muricella grandis Nutting, 1910a, 13b: 34-35.

Materials: Three specimens; ASIZ 51013, 51014, 51015.

Diagnosis: Colony roughly flabellated. Main branches more or less flat. Polyps evenly distributed on the sides and front of colony, but back almost completely bare. On terminal twigs, calyces have tendency to form a regular alternated arrangement. Individual calyces conical in shape. Calyx walls filled with vertically disposed spindles which do not imbricate perceptibly, with points projecting slightly above the margin. Collaret formed of red spindles, above which the operculum rests with a number of small, bar-like spindles arranged en chevron over the tentacle bases. Ends of tentacles armed with similar spindles placed transversely.

Sclerites of tentacles wart spindles and tuberculated spindles. Calyces composed of thorn-scale, tuberculated spindles, thorn-spindles and irregular tuberculated plates. Superficial layer of coenenchyme composed of tuberculated spindles, ovals and spheroids. They are densely tuberculated with their edges closely fitted. Sclerites of inner layer of coenenchyme wart spindles.

Fig. 3A. Ecological photograph of *Muricella grandis* taken at Mao-pi-tou, depth 10-15 m.

Fig. 3B. Ecological photograph of *Hicksonella princeps* taken at Hsiao-wan depth 5-10 m.

Fig. 3C. Ecological photograph of *Rumphella antipathes* taken at B-station, depth 7-12 m.

Fig. 3D. Ecological photograph of *Echinogorgia flora* taken at Hsia-shui-ku, depth 15-20 m.

Fig. 3E. Ecological photograph of *Ellisella maculate* taken at Ta-lau-ko, depth 15-20 m.

Fig. 3F. Ecological photograph of *Ellisella robusta* taken at Wan-li-tung, depth 10-15 m.

Fig. 3G. Two colonies of *Junceella fragilis* which the tip of the whip of the left colony showing fragmental reproduction. B-station, depth 7-10 m.

Fig. 3H. *Junceella juncea*, which the tip of the whip showing fragmental reproduction. Hsia-shui-ku, depth 10-20 m.

Colony deep crimson throughout. Sclerites same color.

Distribution: Borneo, North Celebes, Kei Island (Nutting, 1910a), southern Taiwan.

Remarks: The colony was small in size and anchored along the lateral side of the reef block. Bivalves (*Pteria* spp.) or brittle stars (*Ophiothela danae*) were found associated with this species.

Family Gorgoniidae Lamouroux, 1812

***Hicksonella princeps* Nutting, 1910**

(Fig. 3B, 13)

Hicksonella princeps Nutting, 1910b¹: 15; Bayer, 1956: 210.

Rhabdoplexaura princeps, Kükenthal, 1919: 234.

Material: One specimen; ASIZ 51019.

Diagnosis: Colony densely arborescent, forming a profuse branching. A cross section of the branch showed a thick coenenchyme, large and regularly arranged water vascular canals, and a horny axis cylinder with an exceptionally small central core of white noncalcareous substance. Some of larger branches somewhat flat, but others round. Calyces thickly implanted on all sides of the stem and branches. Openings of calyces usually round, but sometimes oval.

Most sclerites of anthocodia tuberculated spindles with few of them cross sclerites. Calyces and coenenchyme composed of wart rods, spindles and tuberculated spindles. Sclerites of axial sheath tuberculated spindles with a few crosses and crutches.

Colony light buffy brown. Sclerites colorless.

Distribution: Banda Anchorage, Pater-noster Island (Nutting, 1910b), Japan (Bayer, 1956), southern Taiwan.

Remarks: This colony is rarely found in the waters of Taiwan. They are anchored along the lateral side of blocks, where the turbidity is high and the sea bottom has thick deposits of mud.

***Rumphella antipathes* Nutting, 1910**

(Fig. 3C, 14)

Euplexaura antipathes, Kükenthal, 1919: 230.

Rumphella antipathes, Bayer, 1956: 212; Mai-Ba-Thu and Domantary, 1971: 13-15.

Material: One specimen; ASIZ 51020.

Diagnosis: Colony with thick calcareous base from which a short stem arises and usually soon divides into branches. Branching lateral or irregularly dichotomous, bushy, with branches erect or bent downward. Anastomoses occur occasionally. Axis dark, with

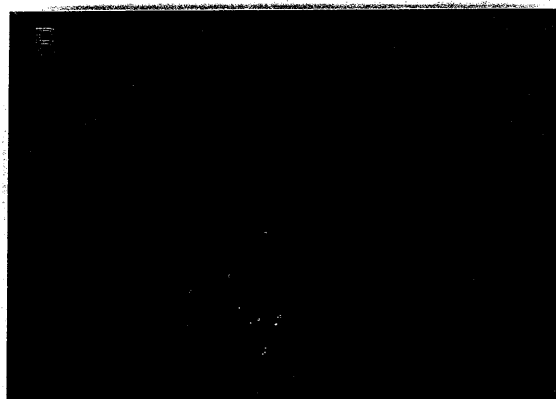
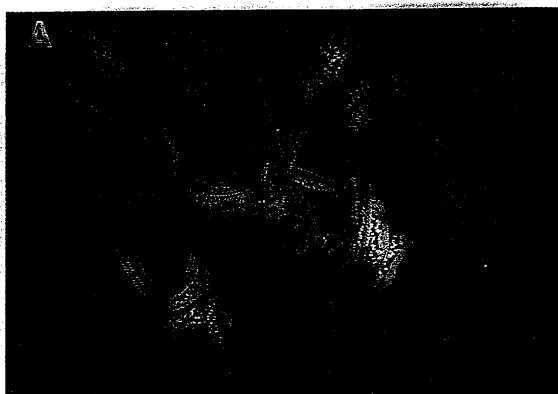


Fig. 4A. *Junceela gemmacea*, showing crinoid clinging on to the branch.

Fig. 4B. Photograph of *Verrucella umbraculum* taken when alive where *Hiata coarctata* is slipping on the branch.

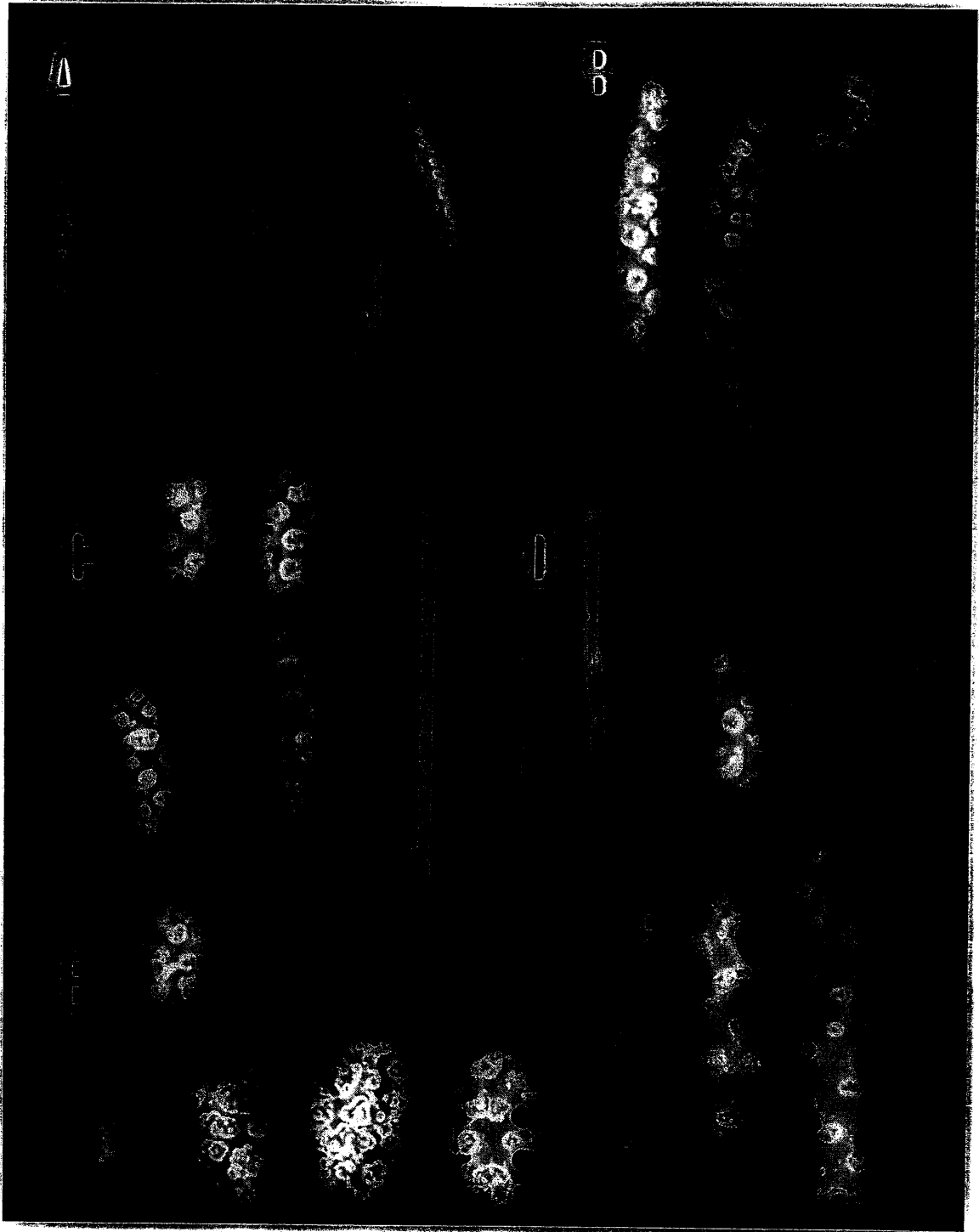


Fig. 5. Sclerites of *Solenocaulon chinense*. A, in anthocodia. B, in calyx. C, in branch's coenenchyme. D, in branch's medulla. E, in stem's coenenchyme. F, in stem's medulla.

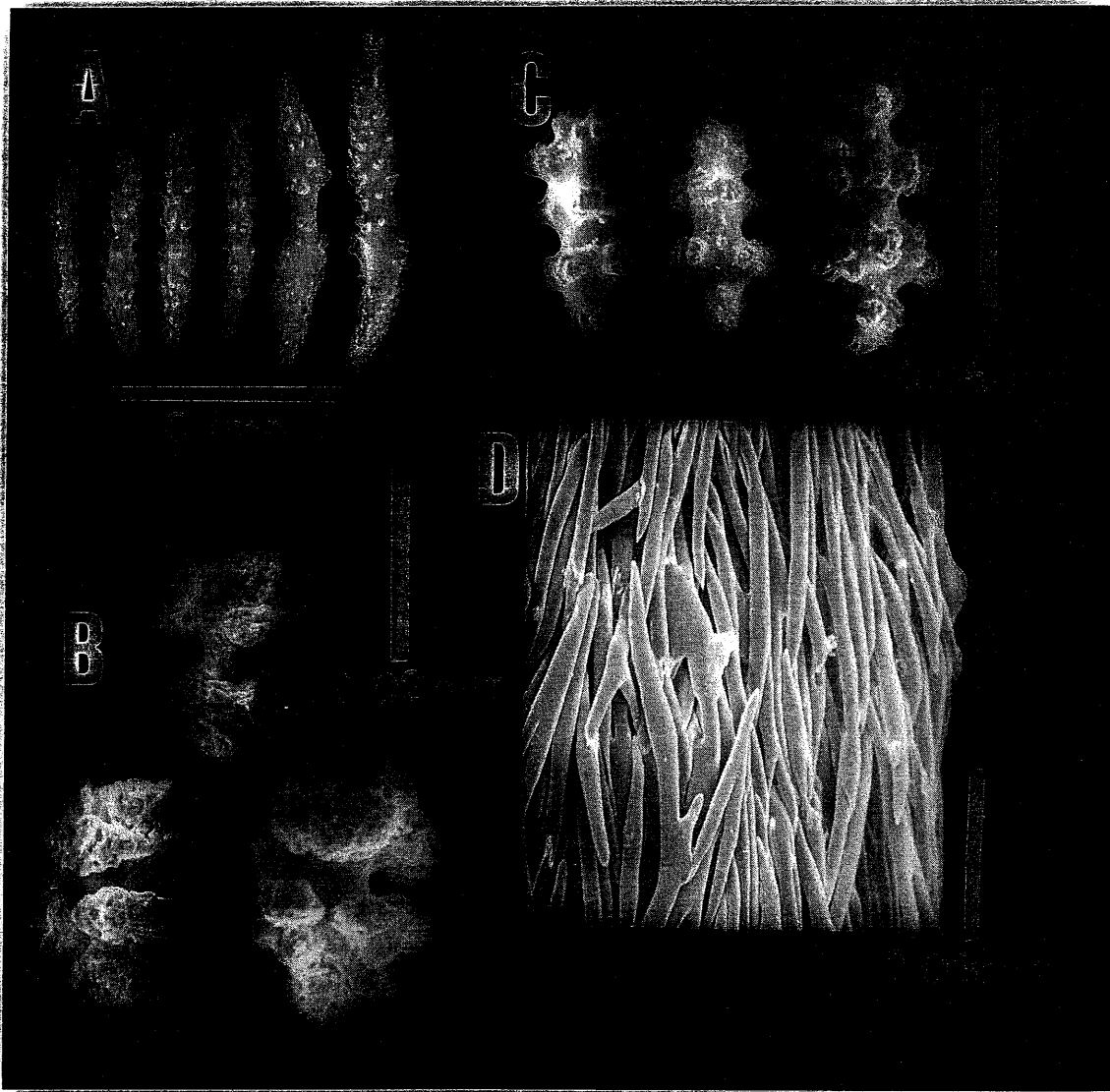


Fig. 6. Sclerites of *Subergorgia mollis*. A, in anthocodia. B, in superficial layer of coenenchyme. C, in inner layer of coenenchyme. D, arrangement of sclerites in medulla.

calcareous deposits. Polyps small and on all sides of branches but very scarce on base. Calyces low or absent by being fully retracted into coenenchyme. Coenenchyme usually thick.

Sclerites composed of warted clubs, warty spindles and belted rods or capstan.

Colony yellowish or brown; sclerites colorless.

Distribution: Gilbert Island (Bayer, 1956), the Philippines (Mai-Bao-Thu and

Domantary, 1971), southern Taiwan.

Remarks: The colony grows on the reef's slope, or on flat limestone with scattered sandgravel. The colony is high and has many soft branches. This species usually grows solitarily in their habitat.

Family Plexauridae Gray, 1859

Bebryce indica Thomson, 1905

(Fig. 2H, 15)

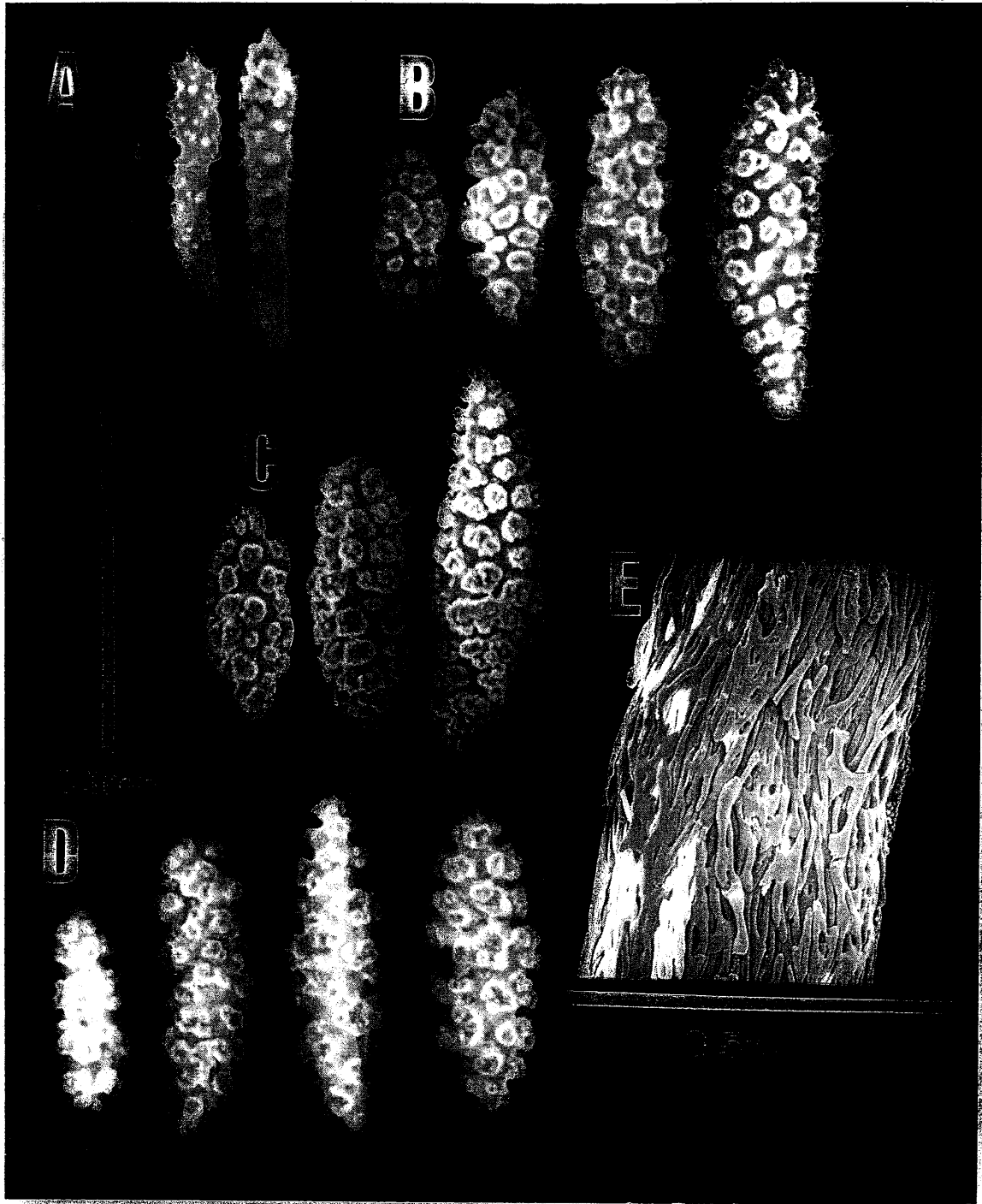


Fig. 7. Sclerites of *Subergorgia rubra*. A, in anthocodia. B, in calyx. C, in superficial layer of coenenchyme. D, in inner layer of coenenchyme. E, arrangement of sclerites in medulla.

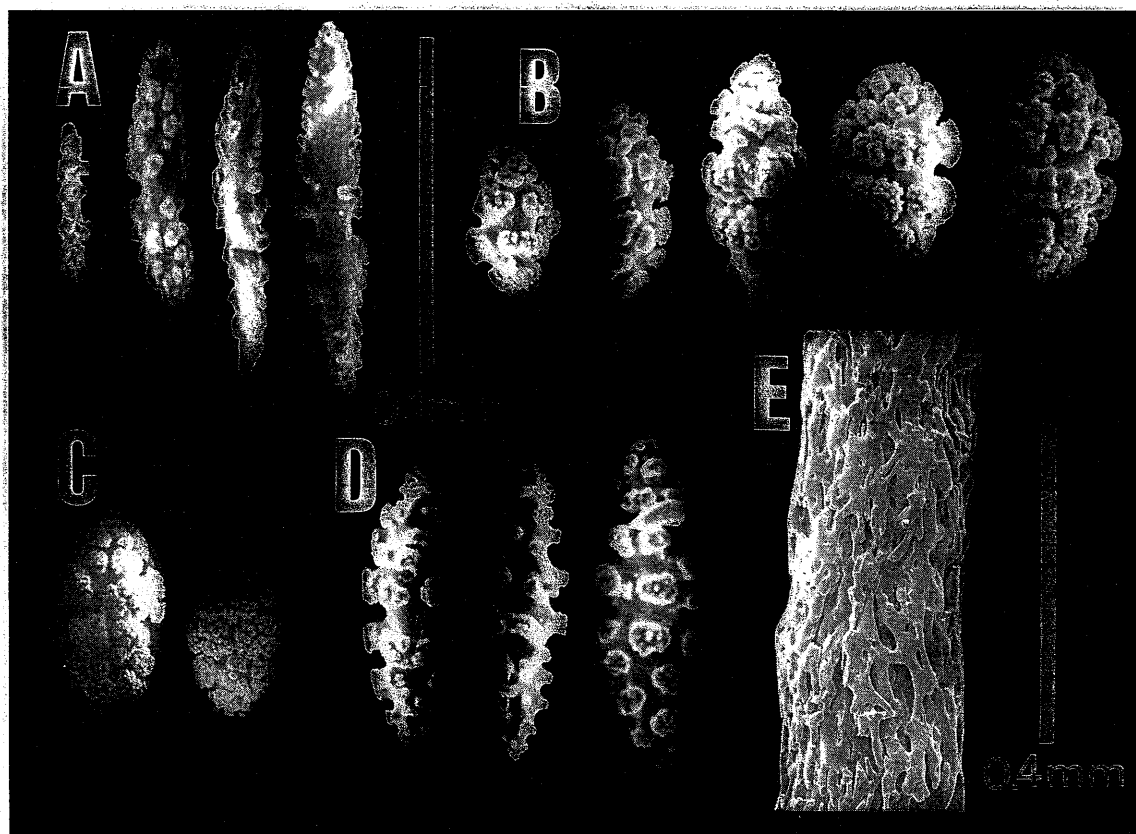


Fig. 8. Sclerites of *Subergorgia suberosa*. A, in anthocodia. B, in calyx. C, in superficial layer of coenenchyme. D, in inner layer of coenenchyme. E, arrangement of sclerite in medulla.

Bebryce indica, Nutting, 1910a, 13b: 48-49.

Materials: Two specimens; ASIZ 51021, 51022.

Diagnosis: Colony obscurely flabellated in form. Coenenchyme thin. Calyces scattered over the whole surface of the stem and branches, with about as many on the front and back as on the sides. Individual calyces verruciform or dome-shaped.

Sclerites of anthocodia mostly wart spindles with a few clubs. Calyces sclerites thorn-scale on that surface with bundles of needles. Coenenchyme composed of stellate plates. Surface of plate with bundles of needles.

Color of living colony light, polyps brown or deep brown. Sclerites colorless.

Distribution: Gulf of Mannaar (Nut-

ting, 1910a), southern Taiwan.

Remarks: The colony grows on the lateral side of reef blocks. There are usually with small encrusting colonies beside the adult one. Barnacles, brittle stars (*Ophiothela danae*) and sea feathers (*Colobometra perspinosa*) are associated with this species.

Echinogorgia flora Nutting, 1910

(Fig. 3D, 16)

Echinogorgia flora Nutting, 1910a, 13b: 66; Zou and Scott, 1980: 145.

Material: One specimen; ASIZ 51023.

Diagnosis: Colonies dichotomously branched with branches nearly in the same plane. Individual calyces entirely embedded in the coenenchyme. Their presence indicated merely by a scarcely

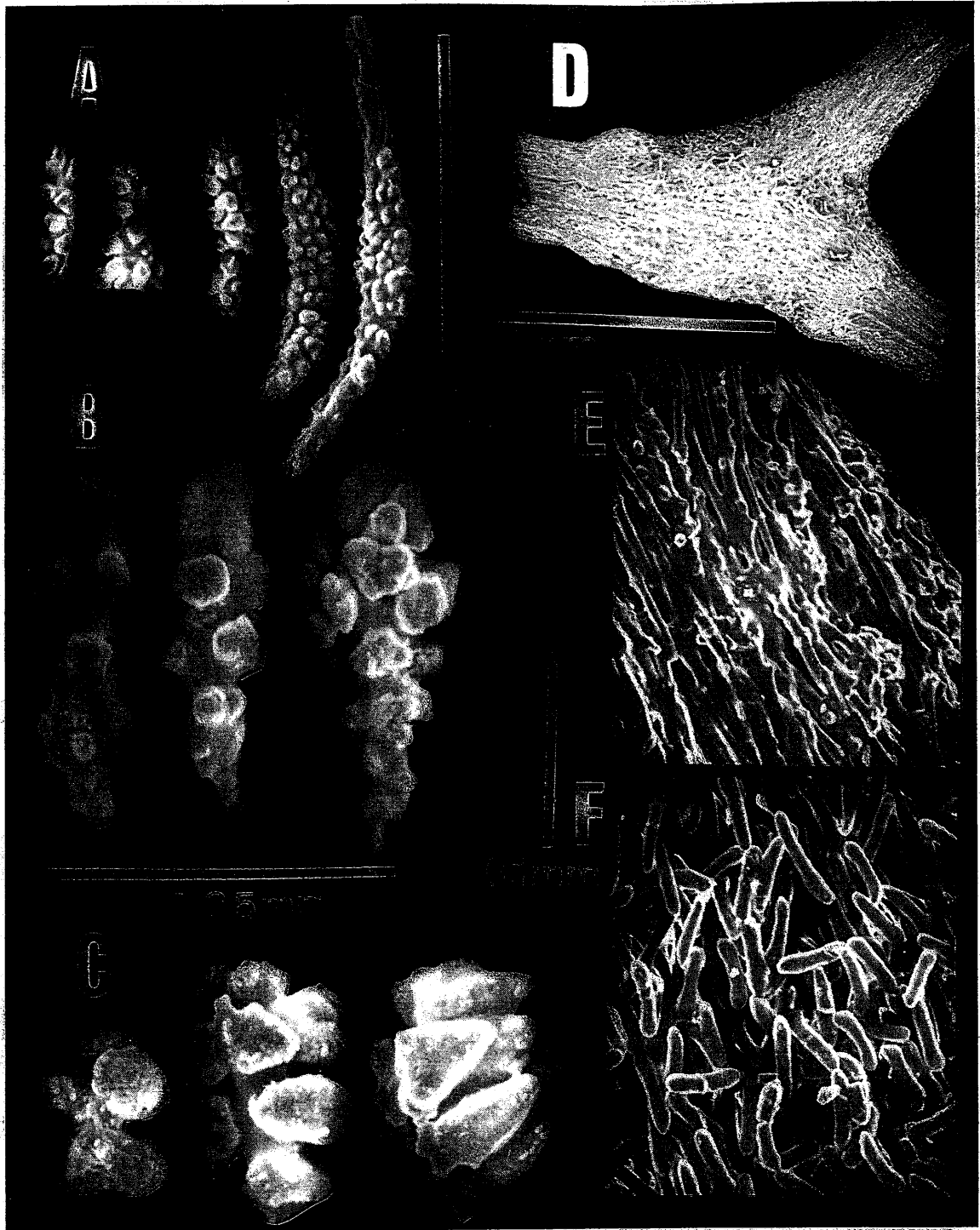


Fig. 9. Sclerites of *Melithaea ochracea*. A, in anthocodia. B, in calyx. C, in coenenchyme. D, arrangement of sclerites between node and internode. E, arrangement of sclerites in internode. F, arrangement of sclerites in node.

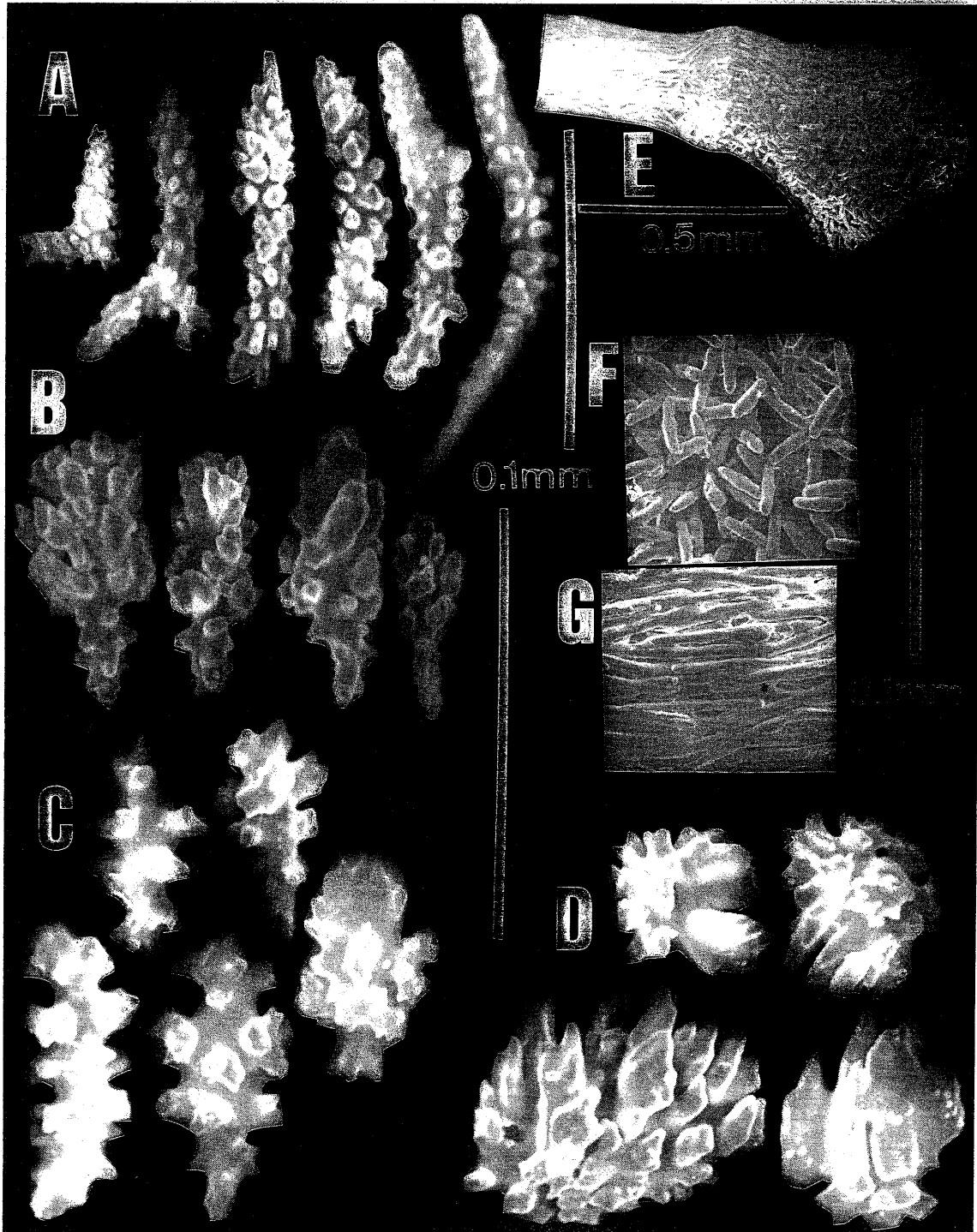


Fig. 10. Sclerites of *Mopsella aurantia*. A, in anthocodia. B, in calyx. C, D, in coenenchyme. E, arrangement of sclerites between node and internode. F, arrangement of sclerites in node. G, arrangement of sclerites in internode.

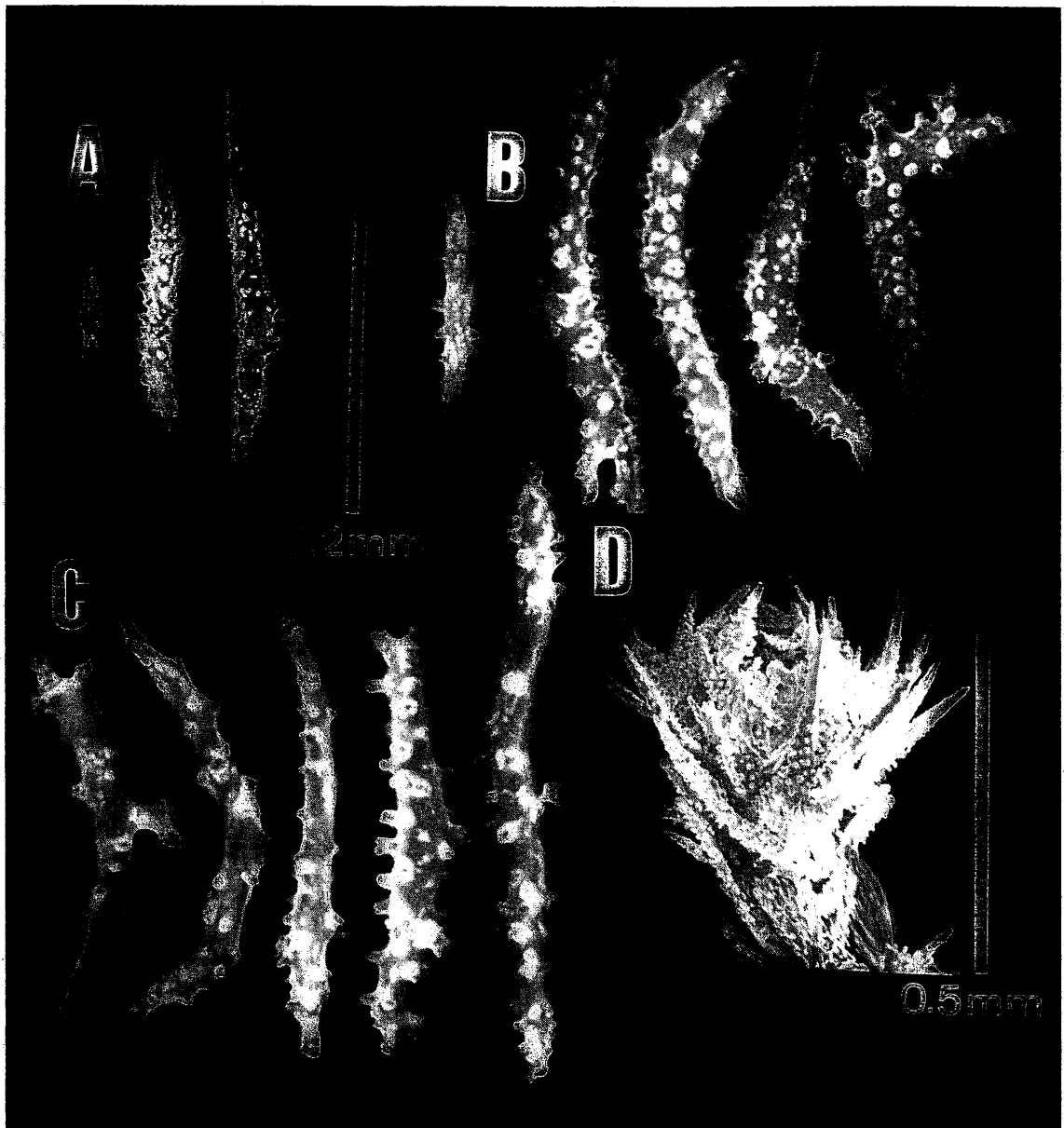


Fig. 11. Sclerites of *Acanthogorgia vegae*. A, in tentacle. B, in calyx. C, in coenenchyme D, arrangement of sclerite of calyx.

evident swelling, not easily seen without magnification.

Sclerites of calyces and coenenchyme rooted leaves. Axial sheath composed of radiates.

Color of colony dark red with red sclerites.

Distribution: New Guinea (Nutting, 1910a), Hongkong (Zou and Scott, 1980), southern Taiwan.

Remarks: The occurrence of this species is rare in southern Taiwan waters. They are usually found on the flat limestone substrates below 20 meters.



Fig. 12. Sclerites of *Muritella grandis*. A, in anthocodia. B, arrangement of sclerites on surface of coenenchyme. C, in calyx. D, in coenenchyme.

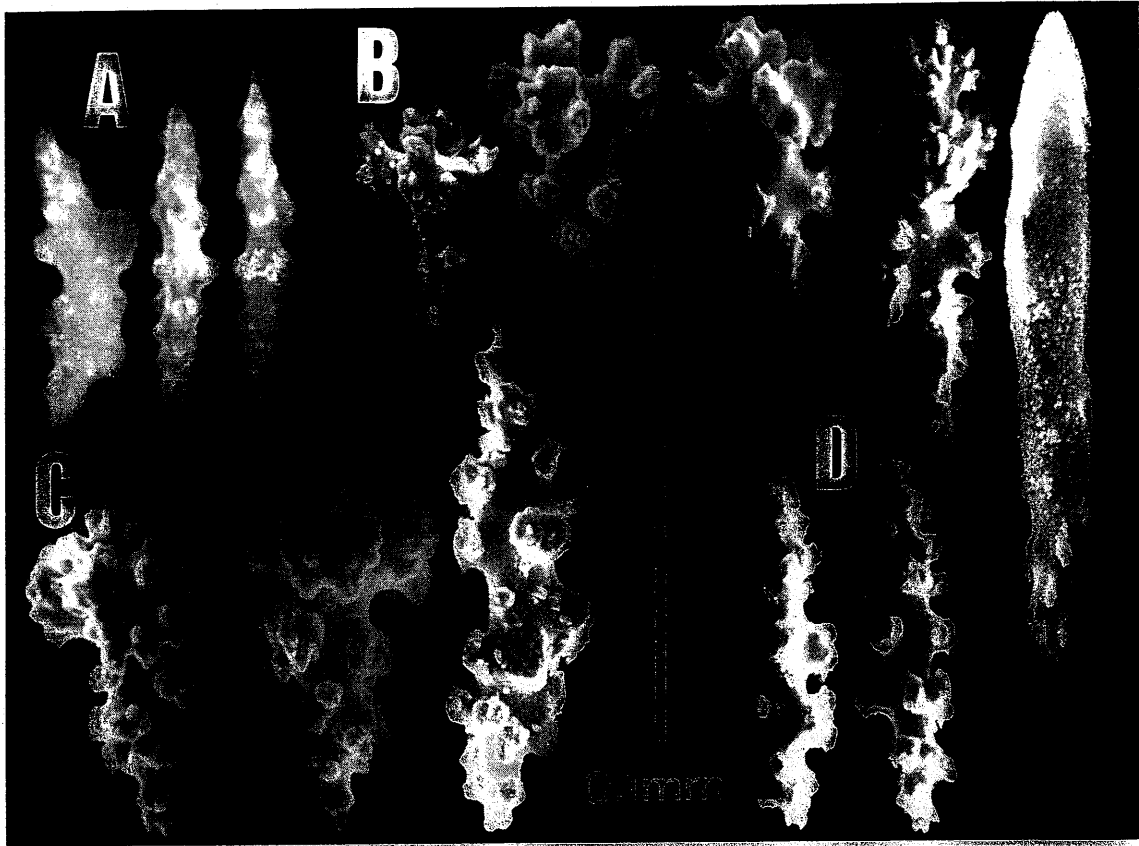


Fig. 13. Sclerites of *Hicksonella princeps*. A, in anthocodia. B, in calyx. C, in superficial layer of coenenchyme. D, in inner layer of coenenchyme.

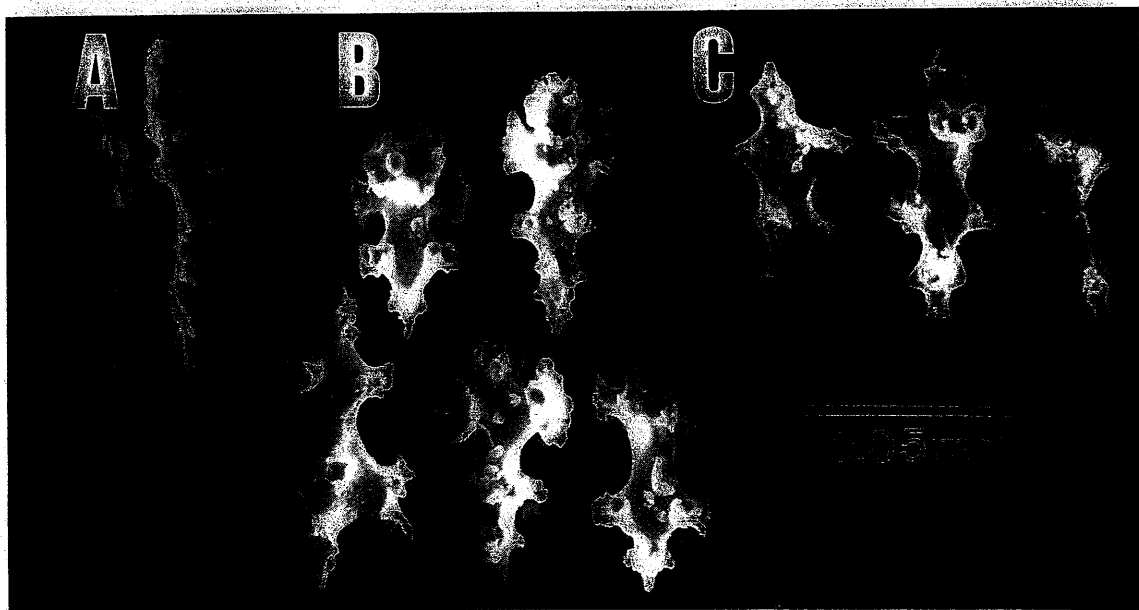


Fig. 14. Sclerites of *Rumphella antipathes*. A, in anthocodia. B, in superficial layer of coenenchyme. C, in inner layer of coenenchyme.

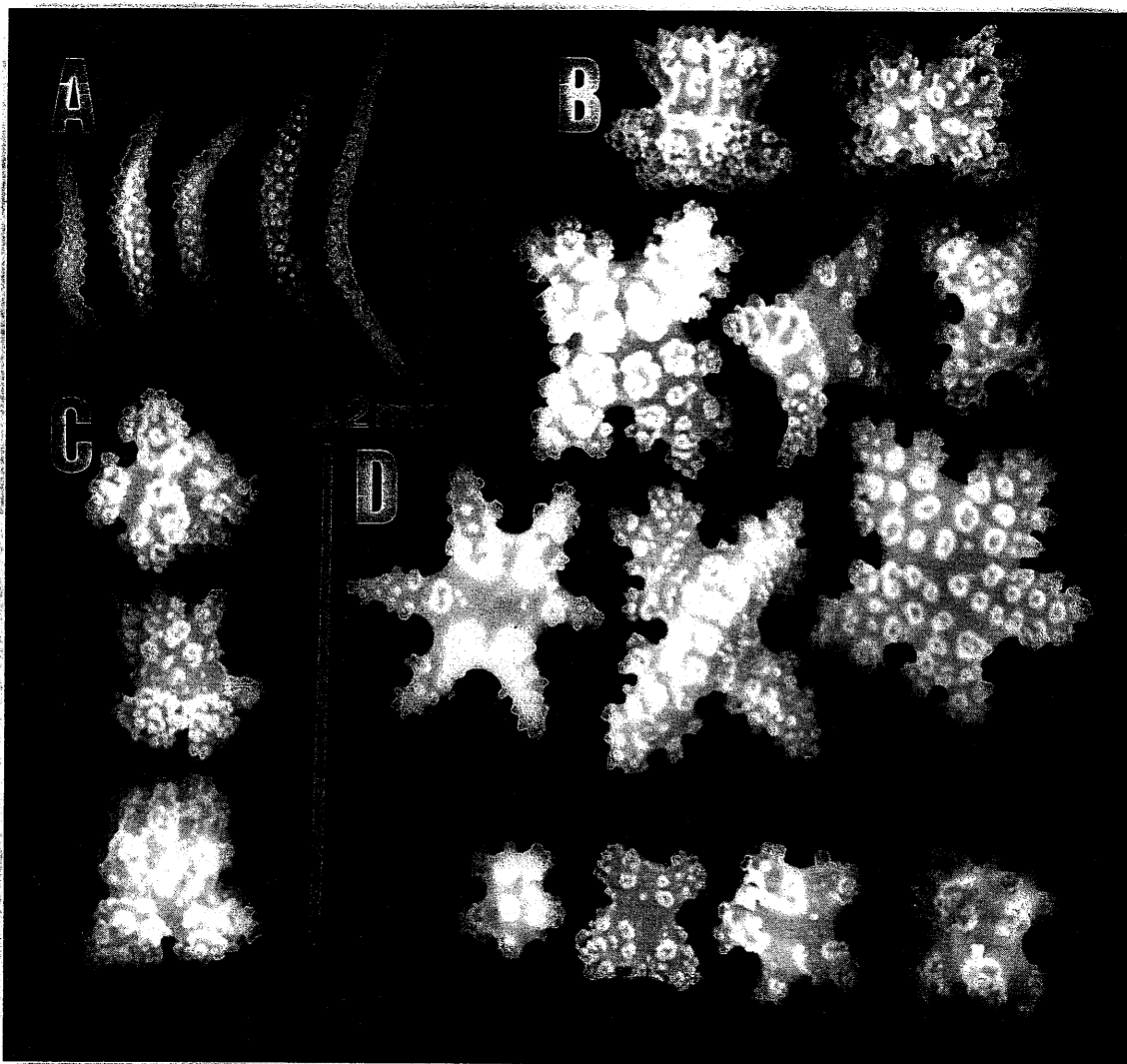


Fig. 15. Sclerites of *Bebryce indica*. A, in anthocodia. B, in calyx. C, in superficial layer of coenenchyme. D, in inner layer of coenenchyme.

Family Ellisellidae Gray, 1859

Ellisella maculata Studer, 1878

(Fig. 3E, 17)

Ellisella maculata, Wright and Studer, 1889: 160.

Material: One specimen; ASIZ 51032.

Diagnosis: Colonies unbranched, filiform, circular in cross-section. Coenenchyme thick. Calyces prominent, dome-shaped, directed upwards, and scattered on all sides.

Sclerites of anthocodia and calyces tuberculated spindles. Coenenchyme composed of a double head and tuberculated spindles. Sclerites in axial sheath double head.

Colony brick red with white axis and yellow sclerites.

Distribution: Banda Island (Wright and Studer, 1889), southern Taiwan.

Remarks: This species grows along the sheltered areas. No animals are found associated with this species.

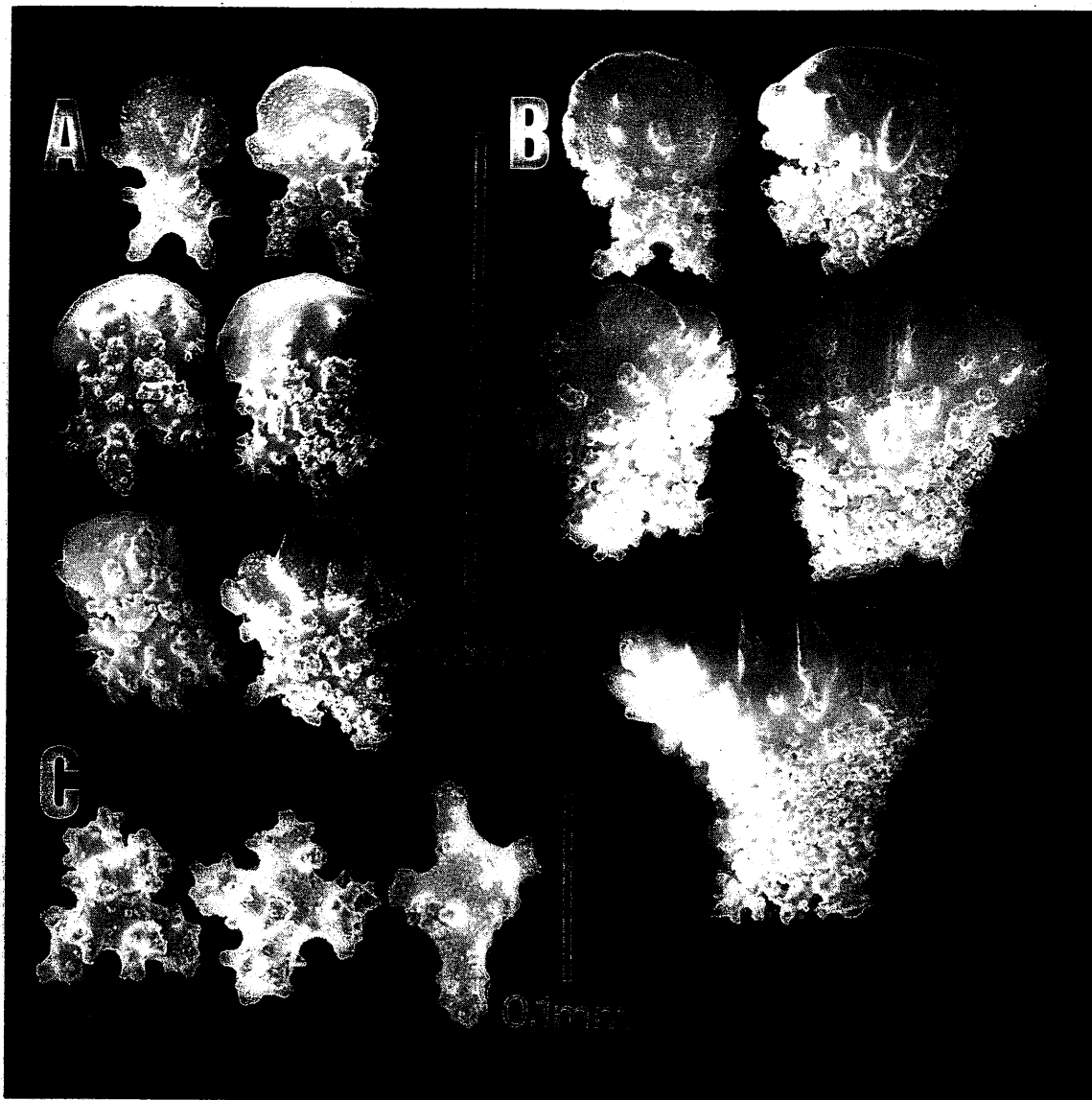


Fig. 16. Sclerites of *Echinogorgia flora*. A, in calyx. B, in anthocodia. C, in axial sheath.

***Ellisella robusta* (Simpson), 1880**

(Fig. 3F, 18)

Materials: Two specimens; ASIZ 51033, 51034.

Diagnosis: Colony bushy. A cross section of a branch shows large and regularly arranged watervascular canals. Calyces prominent conical or dome-shaped, and scattered on all sides of stems and branches.

Sclerites of anthocodia tuberculated rods and double stars. Calyces and

superficial layer of coenenchyme composed of tuberculated spindles and double heads. Inner layer of coenenchyme and axial sheath sclerites capstan.

Color of colony brick red, axis brown, sclerites yellow-brown.

Distribution: Southern Taiwan.

Remarks: The substrate of this species is a flat limestone belt scattered with sandgravel. The colony usually grows solitarily, not forming patchy aggregations. Sea anemones were found

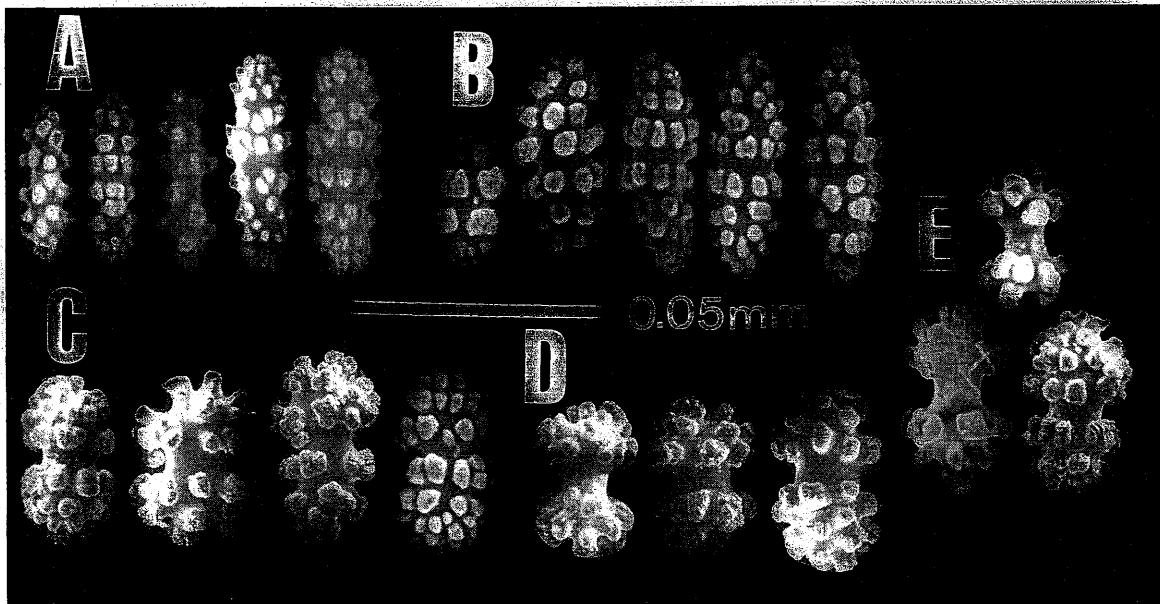


Fig. 17. Sclerites of *Ellisella maculata*. A, in anthocodia. B, in calyx. C, in superficial layer of coenenchyme. D, in inner layer of coenenchyme. E, in axial sheath.

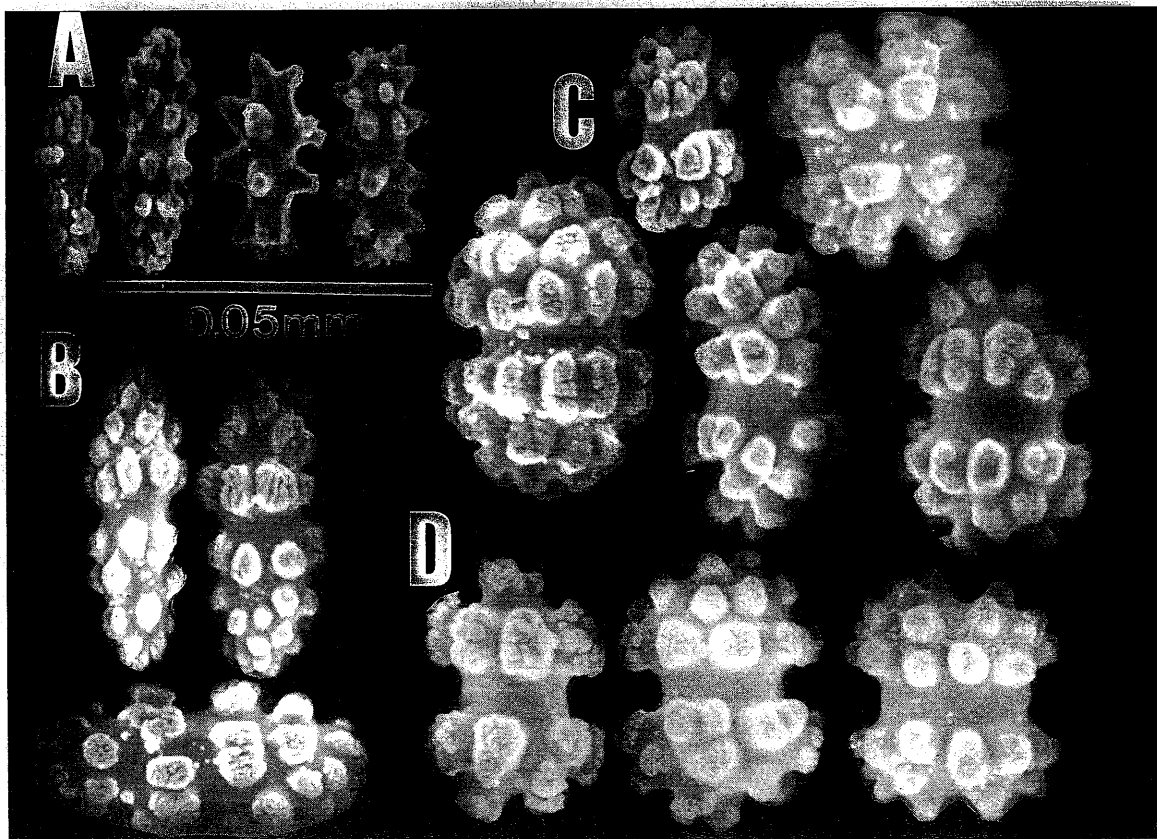
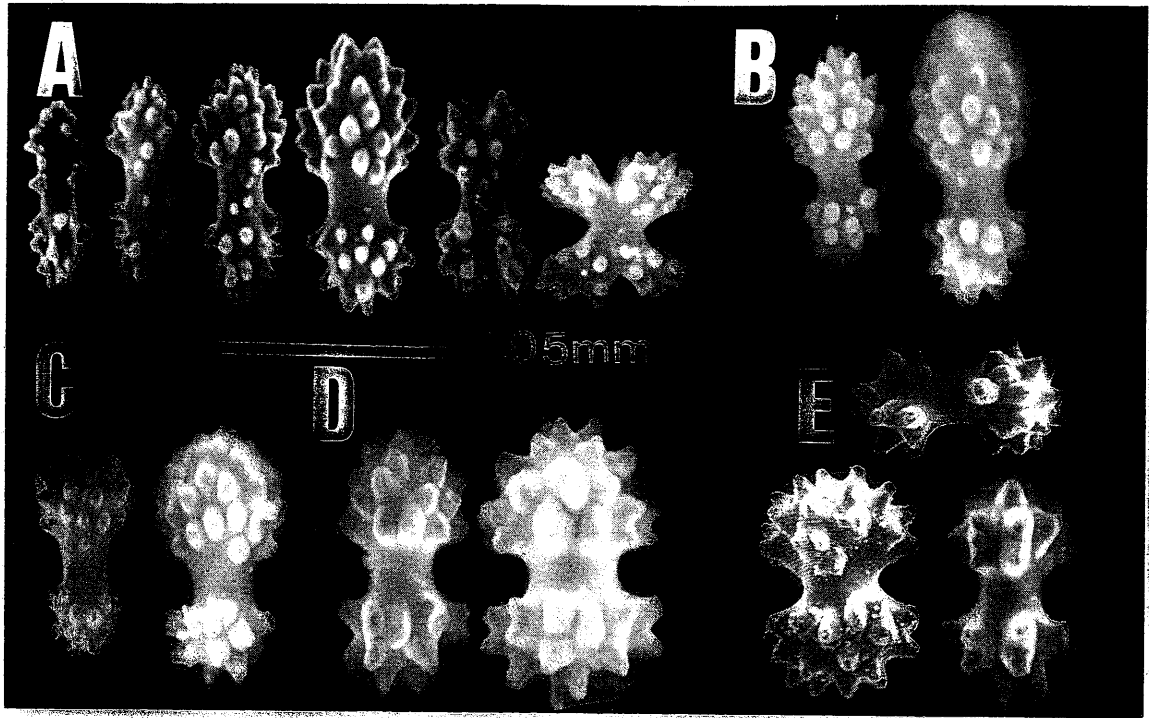
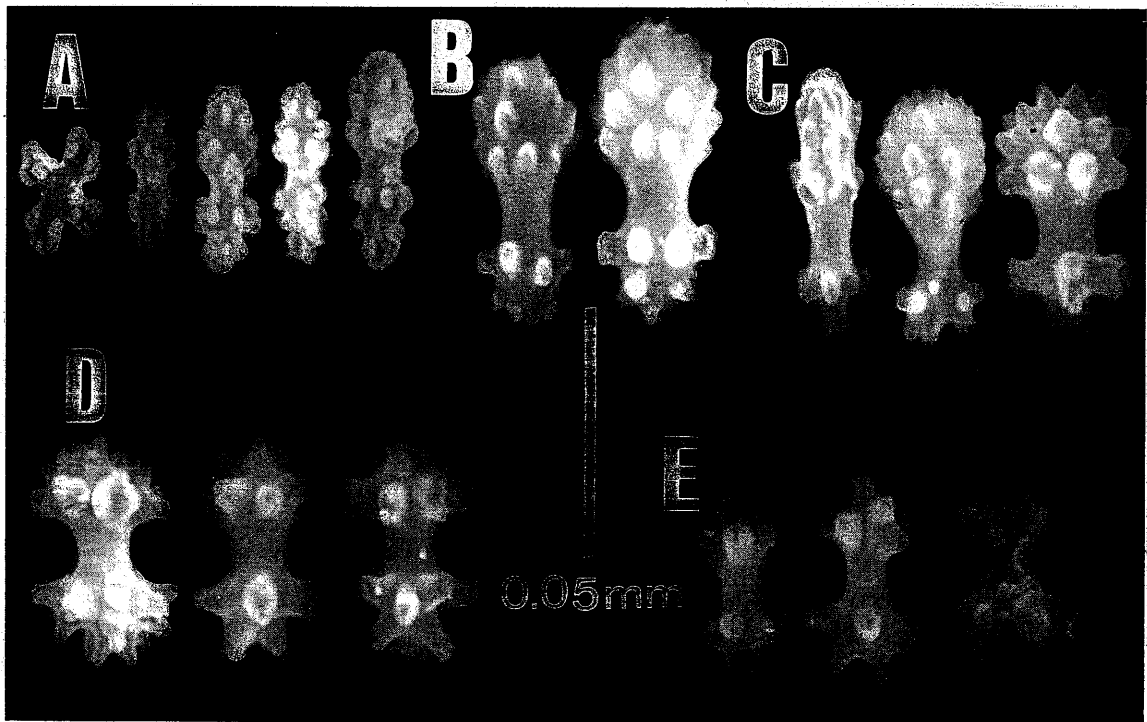


Fig. 18. Sclerites of *Ellisella robusta*. A, in anthocodia. B, in calyx. C, in coenenchyme. D, in axial sheath.



9. Sclerites of *Junceella fragilis*. A, in anthocodia. B, in calyx. C, in superficial layer of coenenchyme. D, in inner layer of coenenchyme. E, in axial sheath.



20. Sclerites of *Junceella juncea*. A, in anthocodia. B, in calyx. C, in superficial layer of coenenchyme. D, in inner layer of coenenchyme. E, in axial sheath.

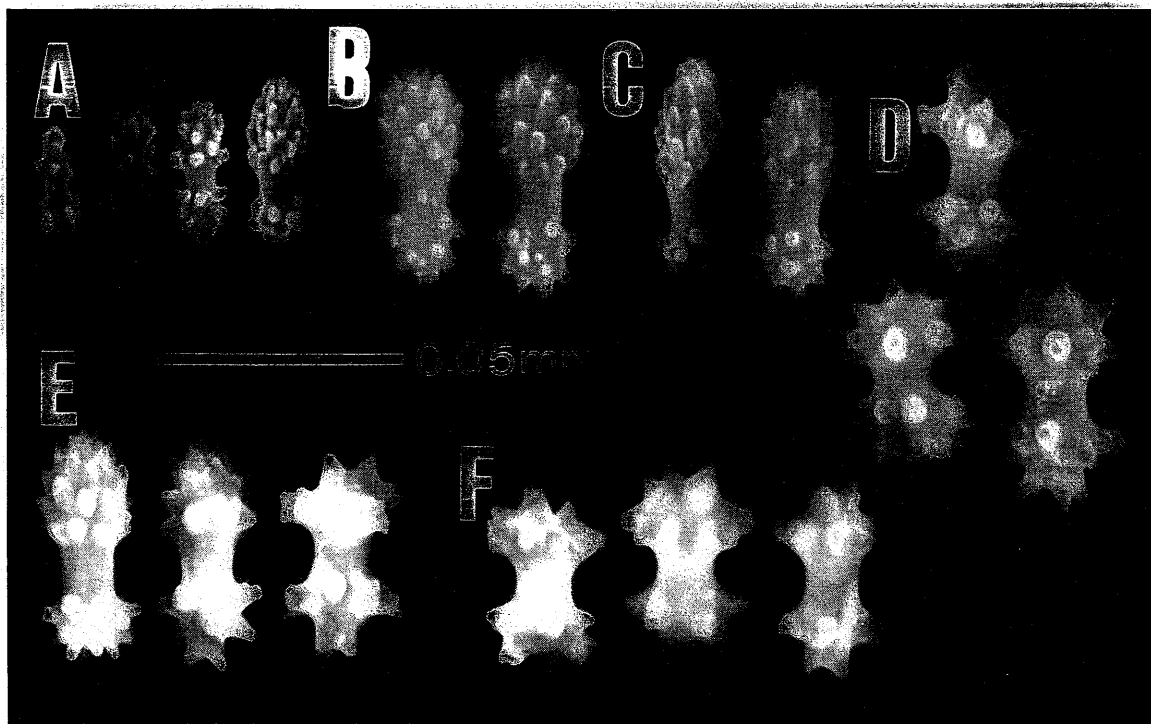


Fig. 21. Sclerite of *Junceella gemmacea*. A, in anthocodia. B, in calyx. C, in superficial layer of coenenchyme. D, in inner layer of coenenchyme. E, in superficial layer of stem's coenenchyme. F, in inner layer of stem's coenenchyme.

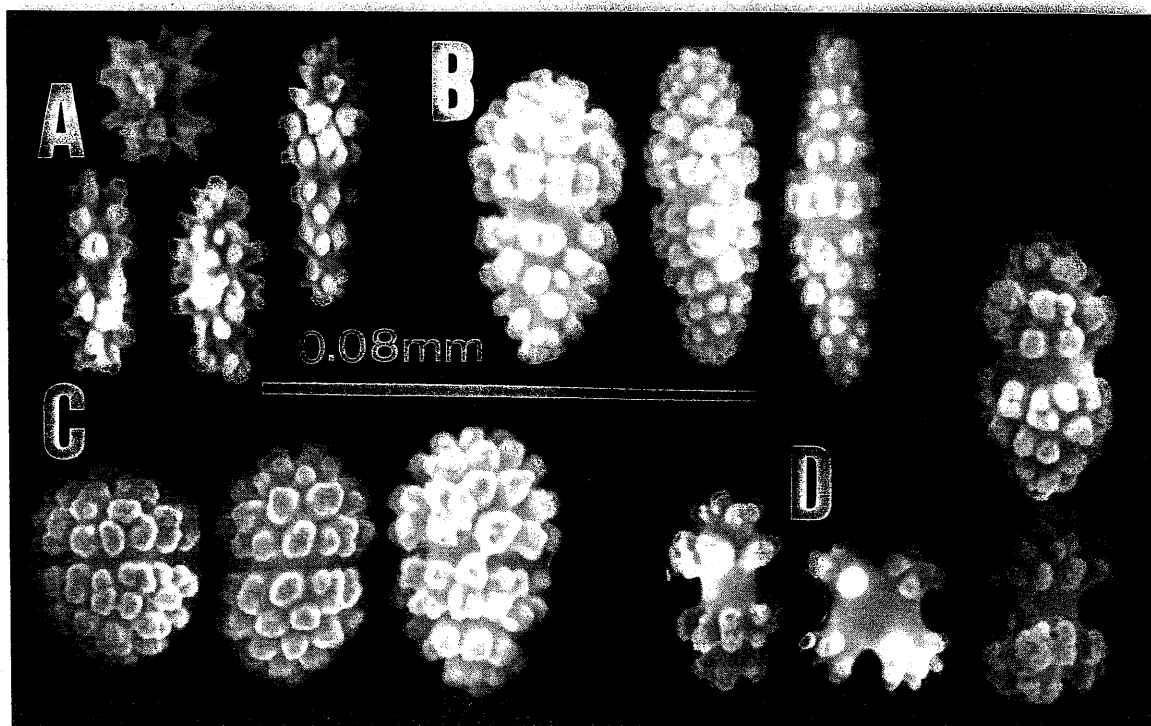


Fig. 22. Sclerites of *Verrucella umbraculum*. A, in anthocodia. B, in calyx. C, in branch's coenenchyme. D, in stem's coenenchyme.

enclosing the top of the colony branch, and ovulids (*Hiata coarctata*) are associated with this species.

***Junceella fragilis* Ridley, 1884**

(Fig. 3G, 19)

Junceella fragilis, Mai-Bao-Thu and Domantary, 1971: 21-22.

Materials: Two specimens; ASIZ 51025, 51026.

Diagnosis: Colonies unbranched, whip-like. Axis strongly calcified, rigid proximally and flexible distally, circular in cross-section. Coenenchyme thick. Calyces prominent, directed upwards, arranged either on all sides or on two lateral sides leaving the naked front and back longitudinal stripes free of polyps. Whole colony white; axis grayish; sclerites colorless.

Sclerites of outer layer of coenenchyme composed of clubs of strong warts; dumbbells of inner layer. Tentacles containing irregular warty rods.

Distribution: Australia, Burma, Ceylon, South China Sea, the Philippines, Singapore, Okinawa (Walker and Bull, 1983), southern Taiwan.

Remarks: This species is dominant in southern Taiwan. They grow on reef slopes, top of reef blocks or on the flat limestone bottom, which undergo strong currents or surges. Reproduction by fragmentation at the top area of the whip. They usually form patches. Bivalves (*Pteria breviaolata*) and pairs of gobies (*Bryanops* spp.) are usually found on this species.

***Junceella juncea* (Pallas), 1776**

(Fig. 3H, 20)

Junceella juncea, Nutting, 1910c, 13b³: 18; Bayer, 1956: 214; Mai-Bao-Thu and Domantary, 1971: 18-20.

Materials: Two specimens; ASIZ 51027, 51028.

Diagnosis: Colonies unbranched, filiform. Axis strongly calcified, rigid proximally and flexible distally, circular in cross-section. Coenenchyme thick. Calyces prominent, directed upwards, arranged either on all sides or on two lateral sides leaving the naked front and back longitudinal stripes free of polyps. Calyces usually absent in the basal region.

Sclerites of the outer layer of coenenchyme composed of clubs, in inner layer dumbbells or symmetrical double heads and double stars. Colony brick red; clubs yellow; dumbbells yellowish; tentacular rods colorless.

Distribution: New Guinea, Kei Island, Aru Island, Flores Sea, Banda Anchorage, Timor (Nutting, 1910c), the Philippines (Bayer, 1956; Mai-Bao-Thu and Domantary, 1971), southern Taiwan.

Remarks: Colony grows on the sheltered areas of reef knolls or flat limestone substrates. Reproduction by fragmentation is similar to that of *J. fragilis*. Crinoids and pairs of gobies (*Bryanops* spp.) are found on this species.

***Junceella gemmacea* Milne Edwards & Haime, 1857**

(Fig. 4A, 21)

Junceella gemmacea, Wright and Studer, 1889: 158; Nutting, 1910c, 13b³: 20.

Materials: Two specimens; ASIZ 51029, 51030.

Diagnosis: Colony subflabellated with regular dichotomous branching. The largest branches nearly round in section. Calyces stout club-shaped and evenly and thickly distributed on all sides of the branches except along the narrow but evident median lines.

Sclerites of outer coenenchyme composed of club with one head like a many-rayed star and the other oval or almost equally rounded. Inner layer has

clubs and double stars. The tentacles are armed with wart-rod sclerites.

Color of colony brick red; club yellowish; double stars and wart-rod colorless.

Distribution: Red Sea (Wright and Studer, 1889), Ceylon, Indian Ocean (Nutting, 1910c), southern Taiwan.

Remarks: Colony grows on flat limestone substrates with scattered sand gravel. The occurrence of this species is rare in southern Taiwan.

***Verrucella umbraculum* (Ellis & Solander), 1786**

(Fig. 4B, 22)

Gorgonia umbraculum and *Verrucella rubra*, Nutting, 1910c, 13b³: 8, 11-12.

Verrucella umbraculum, Mai-Bao-Thu and Domantary, 1971: 23.

Material: One specimen; ASIZ 51031.

Diagnosis: Colonies abundantly branched in one plane, flabelliform, usually anastomosing. Terminal branchlets short. Calyces usually conical or hemispherical, irregularly distributed on all sides, sometimes serially on lateral sides of branches. Tentacular spicules warty rods. Sclerites from coenenchyme double heads and spindles.

Distribution: Batavia, East Indies, Gulf of Mannaar (Nutting, 1910c), the Philippines (Mai-Bao-Thu and Domantary, 1971), southern Taiwan.

Remarks: The colony grows on the lateral side of reef blocks or reef knolls below 10 meters. The bottom of the submarine groves between reef blocks is made up of mud and sand. The planar surface of the colony is perpendicular to the direction of the current. Ovulids (*Hiata coarctata*) and brittle stars (*Ophiothela danae*) are found on the surface of this species.

Notes on distribution and habitats

Among the 18 gorgonian species

found in the present study, 5 species, namely, *Subergorgia mollis*, *S. suberosa*, *Melithaea ochracea*, *Bebryce indica* and *Junceella fragilis*, were more abundant than other species (Table 1). The aggregation colonies of *J. fragilis* were, in particular, most common in the shallow waters along Station B and Mao-pi-tou. By contrast, *Solenocaulon chinense*, *Echinogorgia flora* and *Verrucella umbraculum* were relatively rare; they were observed only once or twice during this study. In general, the species composition and abundance of local gorgonian fauna varied from place to place. At Hsia-shui-ku and Mao-pi-tou, where the underwater topography is characterized by slanting slopes, are two locations with higher species diversity. In contrast, at Tarn-tzy, where the reef is flat, only *Melithaea ochracea* was found.

The gorgonians inhabit a variety of hard substrates, particularly on reef slopes, reef blocks, reef knolls and flat limestone terraces (Table 2). Most species grow on the lateral side of the reef blocks or reef knolls in southern Taiwan. Some of them are distributed on the flat limestone substrate with scattered sandgravel; they were *S. suberosa*, *E. flora*, *R. antipathes*, *J. fragilis*, *J. gemmacea* and *J. juncea*. Two species, *S. rubra* and *J. fragilis*, were found on the sheltered areas of reef blocks or concaved hard substrate. *H. princeps* was found in the areas with high turbidity, and was attached to the lateral sides of reef blocks.

Symbionts

Of the 18 species of gorgonians found in southern Taiwan, 11 species were associated with some other animals (Table 3). The symbionts included sea anemones, bivalves, ovulids, brittle stars, crinoids and gobies. The brittle star, *Ophiothela danae*, was the most common symbiont. It was found in 8 species of

Table 1

A list of gorgonians and their area of distribution at Kenting National Park, Taiwan. B: B-station; D: D-station; H: Hsia-shui-ku; Hs: Hsiao-wan; Hu: Hung-chi; M: Mau-pi-tou; O: Outlet of Nuclear Power Plant; S: Shan-hai-li; Ta: Ta-lau-ko; Tar: Tarn-tzy; W: Wan-li-tung; +: recorded

Species	Locality										
	H	W	S	Hu	M	B	O	D	Ta	Tar	Hs
<i>Solenocaulon chinense</i>			+							+	
<i>Subergorgia mollis</i>	+	+			+					+	
<i>Subergorgia rubra</i>	+	+									
<i>Subergorgia suberosa</i>	+	+	+	+	+	+	+		+		+
<i>Melithaea ochracea</i>	+	+	+	+	+			+	+	+	+
<i>Mopsella aurantia</i>			+								
<i>Acanthogorgia vegae</i>										+	
<i>Muricella grandis</i>	+	+			+						
<i>Bebryce indica</i>	+	+	+	+	+				+		+
<i>Echinogorgia flora</i>	+										
<i>Hicksonella princeps</i>											+
<i>Rumphella antipathes</i>					+	+	+				+
<i>Ellisella maculata</i>	+									+	
<i>Ellisella robusta</i>	+	+			+					+	
<i>Junceella fragilis</i>	+	+	+	+	+	+	+		+		+
<i>Junceella gemmacea</i>				+	+						
<i>Junceella juncea</i>	+	+	+	+	+				+		
<i>Verrucella umbraculum</i>	+										
Total species	12	9	7	6	10	3	3	1	10	1	6

Table 2

The habitat of gorgonians at Kenting National Park, Taiwan

Species	Habitat
<i>Solenocaulon chinense</i>	reef slope
<i>Subergorgia mollis</i>	reef block or reef knoll
<i>Subergorgia rubra</i>	shielded area of reef block or hard substrate
<i>Subergorgia suberosa</i>	block, boulder or flat limestone substrate
<i>Melithaea ochracea</i>	reef block or reef knoll
<i>Mopsella aurantia</i>	reef block or reef knoll
<i>Acanthogorgia vegae</i>	reef block
<i>Muricella grandis</i>	reef block
<i>Bebryce indica</i>	reef block
<i>Echinogorgia flora</i>	flat limestone substrate below 20 m.
<i>Hicksonella princeps</i>	block; surrounding seawater turbidity is often high
<i>Rumphella antipathes</i>	reef slope or flat limestone substrate
<i>Ellisella maculata</i>	shielded area of hard sea bottom
<i>Ellisella robusta</i>	flat limestone belt scattered with sandgravel
<i>Junceella fragilis</i>	reef slope, reef block, or flat limestone bottom
<i>Junceella gemmacea</i>	flat limestone substrate scattered with sandgravel
<i>Junceella juncea</i>	shielded area of reef knoll or flat substrate
<i>Verrucella umbraculum</i>	reef block or reef knoll below 10 m.

Table 3
The symbionts of gorgonians from southern Taiwan

Species	Symbionts
<i>Solenocaulon chinense</i>	—
<i>Subergorgia mollis</i>	<i>Pteria</i> spp. (Bivalves); <i>Ophiothela danae</i> (Brittle star); <i>Basilometra boschmai</i> ; <i>Cenometra bella</i> ; <i>Oligometra serripinna</i> ; <i>Colobometra perspinosa</i> (Crinoids); <i>Bryanops</i> spp. (Gobies).
<i>Subergorgia rubra</i>	<i>Pteria</i> spp. (Bivalves); <i>Ophiothela danae</i> (Brittle star).
<i>Subergorgia suberosa</i>	<i>Pteria</i> spp. (Bivalves); <i>Ophiothela danae</i> (Brittle star); <i>Capillaster multiradiatus</i> , <i>Colobometra perspinosa</i> (Crinoid).
<i>Melithacea ochracea</i>	—
<i>Mopsella aurantia</i>	<i>Prosimnia semperi</i> (Ovulid); <i>Ophiothela danae</i> (Brittle star).
<i>Acanthogorgia vegae</i>	—
<i>Muricella grandis</i>	<i>Pteria</i> spp. (Bivalves); <i>Ophiothela danae</i> (Brittle star).
<i>Bebryce indica</i>	Barnacle; <i>Ophiothela danae</i> (Brittle star); <i>Colobometra perspinosa</i> (Crinoid).
<i>Echinogorgia flora</i>	—
<i>Hicksonella princeps</i>	—
<i>Rumphella antipathes</i>	—
<i>Ellisella maculata</i>	—
<i>Ellisella robusta</i>	Sea anemone; <i>Hiata coarctata</i> (Ovulid).
<i>Junceella fragilis</i>	<i>Pteria breviaolata</i> (Bivalve); <i>Bryanops</i> spp. (Gobies).
<i>Junceella gemmacea</i>	<i>Lamprometra palmata</i> (Crinoid); <i>Ophiothela danae</i> (Brittle star).
<i>Junceella juncea</i>	<i>Comatula pectinata</i> (Crinoid); <i>Bryanops</i> spp. (Gobies).
<i>Verrucella umbraculum</i>	<i>Hiata coarctata</i> (Ovulid); <i>Ophiothela danae</i> (Brittle star).

—: No symbionts were found.

Table 4
Recorded species of gorgonians from southern Taiwan and other Western Pacific Ocean areas. M: Malaya, P: Philippine, S: Southern Taiwan, SC: South China Sea, J: Japan, K: Korea

Species	M	P	SC	S	J	K
<i>Solenocaulon chinense</i>	—	—	+	+	—	—
<i>Subergorgia mollis</i>	+	+	—	+	+	—
<i>Subergorgia rubra</i>	+	—	—	+	—	—
<i>Subergorgia suberosa</i>	+	+	—	+	+	—
<i>Melithacea ochracea</i>	+	+	—	+	—	—
<i>Mopsella aurantia</i>	+	+	—	+	—	—
<i>Acanthogorgia vegae</i>	—	—	+	+	—	—
<i>Muricella grandis</i>	—	—	—	+	—	—
<i>Bebryce indica</i>	—	—	—	+	—	—
<i>Echinogorgia flora</i>	—	—	+	+	—	—
<i>Hicksonella princeps</i>	—	—	—	+	+	—
<i>Rumphella antipathes</i>	—	+	—	+	—	—
<i>Ellisella maculata</i>	—	—	+	+	—	—
<i>Ellisella robusta</i>	—	—	—	+	—	—
<i>Junceella fragilis</i>	+	+	+	+	—	—
<i>Junceella gemmacea</i>	—	—	—	+	—	—
<i>Junceella juncea</i>	—	+	—	+	—	—
<i>Verrucella umbraculum</i>	—	+	—	+	—	—

A plus sign (+) indicates a confirmed report of the species, whereas, a minus (—) indicates absence.

gorgonians. It was especially associated with the colonies of *B. indica* and *V. umbraculum* where over 1,000 brittle stars were found.

7 species of crinoids were found on 5 species of gorgonians. Most of them were clinging to the tops of the colony's branches. The large sea fan, *S. mollis*, was the most abundant of the crinoid species on them. Two species of ovulids, *Prosimnia semperi* and *Hiata coarctata*, were found on 3 species of gorgonians (Wu *et al.*, 1990). They have delicatened mimicry on host species.

The gobies, *Bryanops* spp., were found on *S. mollis* and *J. fragilis*. Those found on *Junceella* were always in pairs, while many gobies may be present on *S. mollis* colony. The bivalves, *Pteria* spp., were found on 5 species of gorgonians, and sea anemones were only found enclosing the middle of whips of *E. robusta*.

DISCUSSION

During this study, 18 species of gorgonians belonging to 7 families and 13 genera were found. They are all new records from Taiwan. Comparing the fauna of Taiwan with that of other west Pacific region's, we found that they are similar to species found in the Philippines, Malaya (Nutting, 1910, a, b, c, d, 1911; Mai-Bao-Thu and Domantary, 1970, 1971), but the similarity is slight in the South China Sea and Japan (Kinoshita, 1907, 1908a, b, 1909, 1910b, 1913a; Zou and Scott, 1908; Kükenthal, 1908c; Kükenthal and Gorzawsky, 1908; Utinomi, 1961). There are no common species found in southern Taiwan and Korea (Rho and Song, 1976; Song, 1980, 1981).

Differences in growth forms, branch diameter, sclerites and color within species are common in gorgonians

(Kinzie, 1970; Grigg, 1972; Opersko, 1973). Such variations may represent structure adaptations associated with water movement. These adaptations have enabled them to withstand different wave strengths (Grigg, 1972). According to Dr. Bayer's observation on *M. ochracea* in Australia, there were no exactly similar forms of sclerites among any two specimens. However, we found that colonies of *M. ochracea* come in two color types, i.e., red and orange-yellow, and they have a mixed distribution on the same reef blocks in southern Taiwan. Variations of the sclerites from these two types are within the variation range of those from Australia. *E. robusta* from southern Taiwan was more similar to those from New Caledonia and New Guinea. The sclerites of *M. aurantia* from southern Taiwan were the same as the type specimen, but there are some differences in color (Dr. Bayer's personal comm.). The mean branch diameter of *S. suberosa* found at Mau-pi-tou was wider than those found at Ta-lau-ko. The color of colonies between two sites was also different, those found at Mau-pi-tou were yellow-brown, but at Ta-lau-ko brownish.

Most gorgonians found in southern Taiwan grow on hard substratum. Bayer (1956) recorded some genera of Isididae growing on soft substratum, but other gorgonians grew all on firm substratum (Bayer, 1956; Kinzie, 1970, 1973). Kinzie III (1970) indicated that the main factor limiting the distribution of gorgonians was the availability of a firm substratum suitable for setting. This might be the reason why most recorded gorgonians from southern Taiwan were found on hard substratum.

Many animals have been associated with gorgonians, such as Porifera, Coelenterata (Hydrozoa, Millepora), Platyhelminthes, Brachiopoda, Echinodermata

(Crinoids, Ophiuroidea), Annelida (Polychaeta), Arthropoda (Pycnogonidae, Copepoda, Cirropedia, Isopoda, Amphipoda, Decapoda), Mollusca (Aplousobranchia, Gastropoda), Chordata (Pisces) (Bayer, 1956; Kinzie III, 1970; Patton, 1972; Zann, 1980; Hazlett and Bach, 1982; Grygier, 1984). Anemones, bivalves, ovulids, brittle stars, crinoids and gobies were associated with gorgonians from southern Taiwan (Table 3). Over 50% of the species were associated with other animals. This indicates that gorgonians may provide a good habitat for the symbionts.

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南臺灣海域角珊瑚目（腔腸動物門）之研究

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南臺灣海域亞潮帶的角珊瑚，共計鑑定七科十三屬十八種，牠們皆為臺灣的新記錄種，包括：中國管莖珊瑚 (*Solencaulon chinense*)，網扇軟角珊 (*Subergorgia mollis*)，紅扇軟角珊瑚 (*Subergorgia rubra*)，軟木軟角珊瑚 (*Subergorgia suberosa*)，紅扇格節珊瑚 (*Melithaea ochracea*)，橙火炬珊瑚 (*Mopsella aurantia*)，星棘角珊瑚 (*Acanthogorgia vegae*)，深紫紅珊瑚 (*Muricella grandis*)，根葉義克森氏珊瑚 (*Hicksonella princeps*)，抗菌柳珊瑚 (*Rumphella antipathes*)，橙鈍角珊瑚 (*Beryce indica*)，花刺角珊瑚 (*Echinogorgia flora*)，絲鞭角珊瑚 (*Ellisella maculata*)，韌柳鞭角珊瑚 (*Ellisella robusta*)，白蘆莖珊瑚 (*Junceella fragilis*)，紅蘆莖珊瑚 (*Junceella juncea*)，芽蘆莖珊瑚 (*Junceella gemmacea*)，網傘疣珊瑚 (*Verrucella umbraculum*) 等。

各種角珊瑚的形態、骨片的形狀分佈，棲所特徵，以及其共棲生物在文中皆有論述。本文並依據角珊瑚的顏色，生長形式，形態特徵，骨片等形質建立檢索表。文中並附有各種角珊瑚的生態照片和骨片的電顯照片。