

# ASSOCIATIONS OF HYDROCORALLIA STYLASTERINA WITH GALL-INHABITING COPEPODA SIPHONOSTOMATOIDEA FROM THE SOUTH-WEST PACIFIC

## PART I. ON THE STYLASTERINE HOSTS, INCLUDING TWO NEW SPECIES, *STYLASTER PAPUENSIS* AND *CRYPTHELIA CRYPTOTREMA*

by

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### ABSTRACT

Several associates of stylasterine corals were previously known (reviewed in the present paper) but no specialized Copepoda have been recorded thus far. Six such copepod species (described by J. H. Stock in part 2) have been found in cage-like globular galls (walls perforated) on *Stylaster sanguineus* (one species, from the New Hebrides), *Stylaster papuensis* (one species, from the Louisiade Archipelago, Papua), *Conopora laevis* (three species, from the Kermadec Islands and northern New Zealand), *Cryptbelia cryptotrema* (one species, from New Caledonia). Each association appears characterized by a special type of gall, though some associations are known from one or two galls only. At least for some associations it is proved that the gall develops from a cyclosystem infested by an early stage of the copepod; the same process is assumed in the case of the remaining associations.

*Stylaster papuensis* and *Cryptbelia cryptotrema*, new species, are described in detail, whereas for the other host species the distribution is reviewed, including some new records. A synonymy is given for *Conopora laevis*.

### RÉSUMÉ

Plusieurs Invertébrés associés à des Coraux Stylastérides étaient déjà connus (ils sont passés en revue dans le présent travail), mais jusqu'à présent, aucun Copépode spécialisé n'avait été trouvé dans de telles conditions. Six espèces de Copépodes (décrites par J. H. Stock dans la 2<sup>e</sup> partie de ce travail) ont été trouvées dans des galles globuleuses à aspect de cage et à parois perforées, sur *Stylaster sanguineus* (une espèce, des Nouvelles Hébrides), *Stylaster papuensis* (une espèce, de l'Archipel des Louisiades, Papua), *Conopora laevis* (trois espèces, des Iles Kermadec et du nord de Nouvelle Zélande), ainsi que sur *Cryptbelia cryptotrema* (une espèce, de Nouvelle Calédonie). Chacune de ces associations semble être caractérisée par un type spécial de galle, bien que certaines associations soient actuellement documentées seulement par une ou deux galles. Pour certaines de ces associations tout au moins, il est actuellement démontré que les galles se développent à partir d'un cyclosystème infesté par un jeune stade du Copépode; on suppose que le même phénomène joue aussi dans le cas des autres associations.

Deux nouvelles espèces (*Stylaster papuensis* et *Cryptbelia cryptotrema*) sont décrites en détail, et la distribution des

autres espèces hôtes est passée en revue (avec quelques stations nouvelles). On donne une synonymie pour *Conopora laevis*.

### PREVIOUSLY KNOWN STYLASTERINE ASSOCIATES

Representatives of several zoological groups are known as associates of stylasterine corals. These are briefly reviewed below.

Moseley (1879: 469; 1881: 78) mentioned a nemertean twisted in many coils round the tips of the branches of *Errina labiata* Moseley, 1879, from the "Challenger" expedition (probably sta. 320 in the south-west Atlantic). According to the author the branches thus irritated grow out into a burr-like mass of projecting points of hypertrophied dactylopore prominences. The nemertean in question has apparently never been studied in detail; it is not mentioned by Hubrecht (1887) in the monograph of the nemerteans from the "Challenger" expedition.

Among the polychaete associates various types can be distinguished. *Polydora alloporeis* Light, 1970, is a borer in the living parts of *Allopora californica* Verrill, 1866. The same coral species also shows the calcified blister-like galls, with a pore or opening, in which lives *Autolytus penetrans* Wright & Woodwick, 1977. Information on gallery-like gall-tubes inhabited by polychaetes along the branches of various species is widely scattered in the stylasterine literature, but up to now only two species of these polychaete symbionts have been described in detail: *Lagisca irritans* Von Marenzeller, 1904b, found on *Errina*

*macrogastra* Von Marenzeller, 1904a, and *Stenohelia robusta* Boschma, 1964 [= *S. profunda* sensu Von Marenzeller, 1904a], both from the Galapagos islands, and *Harmothoe corralophila* [sic!] Day, 1960, found on *Allopora bitbalamus* Broch, 1936, from South Africa (Boschma, 1960).

*Pedicularia*, a genus of prosobranch gastropod, apparently comprises only obligate symbionts of stylasterines, in spite of contradictory indications in the literature about scleractinians, gorgonians, bryozoans and echinoids as host species. Arnaud & Zibrowius (1979) summarized information on the Mediterranean representatives of this type of association: *Errina aspera* (Linnaeus, 1767) with *Pedicularia sicula* Swainson, 1840.

Moseley (1879: 469; 1881: 78) mentioned small parasites, apparently pycnogonid larvae (badly preserved) in small capsules inside the gastric cavities of the gastrozooids of *Pliobothrus symmetricus* Pourtalès, 1868, from deep water off Florida. According to Broch (1951: 36) small parasitic crustaceans were found in ampullae-like cavities ("evidently caused by the parasites") not visible to external examination, inside colonies referred to *Errina antarctica* (Gray, 1872) from the Antarctic-Subantarctic area (exact locality not indicated; Broch confused several species under that name — S. D. Cairns, in litt.). One may tend to link Broch's observation of small "crustaceans" with Moseley's of presumed pycnogonid larvae.

The thoracic cirriped *Armatobalanus nefrens* Zullo, 1963, has been described as a typical associate of *Allopora californica* Verrill, 1866, and of *Errinopora pourtalesi* (Dall, 1884), from California, most of the barnacles being completely encrusted by the coral, leaving only a small opening visible. Thoracic cirripeds of the genus *Pyrgoma* are reported by Broch (1947: 309, pl. I fig. 1) as associates of *Stylaster ramosus* Broch, 1947, from Tanzania (Pemba Channel). Pyrgomatid cirripeds (not mentioned in the text) can further be seen on a colony of *Allopora scabiosa* Broch, 1935, from Japan (Sagami Bay) figured by Eguchi (1968, pl. 18 fig. 8).

Broch (1942: 62) presumed a "commensalistic or symbiotic connection" between *Paraerrina decipiens* Broch, 1942, from Mauritius, and an acrothoracic cirripid, *Lithoglyptes* sp., which caused

swellings with a narrow elliptical slit at the summit in most of the branches; the other stylasterine species from the same stations were found not to be infested.

## THE STYLASTERINE-COPEPOD ASSOCIATIONS

Up to now specialized copepods symbiotic with stylasterines have not been mentioned in the literature. They were first discovered when various stylasterine collections were examined in view of associated gastropods (*Pedicularia*) and polychaete induced galls. The six copepod species discovered live on four different stylasterine hosts: *Stylaster sanguineus* Milne Edwards & Haime, 1850, *Stylaster papuensis* n. sp., *Conopora laevis* (Studer, 1878), and *Cryptohelia cryptotrema* n. sp. According to Stock (1981) the copepods are phylogenetically related and belong to the family Asterocheridae.

The calcified galls they induce on the branches of the coral are globular cage-like structures with small pores. The ovigerous female of the copepod is definitely enclosed in the gall and only the young stages are able to leave through the pores. The galls induced by each copepod species on the various coral hosts differ in various details, mainly of development, shape and arrangement of pores.

***Stylaster sanguineus* Milne Edwards & Haime, 1850.**

Pl. I figs. 1-5.

*Stylaster sanguineus* Milne Edwards & Haime, 1850: 96, pl. 3 fig. 2.

*Stylaster (Eu-Stylaster) sanguineus*; Broch, 1936: 33, text-fig. 8a-e, pl. III fig. 11, pl. IV fig. 12.

*Stylaster elegans*; Wells, 1954: 476, pl. 184 figs. 3-4.

*Stylaster sanguineus*; Boschma, 1964: 183, text-fig. 1-4, pl. I figs. 1-2, pl. II figs. 1-2.

The most recent and most detailed critical description of *Stylaster sanguineus* is that by Boschma (1964) based on various specimens in old museum collections (Paris, Washington). It notably includes photographic illustrations of big flabellate colonies and indications on the variation of the cyclo-systems. Following Milne Edwards & Haime (original description quoted in extenso), Bosch-

ma credited Valenciennes with the authorship of the species which is quoted as *S. sanguineus* Valenciennes in Milne Edwards & Haime, 1850. Boschma (1957, 1964) reviewed the literature on the species and pointed out its synonymy, referring both *Stylaster elegans* Verrill, 1864 (type locality: Ebon, Marshall Islands) and *Stylaster tenuis* Verrill, 1864 (type locality: Upolu, Samoa Islands) to *S. sanguineus* (type locality: Australia, no further details).

The distribution of *S. sanguineus* as compiled by Boschma (1957, 1964) from the generally rather undetailed indications in the literature and on the labels in old museum collections, comprises a large area in the central and south-west Pacific: the Palau, Caroline, Marshall, and Gilbert Islands, Australia (no details), New Zealand (no details), the Fiji and Samoa Islands. The species apparently does not occur in the Hawaiian Islands; abundant material in old museum collections labeled as from Hawaii most likely had been collected elsewhere, mainly in the Gilbert and Samoa Islands.

Furthermore, *S. sanguineus* has been reported from La Réunion, Mascarene Islands, by Maillard (1862: 176) and from the south of Madagascar by Pichon (1978: 421, 433). However, its presence in the south-western Indian Ocean has still to be confirmed; at least Pichon's material (re-examined) belongs to a different species of pink *Stylaster*.

**Additional records.** — Abundant material from the "Challenger" expedition in the British Museum (Natural History) had remained unstudied up to now. Moseley (1879, 1881) did not provide any new record of *S. sanguineus* in his reports on the "Challenger" stylasterines. Accordingly, Murray (1895) did not mention the species in the summary of the results of the expedition supplied with a list of species for each station. The "Challenger" material in question comprises four lots of colonies and branches, two of them (1893.3.6.1 and 1933.5.3.317) found labeled "Challenger, Api, New Hebrides, 60-70 fathoms", the two other lots (1889.7.6.1-4 and 1889.7.6.6) found labeled "Challenger stat. 232".

The former perfectly fit with "Challenger" sta. 177, off Api Island, New Hebrides (18 August

1874, 16°45'S 168°07'E) where, according to Murray (1895: 665) the dredge and swabs brought up a diversified fauna from depths between 63 and 70 fathoms (= 115 and 128 m) off the "edge of the fringing coral reef" (lower horizon of the outer slope of the reef). On the contrary, in view of its depth, "Challenger" sta. 232, off the Bay of Yokohama, Japan (12 May 1875, 35°11'N 139°28'E, 345 fathoms (= 632 m)) appears most unlikely for *S. sanguineus* (never again reported from Japan); probably the origin of this material had been confused.

The abundance of *S. sanguineus* in many old museum collections points to a rather shallow water habitat from where it was easy to obtain by unsophisticated fishing gear and eventually by diving by the indigenous population of the South Sea islands. For example Broch (1936: 33) already mentioned specimens from Jaluit (Marshall Islands) obtained by diving. More recently, Wells (1954) indicated new records (under *Stylaster elegans*) from rather shallow water from Bikini Atoll (lagoon 15-42 m and seaward slope 23-165 m) and from Eniwetok Atoll (lagoon 38 m).

**Occurrence of copepod galls.** — Four galls, all of the same type and apparently all caused by the same copepod species, *Hammatomyzon dimorphum* Stock, 1981, have been obtained from 3 lots of *S. sanguineus*. Copepods have been found in three galls, while the fourth was empty except for some organic detritus.

— "Challenger" sta. 177: Api, New Hebrides, 115-128 m (see above). Alcohol preserved material; one gall containing one ovigerous female and one male of *H. dimorphum*.

— "Challenger" sta. 232: origin dubious (see above). Alcohol preserved material; one gall containing one ovigerous female of *H. dimorphum* and one gall containing organic detritus.

— No information (British Museum (Natural History), old collection, no register number). Dry material; one gall containing one ovigerous female presumably of *H. dimorphum* (in poor condition).

**Description of copepod galls.** — Galls of *Hammatomyzon dimorphum* Stock, 1981, on *S. sanguineus*, of the same pink colour as the colony, are known only in the adult stage, about 1.8 to 2.0 mm in diameter, roughly hemispherical on thicker branches, more prominent and closer

to spherical on thinner ones. They occur in various positions on the colonies, on a straight part or near a ramification, always placed on the row of cyclo-systems or slightly turned towards the anterior or posterior side of the branch; they may contribute to anastomosis of branchlets in the flabellate colony.

Their outer surface is rather smooth or slightly wrinkled and rugose, similar to that of the ampullae; however they differ from ampullae by their larger size and several (2 to 7) small pores in the upper and peripheral wall. These apertures are arranged quite irregularly, and all galls differ from each other in detail. The pores are rather constant in shape, from subcircular to slightly elongate, but differ considerably in diameter (0.08 to 0.22 mm). The smallest perforations (two only) were found in a gall which apparently was about to be filled in and recovered by the coral; it was found to contain only some organic detritus.

The wall of the gall is solid, about 0.2 mm thick. The cavity is spherical, with the bottom slightly concave into the branch; no particular structures are evident; the slight concavity of the gall lumen into the branch does not show distinct traces of a cyclo-system. Though a correlation between the gall and a pre-existing cyclo-system is not evident, this is suggested by the position of the gall aligned with typical cyclo-systems.

### ***Stylaster papuensis* n. sp.**

Pl. I figs. 6-10, pl. II figs. 1-7, pl. III figs. 1-7.

Species known only from three specimens (holotype and two paratypes), all from the same diving station in the Louisiade Archipelago, Papua-New Guinea: Tagula Island, Snake Pass, depth to 40 m, coll. R. H. Chesher, 1979.

Holotype large flabellate colony about 85 mm high and 130 mm wide, with base. Paratype I small flabellate colony about 35 mm high and 50 mm wide, base not preserved. Paratype II flabellate branch 60 mm high and 27 mm wide. In addition there are various small fragments accidentally broken off from the holotype and either paratypes. The main material is deposited at the National Museum of Natural History (Smithsonian Institution), Washington (holotype coll. no. 60269, paratype I 60274, paratype II 60275, fragments). One branch has been donated to the British Museum (Natural History), London (coll. no. 1981.6.9.2).

**Description.** — Coenosteum hard and compact, vividly pink except in the youngest parts of

the branchlets which are white — the colour appears gradually towards the older parts. Colour tending towards red, with occasionally a shade of orange (paratype II). Youngest whitish parts with slightly embossed surface, older parts smooth, generally without conspicuous outgrowths and devoid of distinct costae, but covered with thin white lines connecting tiny pores and coalescing into a somewhat irregular reticulation. Meshes of reticulum with minute longitudinal ridges (not minute rounded transverse ridges as in many other species of *Stylasterina*). On some of the thicker branches (towards the base of the holotype) the generally smooth surface is locally interrupted by small outgrowths, apparently in connection with tiny pores of the reticulum, but altogether the surface in these parts is not really coarse. Rare isolated deep pores (possibly dactylo-pores) of circular outline and about half the size of typical dactylo-pores of the cyclo-systems are scattered over the thicker branches.

Ramification dense, roughly in one plane, with lateral branchlets of neighbouring main branches often slightly divergent from each other and the main plane. Branchlets in two opposite rows on main branches, fairly regularly alternate; second generation branchlets poorly developed. Resultant flabellate colony fragile; thickest branches observed near base only about 3.5 mm in diameter. Anastomoses rare. Branches about circular in cross section. Anterior and posterior side of branches without cyclo-systems; these are strictly located on the lateral sides of the branches, in the general plane of the flabellate colony. Distance between consecutive cyclo-systems up to twice their diameter. Youngest parts of branches zigzag-shaped, new cyclo-system budding from the top part of the previous one, in alternate direction; zigzag pattern attenuates further down, thicker and older branches becoming straight.

The holotype shows an interesting case of polarity inversion: several branches in the lower part of the flabellate colony have been transformed into diverging adventitious roots and became attached to the substrate. These roots are circular in cross section, smooth and devoid of cyclo-systems. Near the substrate they generally divide irregularly, multiplying the points of attachment.

In young thin branches the terminal cyclo-system is about 0.5 mm wide, whereas on thick branches cyclo-systems may attain a diameter of 0.8 mm. The terminal (and youngest) ones are perfectly round, with a complete circle of dactylo-pores closely packed around the cylindrical gastropore tube. Distinct notches in the upper gastropore wall (dactylotomes) alternate with prominent pseudosepta, which separate the dactylo-pores laterally from each other; in side view of the cyclo-system the pseudosepta appear as a conspicuous crenulation. Further down the branches the older cyclo-systems are generally less regular, especially those squeezed into the angle between the main branch and a lateral branchlet. Nevertheless, typical cyclo-systems persist even on the oldest and thickest branches, down to the base. In the older cyclo-systems the upper part of the gastropore tube is slightly flared out, somewhat funnel-shaped; accordingly the dactylo-pores appear less closely packed around, tending to take a more peripheral position with dactylotomes becoming less conspicuous. The final stage is a cyclo-system with the dactylo-pores separated from the central gastropore not by a thin vertical wall, but by a larger massive zone. In addition, the circle of dactylo-pores frequently becomes incomplete in these older cyclo-systems, the interruption (towards the distal part of the branch) corresponding in width to only a few missing dactylo-pores (generally 1 to 3); it is thus far from becoming horseshoe-shaped with a wide poreless zone (diastema) as this is not infrequent in the genus *Stylaster*.

The number of dactylo-pores has been found to vary from 8 to 14 in 100 cyclo-systems examined in detail; 10 dactylo-pores per cyclo-system is the most common number, followed by 11 and 9. The terminal (youngest) cyclo-systems frequently have only 9 dactylo-pores, hardly ever the highest numbers, while in the old cyclo-systems on thicker branches any numbers are to be expected depending on a more or less incomplete circle.

Dactylo-pores per cyclo-system	8	9	10	11	12	13	14
Number of cyclo-systems	1	19	26	23	14	16	1

The dactylostyles can be seen from above on the peripheral wall of the dactylo-pores as a row of very small spiny outgrowths.

The gastrostyle can always be seen from above, rather deep down in the gastropore as an elongate brush-like structure. The style is slenderly sub-cylindrical with a pointed top and consists of a solid axial structure completely covered by tiny spines. Typically, it is about 0.11 to 0.14 mm wide and about 0.31 to 0.40 mm high, its height being about half the depth of the gastropore, or slightly less (data from young cyclo-systems in distal branchlets; in older cyclo-systems on thicker branches the gastrostyle may be higher and the gastropore deeper). Corresponding to the upper level of the gastrostyle, there is an annular series of thin sub-cylindrical outgrowths of the gastropore wall projecting towards the gastrostyle; these elongate blunt structures are easily seen from above as a discontinuous annular constriction around the gastrostyle in the otherwise regularly cylindrical lower part of the gastropore tube.

Ampullae are hemispherical prominent structures of about the same diameter as the cyclo-systems. They may first appear on the still whitish or hardly coloured part of young branches; further down they are generally pink, corresponding to the ambient colour. Occasionally young ampullae are found, among mature ones, away from the distal end of the branches; they contrast by their more fragile structure and whitish colour from the older ones. Ampullae develop on the anterior and posterior sides of the branches which are free of cyclo-systems. They are closely lined up on thin branches, whereas on thicker ones they form larger clusters, with two or three ampullae placed side by side. No ampullae are found on the thickest and oldest branches. They rarely invade the lateral sides (between the cyclo-systems) from the front and the back. Thin branches with a series of ampullae lined up on both the anterior and posterior side appear considerably thickened and proportionally flattened laterally.

The ampullae are either smooth (holotype and paratype II) or echinate with up to about 10 small conical outgrowths (paratype I) which appear to contain a tiny pore. The reticulate surface structure of the branches is continued on the

ampullae and the tiny pores are here very conspicuous. The wall of adult ampullae is solid and hardly ever found damaged or broken. All ampullae (the smooth and the echinulate ones) have a distinct circular pore (about 0.1-0.14 mm wide) in the peripheral wall at the base; generally it is found closed by a deposit (less coloured than the wall to whitish), less solid than the surrounding wall. It is presumed that the mature planulae escape from the ampullae via this aperture (for resorption of skeletal structures into a passage for the birth of stylasterine larvae, see Fritchman, 1974).

*Derivatio nominis.* — From *papuensis*, Latin, meaning “from Papua”, alluding to the geographical origin of the type material.

*Remarks.* — Boschma (1957) listed 33 nominal living species and subspecies of *Stylaster*, together with a few fossil ones; afterwards only one more living species of *Stylaster* has been described (cf. Vervoort & Zibrowius, 1981): *S. brunneus* Boschma, 1970. Two of the species in Boschma's list, *S. laevis* Studer, 1878, and *S. verrucosus* Studer, 1878, do not belong to the genus *Stylaster* but to *Conopora* (see below). Five species originally described as *Stylaster* have already been referred by Boschma (1957) to other genera: two species to *Allopora* (*S. divergens* Von Marenzeller, 1904a, *S. stellulatus* Stewart, 1878) and three species to *Stenohelia* (*S. obliquus* Studer, 1878, *S. tiliatus* Hickson & England, 1905, and *S. umbonatus* Hickson & England, 1905). Of these, *S. obliquus* has been erroneously referred to *Stenohelia*; it does not belong to that genus but to *Conopora* (see below).

Descriptions and figures of most of the species remaining in the genus *Stylaster* provide sufficient information as to enable to separate *S. papuensis* as a new species from the previously named ones. In addition, the type material of many of these species has been checked, which, in some cases, proved helpful to confirm *S. papuensis* as indeed different from previously described forms. For example, it was desirable to examine *Stylaster asper* Saville Kent, 1871, a species rather poorly described after material from unknown origin and

said to be of pale pink colour; however the type specimen at the British Museum (Natural History) (coll. no. 1843.3.6.152) proved to have an entirely white skeleton and to differ otherwise from *S. papuensis*.

*Stylaster bellus* (Dana, 1848), figured very pale pink, from the Tuamotu (= Paumotu) Islands, and *Stylaster gracilis* Milne Edwards & Haime, 1850, of pink colour and said to come from Australia, are poorly described and poorly figured species the types of which appear lost. However, it appears that they both differ from *S. papuensis*: *S. bellus* by the high number of dactylopores per cyclo-system (about 24 according to Dana), and *S. gracilis* by the considerably exerted pseudosepta of the cyclo-systems. *S. gracilis* sensu Moseley, 1881, from the Philippine and Kermadec Islands, “Challenger” expedition (not necessarily conspecific with the type material of *S. gracilis*) differs considerably from *S. papuensis*.

*S. papuensis* is distinct, too, from the various “facies” (*altus*, *dentatus*, *irregularis*, *minor*), some of which are pink, from Indonesia, ascribed by Hickson & England (1905) to *Stylaster eximius* Saville Kent, 1871 (the latter a West Indian species!). In his list, Boschma (1957) did not deal with these “facies” as nominal species or subspecies and they are not included in the above considerations.

*S. papuensis* appears well distinguished from the previously named forms by the combination of the following characters: vivid pink colour (except in the youngest parts), generally smooth surface (notwithstanding occasionally echinulate ampullae), small cyclo-systems with most frequently 9 to 11 dactylopores, a deeply seated slender gastrostyle, hemispherical solid ampullae lined up on the anterior and posterior side, giving the branches a laterally compressed appearance, and a distinct peripheral pore on the ampullae.

*Occurrence of copepod galls.* — About 40 galls have been found on the holotype of *S. papuensis* and 3 on paratype II (all dry material), no galls at all on paratype I. The galls exhibit different stages of development and all are referable to *Cystomyzon dimerum* Stock, 1981, though some were found broken and empty. Cope-

Pods obtained from the galls: 24 females, 8 males, 21 copepodids, 5 nauplii.

**Description of copepod galls.** — Galls of *Cystomyzon dimerum* Stock, 1981, on *S. papuensis* are known from very early stages occurring about anywhere on the colony, including on the youngest distal and peripheral branchlets, to fully grown ones measuring from 1.8 to 2.4 mm wide and located on older thicker branches. The galls start as a small white cushion-like outgrowth of highly fragile spongy and porous structure and an alveolous surface covering a normally developed cyclo-system, obstructing its gastropore and dactylo-pores. When the galls grow bigger, extending peripherally away from the cyclo-system, they become more prominent and develop small subcircular pores penetrating the now more consolidated wall. The biggest galls, about hemispherical and strongly prominent, may have a rather massive wall about 0.2 mm thick with a variable number of pores, for example 6 (maximum about 10) which are about 0.1-0.14 mm wide and randomly arranged.

The alveolous appearance of the wall may already have disappeared from the outer side of the gall while it is still very obvious on the inner side. The galls remain white until an advanced stage, contrasting with the pink colour of the branches, and only the oldest and most consolidated galls are slightly coloured (pale pink). The wall of the gall appears to be added onto the branch and only in the oldest coloured galls does the wall look more continuous with the surrounding branch surface. Even under the biggest and oldest galls the underlying cyclo-system remains distinct, almost unaltered; there may be just traces of a thin calcareous deposit in the gastropore and a slight excavation of the gall bottom into the pseudosepta.

In the earliest stage of the gall, an early copepod stage is found inhabiting the gastropore cavity; it may be assumed that a copepodid settles on the gastrozoid (unfortunately all material was dry). Later on the wide gall cavity may contain a couple of mature copepods, the male and the big ovigerous female. It is obvious that the wide spheric gall cavity results from progressive dissolution of

the inner side (earlier layers) while the outside growth, by concentric accretion, is directed away from the cyclo-system.

**Other associates.** — In addition to the copepod galls, four specimens of *Pedicularia* with pink shells were present on branches of the holotype of *S. papuensis*, the rim of their shells fitting exactly the branch surface. Only one trace of *Pedicularia* ("footprint") was found on paratype I.

**Conopora laevis** (Studer, 1878), n. comb.

Pl. III figs. 8-11, pl. IV figs. 1-5.

*Stylaster laevis* Studer, 1878: 635, pl. 2 fig. 5a-b.

*Stylaster obliquus* Studer, 1878: 635, pl. 2 fig. 7a-d.

*Conopora tenuis* Moseley, 1879: 503; Moseley, 1881: 82, pl. XII figs. 5, 5a-b, 6.

The species is presented here for the first time under the above new combination. The synonymy was overlooked by Boschma (1957) who knew Studer's poorly described species only from the literature; he erroneously listed *Stylaster laevis* as a typical representative of the genus *Stylaster* and referred *Stylaster obliquus* to the genus *Stenobelia* (Boschma, 1957: 17, 32).

Studer's short descriptions of *Stylaster laevis* and *Stylaster obliquus* are based both on one specimen (holotype) dredged by the "Gazelle" near the Three Kings Islands, off northern New Zealand, both at one station (sta. 58/42, 27 October 1875, 34°09.9'S 172°35.8'E, 90 fathoms = 165 m; Studer indicated different station numbers, 58 in 1878, 42 in 1889 — the latter publication has been overlooked by Boschma, 1957). The type material is preserved at the Museum für Naturkunde, Berlin (holotype of *S. laevis* coll. no. 1776, holotype of *S. obliquus* coll. no. 1778).

Moseley's (1879, 1881) short descriptions of *Conopora tenuis* (type species of the genus *Conopora*) are based on small colonies dredged by the "Challenger" at the Kermadec Islands (sta. 170, 14 July 1874, 29°55'S 178°14'W, 520 fathoms (= 951 m), between Macauley Island and Raoul Island). Three syntypes including the figured one (Moseley, 1881, pl. XII figs. 5, 5a) are preserved at the British Museum (Natural History), coll. no. 1880.11.25.184.

The type material of all three nominal species

*Stylaster laevis*, *Stylaster obliquus* and *Conopora tenuis* is very similar in the structure of the cyclo-systems and the smooth surface of the branches; their specific identity cannot be doubted. However, later records under these names do not necessarily belong to the same species.

Moseley (1881: 81) referred, with doubts (question mark) a specimen from the Kermadec Islands ("Challenger" sta. 171, 15 July 1874, 28°33'S 177°50'W, 600 fathoms (= 1098 m), north of Raoul island) to Studer's *Stylaster laevis*. The specimen in question (British Museum (Natural History) coll. no. 1880.11.25.178) is a typical *Conopora* (not a *Stylaster*!) and resembles the types of *Stylaster laevis*, *Stylaster obliquus* and *Conopora tenuis*, except for the surface structure, which is not smooth but covered by tiny warts with pores. Accordingly, Moseley's specimen from "Challenger" sta. 171 should better be referred to *Conopora verrucosa* [= *Stylaster verrucosus* Studer, 1878] and not to *Conopora laevis* pending a more detailed study of the genus *Conopora* in the New Zealand-Kermadec region, and preferably, worldwide. Appropriately, *verrucosus* means warty while *laevis* means smooth, which is a good characterization of the presumed difference between these species of *Conopora*. Studer's (1878) short description of *Stylaster verrucosus* is based on one specimen (holotype in Museum für Naturkunde, Berlin, coll. no. 1764) dredged by the "Gazelle" east of North Island, New Zealand (sta. 60/44, 12 November 1875, 35°21'S 175°40'E, 597 fathoms (= 1092 m); Studer indicated different station numbers, 60 in 1878, 44 in 1889; the latter publication has been overlooked by Boschma, 1957).

There has been no additional record of *Stylaster obliquus* in the literature.

After Moseley, various authors referred to *Conopora tenuis* new records from the west Pacific and Indian Oceans: eastern Indonesia (Wai-geu, 469 m), southern Japan (Sagami Bay, 110 m), "Indian Seas" (no details), Mauritius (238 m), Chagos Archipelago (Salomon Atoll, 219-274 m), Providence Island (between the Seychelles and Madagascar, 137 m). Boschma (1957: 39) compiled all these references from the literature, but no critical comparative study has been done yet.

According to the records compiled by Boschma (*Conopora tenuis*, if correctly identified) combined with Studer's records (*Stylaster laevis*, *Stylaster obliquus*), *Conopora laevis* new combination (here kept separate from *Conopora verrucosa*) is a deep-water species wide-spread in the Indo-Pacific.

**Additional records.** — Five records of *C. laevis* (typical, with smooth surface), all from the New Zealand region, are published here for the first time.

- "Terra Nova" sta. 90, 27 July 1911, Three Kings Islands, from Summit, Great King, S 10° W, 25 miles, 183 m.
- New Zealand Oceanographic Institute (NZOI) sta. E 305, 9 April 1965, 34°10'S 171°55'E, 282 m, Three Kings Islands.
- NZOI sta. E 306, 9 April 1965, 34°05'S 171°47.5'E, 263 m, Three Kings Islands.
- NZOI sta. A 910, 13 September 1963, 43°04'S 178°39'W, 349 m, between New Zealand and the Chatham Islands.
- NZOI sta. D 90, 17 May 1963, 43°50'S 179°00'W, 399 m, Chatham Islands.

**Occurrence of copepod galls.** — Four lots of *C. laevis* provided 15 galls which belong to three different types and are caused by three distinct copepod species, *Cecidomyzon conopora* Stock, 1981 (12 galls from two lots), *Oedomyzon tripodum* Stock, 1981 (two galls from two lots) and *Cystomyzon* sp. (one gall). One colony possessed galls caused by two different copepod species, *Oedomyzon tripodum* and *Cystomyzon* sp.

- NZOI sta. A 910: between New Zealand and the Chatham Islands, 349 m (see above). Alcohol preserved material and dry material. Ten galls, two containing each one ovigerous female and one containing one male of *Cecidomyzon conopora*: the other galls empty, some with apertures filled in and covered again by the sclerenchyme.
- "Challenger" sta. 170: Kermadec Islands, 951 m (see above). Dry material; two galls on small colony (syntype of *Conopora tenuis*), one of them found broken open and empty, the other containing debris of a male copepod, probably *Cecidomyzon conopora*. Galls not mentioned by Moseley (1879, 1881) in his descriptions of *Conopora tenuis*.
- "Terra Nova" sta. 90: Three Kings Islands, 183 m (see above). Dry material. One gall containing debris of one female of *Oedomyzon tripodum*.
- "Gazelle" sta. 58/42: Three Kings Islands (see above), 165 m. Alcohol preserved material. One gall containing one male and one female of *Oedomyzon tripodum*. One gall containing one damaged female of *Cystomyzon* sp.



**Description of copepod galls.** — Galls of *Cecidomyzon conoporae* Stock, 1981, on *C. laevis* are roughly hemispheric to more elongate and more prominent on the branches. They range from 1.6 to 3.2 mm in diameter, but in most cases exceed 2.0 mm. They are generally found on slender distal or peripheral branches, either on straight simple parts or close to ramifications, occasionally close to gallery-like polychaete gall-tubes (the latter preferably localized on the more basal and stronger parts of the branches). The outer surface of the galls is smooth, without any particular sculpture. There are typically four sub-equal apertures in the upper part of the gall, narrowly slit-shaped and meridianly oriented. The largest apertures observed are about 0.8 mm long and 0.16 mm wide while on other galls they are considerably smaller or even filled in when empty galls are recovered by the sclerenchyme. The slit-shaped apertures are not randomly distributed but usually placed at about 90° from one another in all four quadrants of the globular structure. One gall had only three slits at about equal distances. In some other cases the usual fairly equal-distance distribution of the slits is disturbed by the position of the gall next to a ramification. The upper part of some galls, though consisting of a rather thick wall, shows a rather distinctly porous to alveolous structure when broken up; in other galls the wall is more massive and consolidated. These differences appear to be a matter of age.

Occasionally traces of a cyclo-system modified by dissolution can be detected at the bottom and on the upper peripheral wall of the spherical to more elongate gall cavity. These structures may include, at the bottom, remains of the basal chamber of the gastropore tube (in the genus *Conopora* without a gastrostyle) and its limiting circular constriction, and in the upper peripheral wall remains of the dactylo-pores and their separating pseudosepta. It is evident from these observations that the galls have developed from a normal cyclo-system .

Two galls of *Oedomyzon tripodum* Stock, 1981, on *C. laevis* are known. One of these, from "Terra Nova" sta. 90, containing a female copepod, is located in the distal part of a thin branch, just

above a ramification. About 3.15 mm wide, with a smooth surface, it has the appearance of a general and not particularly prominent swelling, extending almost all around the branch. Four small apertures, subcircular to more irregular and slightly elongate (size of larger ones 0.2-0.25 mm) are situated near the center of the gall, about halfway between the nearest lower and upper cyclo-systems. The walls of the gall are particularly thick and massive while the disproportionately small gall cavity is only 1.2 mm wide. Possibly this was an old gall and therefore considerably consolidated and on the way to being recovered by the coral. From the section it appears that the gall developed from a cyclo-system: remains of the basal chamber of the gastropore tube are recognizable at the bottom of the gall.

The other gall of *Oedomyzon tripodum*, from "Gazelle" sta. 58/42, containing a well-preserved male and a female, is less obvious, located on a thick branch near the orifice of a polychaete gall-tube and squeezed between two lateral branchlets. The gall has a solid wall, about 0.3 mm thick, with two irregularly shaped elongate apertures (the largest 0.8 mm wide), respectively near the top of the gall and at the anterior side. The poorly individualized gall is about 2 mm high. No distinct traces of a cyclo-system are found inside the wide spherical cavity, but the position of the gall suggests that it originated from such a structure.

The only gall on *C. laevis* (the holotype of *Stylaster obliquus*) caused by *Cystomyzon* sp. is a very conspicuous blister-like outgrowth near a polychaete gall-tube on a thick branch, somewhat asymmetric and slightly oblique, constricted at the base (height 1.6 mm, maximum diameter 1.5 mm, base 1.1 mm). Though smooth in its general appearance, the wall has a somewhat porous-alveolous structure, especially in the upper part; the wall is more massive and thicker (about 0.2 mm) near the base. The three subcircular to more irregular apertures (about 0.11 mm wide) are all located on one side of the gall. The gall was aligned with the adjacent cyclo-systems, and the bottom of the gall cavity may correspond to the basal chamber of the gastropore tube of a cyclo-system (in the genus *Conopora* without a gastrostyle) but there were no distinct traces left.

**Other associates.** — In all lots of *C. laevis* which possessed copepod galls (as well as in the additional ones) the main branches are generally modified by gallery-like gall-tubes caused by a polynoid polychaete.

***Crypthelia cryptotrema* n. sp.**

Pl. IV figs. 6-12, pl. V figs. 1-11.

Species known only from two specimens (holotype and paratype) from one dredging station at New Caledonia: "Vauban" sta. HSP 27, 13 April 1978, 22°39.0'S 167°07.0'E, 170-190 m, east entrance of Havannah Channel, coll. A. Intès (ORSTOM).

Both colonies comprising two distinct flabellate parts in two parallel plans, one behind the other, the anterior (= distal) one being the larger. Holotype about 58 mm high and 35 mm wide, stem at basal fracture about 4 mm thick, base not preserved. Paratype about 33 mm high and 53 mm large, base dead and partly encrusted by pink Foraminifera. In addition, there are various small fragments from either colony, comprising altogether about 100 cyclo systems.

Both colonies have been cut into two; anterior flabellate part of each colony at the National Museum of Natural History, Smithsonian Institution, Washington (holotype coll. no. 60270, paratype 60271, fragments), posterior flabellate part of each colony at the Muséum National d'Histoire Naturelle, Paris. Small fragments of branches at the British Museum (Natural History), London (coll. no. 1981.6.9.1).

**Description.** — Coenosteum hard and compact, white, with smooth surface, all over costate. Narrow longitudinal costae alternate with very narrow depressions which contain tiny pores. Costae densely covered by minute rounded transverse ridges (a wide-spread surface structure in *Stylasterina*). Ramification dense, largely dichotomous with two diverging young branches originating from a cyclo system; resulting structures flabellate, occasionally with anastomoses, highly fragile. Youngest cyclo systems about twice as large as connecting branchlets. Older cyclo systems further away from apical zone recovered by coenosteum when the thickness of the branches is in excess of about twice the size of the cyclo systems; no functional cyclo systems are left on the thicker branches and on the base of the colony. Almost all cyclo systems oriented towards the anterior side of the colony; those turned to the posterior side very rare, occasionally inserted between "normally" oriented ones on thinner branches. Cyclo systems widely spaced on branches, distance

between systems at least once, and more generally twice, their width.

Younger and older cyclo systems of about the same size, generally about 0.8 mm in diameter (from 0.7 to 0.9 mm); apical and subapical ones subcircular, those further down on the branches slightly compressed with larger diameter transverse to the branch. Distal peripheral rim of cyclo systems on thin branches slightly curved outward. Upper end of pseudosepta slightly exsert, forming a low crenulation (side view); their upper rim flattened to slightly concave, with a narrow triangular surface, their upper axial part a vertical narrow ridge projecting into the gastropore.

Cyclo systems normally with a distinct though rather small lid which occasionally may be poorly developed or absent (more frequently broken away). Lid a rounded to triangular solid lobe originating from the peripheric zone of the cyclo system (proximal side); when fully developed extending towards the axis of the gastropore, but frequently considerably smaller and never covering the whole cyclo system. Lid straight, pointing up over the cyclo system, inclination about 45 to 60°. Base of lid continuous, massive on the inner side, corresponding in width generally to about two or three pseudosepta, exceptionally to more or only one; no distinct pseudosepta or dactylo pores in this zone. Outline of cyclo system with moderate concavity at the base of lid (outer side); concavity extending on the lid as a slight longitudinal depression. Costae of connecting branch not continued on the lid, surface irregularly reticulate with some small pores (possibly nematopores) similar to those which can be found on thin branches at the lower side of cyclo systems.

Seen from above the cyclo systems show a large gastropore opening surrounded by a circle of closely set pseudosepta alternating with narrow and rather shallow depressions. The bottom of these depressions, sloping down towards the axis, covers the dactylo pore openings which are thus hidden to the view from above. The dactylo pores communicate with the upper part of the gastropore tube by small apertures (dactylo tomes) situated between the pseudosepta just below the bottom of the peripheric depressions; these apertures can be seen in oblique view into the gastropore. Dacty-

lopores without a dactylostyle, extending as very narrow channels down into the peripheric part of the basal chamber of the gastropore, behind the conspicuous overhanging constriction.

The number of dactylopores has been found to vary between 11 and 17 in 129 cyclo systems examined in detail; 14 is by far the most common number, followed by 13 and 15.

Dactylopores per cyclo system	11	12	13	14	15	16	17
Number of cyclo systems	1	6	27	55	26	11	3

Basal chamber of gastropore rather low with concave bottom, separated from the upper part by a well-developed annular projection from the wall: this overhanging structure continuous all around, smooth and slightly concave on the upper side. Width of annular constriction only about 2/3 of width between projecting pseudosepta in the upper part. Gastropore tube rather deep (deeper than wide), slightly curved backward into the branch; annular constriction and bottom of gastropore only partially visible from above.

Ampullae (one per cyclo system, if present at all) are conspicuous globular swellings in angle formed by branch and cyclo system (proximal side, close to lid). Wall rather porous or spongy (not massive), thin and fragile, surface reticulate. Most ampullae observed are smaller than the corresponding cyclo systems, only a few are as wide or even wider. Various stages of development are present on the two colonies (holotype and paratype), from initial stages through well-developed ampullae to traces left by previous ones. Most ampullae on holotype (male ?), here considered as most representative, are characterized by a tiny hooked outgrowth on the side opposite to the lid. The outgrowth, subcircular at the base and flattened in the distal part, covers a minute pore (diameter about 0.02 mm) in the wall of the ampulla. Complete ampullae are very rare on the paratype (female ?), all without a hooked outgrowth.

On both colonies traces of former ampullae (walls broken away) can be seen as a kind of elliptical impression extending from the branch on the wall of the cyclo system. They have a more or less distinct rim which appears caused by dif-

ferential thickening of the branch within and outside the former spherical structure. On the paratype colony these traces (more frequent than the complete ampullae) are particularly evident and large, and generally comprise a pore in the wall of the cyclo system which communicates with the gastropore. Possibly the mature planulae escape from the ampullae via this aperture (for resorption of skeletal structures into a passage for the birth of stylasterine larvae see Fritchman, 1974). No such pore has been observed on the holotype colony. The differences between both colonies (hooked outgrowth, inner pore of the ampullae) may indicate a sexual dimorphism.

*Derivatio nominis.* — From κρυπτός, Greek, meaning "hidden" and from τρήμα, Greek, meaning "hole", alluding to the hidden position of the dactylopore openings.

*Remarks.* — Boschma (1957) listed 12 living species of *Cryptbelia*, one of which, *C. pachypoma* Hickson & England, 1905, he referred later on (Boschma, 1968) to the genus *Calyptopora*. Another species, originally described as *Cryptbelia* (*C. virginis* Lindström, 1877) does not belong to that genus but to *Stenobelina* and has been correctly transferred by Boschma (1957). Since Boschma's list, only one fossil species (*Cryptbelia vetusta* Wells, 1976) has been described (cf. Vervoort & Zibrowius, 1981).

From the descriptions and figures of all these species, detailed enough as far as the main characters are concerned, it is evident that *Cryptbelia cryptotrema* is a distinct new species. This has further been confirmed by comparison with the types of various species. *C. cryptotrema* was found distinguished from all previously known species by the combination of the following characters: small cyclo systems (diameter < 1 mm), dactylopore openings hidden to the view from above, gastropore tube curved into the branch — the bottom of its basal chamber visible only in part from above —, lid small, overhanging only part of the cyclo system, prominent globular ampullae (only one) seated on the branch against the wall of the cyclo system near the lid, ampullae (male ?) with a flattened outgrowth covering a tiny pore.

*Crypthelia platypoma* Hickson & England, 1905, is the only other species known from the Indo-Pacific region with similarly small cyclo systems (< 1 mm) but it has a smaller number of dactylopores (10 or less) and does not exhibit the other above-mentioned characters.

Occurrence of copepod galls. — On the two colonies (holotype and paratype, dry material) of *C. cryptotrema* altogether 13 galls have been found, exhibiting different stages of development and all referable to *Hammatimyzon zibrowii* Stock, 1981, though some were empty or broken. One male and seven females of the copepod have been obtained.

Description of copepod galls. — Fully grown galls of *Hammatimyzon zibrowii* Stock, 1981, on *C. cryptotrema* are roughly globular structures with a smooth surface and sometimes slight bumps at the top. About 1 mm large (0.9-1.2 mm) they occur on thin peripheral or terminal branches as well as on thicker more consolidated ones. The solid wall of the gall is perforated, in its upper part, by several holes (generally 3 to 5, occasionally up to 8) of irregular shape and position, either crowded together or more distant from one another. These apertures may be subcircular to elongate, straight or curved, occasionally 8-shaped, and measure from about 0.08 to 0.3 mm in length.

These cage-like galls develop from normal cyclo systems and various intermediate stages are known. First, after the settlement of an early stage of the copepod inside the cyclo system, the upper peripheral rim grows out from several points into irregular lobes extending upwards and towards the axis. These lobes approach each other and the lid and finally merge, the irregular slits between the different parts being gradually reduced into small apertures. Galls showing different stages of development have been found close to each other; the apical (youngest) cyclo system of a branch may thus be a still incomplete gall with the lobes originating from the distal-peripheral rim not yet merged with the lid, while the subapical (next older) one is completely transformed into a typical cage-like gall with only some small apertures left.

Some galls have been found broken open and more or less recovered by the sclerenchyme.

The bottom and the inside wall of the fully grown galls generally exhibit some traces of the inner structures of the cyclo system from which the cavity developed by partial dissolution; the recognizable remains may be the basal chamber (in the genus *Crypthelia* without a gastrostyle), its limiting annular constriction, and the more peripheral parts of the dactylo pore channels and their separating pseudosepta.

Other associates. — In addition to the copepod galls, two specimens of *Pedicularia*, with white shells were present on the paratype of *C. cryptotrema*, attached to the posterior side (without cyclo systems) of two branches, the rim of their shells fitting exactly the branch surface.

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## LEGENDS TO THE PLATES

## PLATE I

- Figs. 1-5, *Stylaster sanguineus* Milne Edwards & Haime, 1850. Origin: "Challenger" sta. 177, Api, New Hebrides (figs. 1-2); "Challenger" sta. 232, dubious (figs. 3-4); unknown, British Museum (Natural History) old collection (fig. 5). Copepod galls: all caused by *Hammatimyzon dimorphum*.  
Fig. 1 (× 7.0), detail of colony with gall on thick branch.  
Fig. 2 (× 18), the same gall, from another angle, between two cyclo-systems.  
Fig. 3 (× 6.6), detail of colony with gall on small branchlet.  
Fig. 4 (× 6.6), detail of another colony with gall causing anastomosis.  
Fig. 5 (× 18), gall near distant end of branchlet.
- Figs. 6-10, *Stylaster papuensis* n. sp.  
Origin and copepod galls: see pl. II.  
Figs 6 & 7 (× 120), gastrostyles.  
Fig. 8 (× 27), consolidated gall and branchlet.  
Fig. 9 (× 27), gall with porous-alveolous wall.  
Fig. 10 (× 20), rather consolidated gall on branch with coarse surface (small outgrowths), lower part of holotype.

## PLATE II

- Figs. 1-7, *Stylaster papuensis* n. sp.  
Origin: Type locality, Tagula Island, Louisiade Archipelago.  
Copepod galls: all caused by *Cystomyzon dimerum*.  
Fig. 1 (× 0.9), holotype colony with various globular galls still unopened; base partly encrusted.

Fig. 2 ( $\times 1.5$ ), lower part of holotype (cleaned) with gall and various branches transformed into adventitious roots.  
 Fig. 3 ( $\times 1.7$ ), paratype II, flabellate branch with galls.  
 Fig. 4 ( $\times 7.5$ ), detail of colony (holotype) with gall, smooth ampullae and coarse surface (small outgrowths) on thicker branch.  
 Fig. 5 ( $\times 20$ ), thin branchlet.  
 Fig. 6 ( $\times 27$ ), gall with porous-alveolous wall.  
 Fig. 7 ( $\times 27$ ), inside view of detached big gall, outer surface rather consolidated, inside alveolous.

## PLATE III

Figs. 1-7, *Stylaster papuensis* n. sp.  
 Origin and copepod galls: see pl. II.  
 Fig. 1 ( $\times 20$ ), branchlet with echinulate ampullae of paratype I.  
 Fig. 2 ( $\times 5.0$ ), branch from lower part of holotype, transformed into adventitious root.  
 Fig. 3 ( $\times 7.5$ ), detail of holotype with initial stage of gall covering cyclo-system (arrow) and well-developed gall.  
 Figs. 4 & 5 ( $\times 25$ ), smooth ampullae with pore (closed) on branchlets from holotype.  
 Fig. 6 ( $\times 5.5$ ), detail of holotype colony; cyclo-systems in front view; broken up gall with gastropore obstructed in underlying cyclo-system.  
 Fig. 7 ( $\times 5.5$ ), another detail of holotype colony; cyclo-systems in front view, some showing the gastrostyle; ampullae, broken up gall.

Figs. 8-11, *Conopora laevis* (Studer, 1878).  
 Origin: "Challenger" sta. 170, Kermadec Islands (fig. 8); NZOI sta. A 910, between New Zealand and the Chatham Islands (figs. 9-11).  
 Copepod galls: all caused by *Cecidomyzon conopora*.  
 Fig. 8 ( $\times 25$ ), normal subapical cyclo-system and side view of broken up gall, originally with four slits, from syntype of *Conopora tenuis* (synonymy).  
 Fig. 9 ( $\times 7.3$ ), branch with typical gall (four slits).  
 Fig. 10 ( $\times 7.3$ ), side view of the same gall.  
 Fig. 11 ( $\times 25$ ), gall with only three slits.

## PLATE IV

Figs. 1-5, *Conopora laevis* (Studer, 1878).  
 Origin: "Gazelle" sta. 58/42, Three Kings Islands, New Zealand (figs. 1-3); "Terra Nova" sta. 90, Three Kings Islands, New Zealand (figs. 4-5).  
 Fig. 1 ( $\times 1.6$ ), holotype of *Stylaster obliquus* (synonymy) with polychaete gall-tubes and two copepod galls (arrows), the gall on the left caused by *Cystomyzon* sp., the gall on the right caused by *Oedomyzon tripodum*.  
 Fig. 2 ( $\times 21$ ), detail of the same colony; gall of *Cystomyzon* sp. from the other side, between two cyclo-systems.

Fig. 3 ( $\times 7.5$ ), detail of the same colony; gall of *Oedomyzon tripodum*: further to the left openings of polychaete gall-tube.  
 Fig. 4 ( $\times 6.5$ ), branch with gall due to *Oedomyzon tripodum* (general swelling with four pores) and with polychaete gall-tube at lower end.  
 Fig. 5 ( $\times 7.4$ ), the same branch; transverse section of the copepod gall showing trace of cyclo-system.

Figs. 6-12, *Crypthelia cryptotrema* n. sp.  
 Origin and copepod galls: see pl. V.  
 Fig. 6 ( $\times 27$ ), closed perforate gall at ramification.  
 Fig. 7 ( $\times 22$ ), aged gall broken up between two normal cyclo-systems.  
 Fig. 8 ( $\times 22$ ), branchlet springing off from thicker branch, with three cyclo-systems: the lower one normal, the distal one preparing to close as a gall, the intermediate a well-developed gall here broken up, showing traces of the gastropore and dactylo-pores.  
 Fig. 9 ( $\times 22$ ), double gall on the side of a thick branch: the lower part a closed perforate gall, the upper part a cyclo-system preparing to close as a gall.  
 Fig. 10 ( $\times 22$ ), a closed perforate gall between normal cyclo-systems.  
 Fig. 11 ( $\times 27$ ), distal cyclo-system of a branchlet transformed into a closed perforate gall, side view.  
 Fig. 12 ( $\times 27$ ), the same gall, view from above.

## PLATE V

Figs. 1-11, *Crypthelia cryptotrema* n. sp.  
 Origin: Type locality, New Caledonia.  
 Copepod galls: all caused by *Hammatimyzon zibrowii*.  
 Fig. 1 ( $\times 1.6$ ), holotype colony.  
 Fig. 2 ( $\times 1.9$ ), paratype colony.  
 Fig. 3 ( $\times 22$ ), branch from holotype showing ampullae with hooked outgrowth.  
 Fig. 4 ( $\times 22$ ), branchlet with normal cyclo-system and cyclo-system preparing to close as a gall.  
 Fig. 5 ( $\times 22$ ), thicker branch from paratype, with an almost closed perforate gall and trace of a decayed former ampulla (arrow).  
 Fig. 6 ( $\times 22$ ), detail from paratype with trace of a decayed former ampulla (arrow).  
 Fig. 7 ( $\times 22$ ), branch from paratype with trace of a decayed former ampulla (arrow).  
 Fig. 8 ( $\times 22$ ), detail of paratype showing large smooth ampulla.  
 Fig. 9 ( $\times 22$ ), anastomosing branchlets with a cyclo-system preparing to close as a gall.  
 Fig. 10 ( $\times 22$ ), branchlet from holotype showing dactylo-pore openings in oblique view.  
 Fig. 11 ( $\times 22$ ), the same branchlet from the other side.

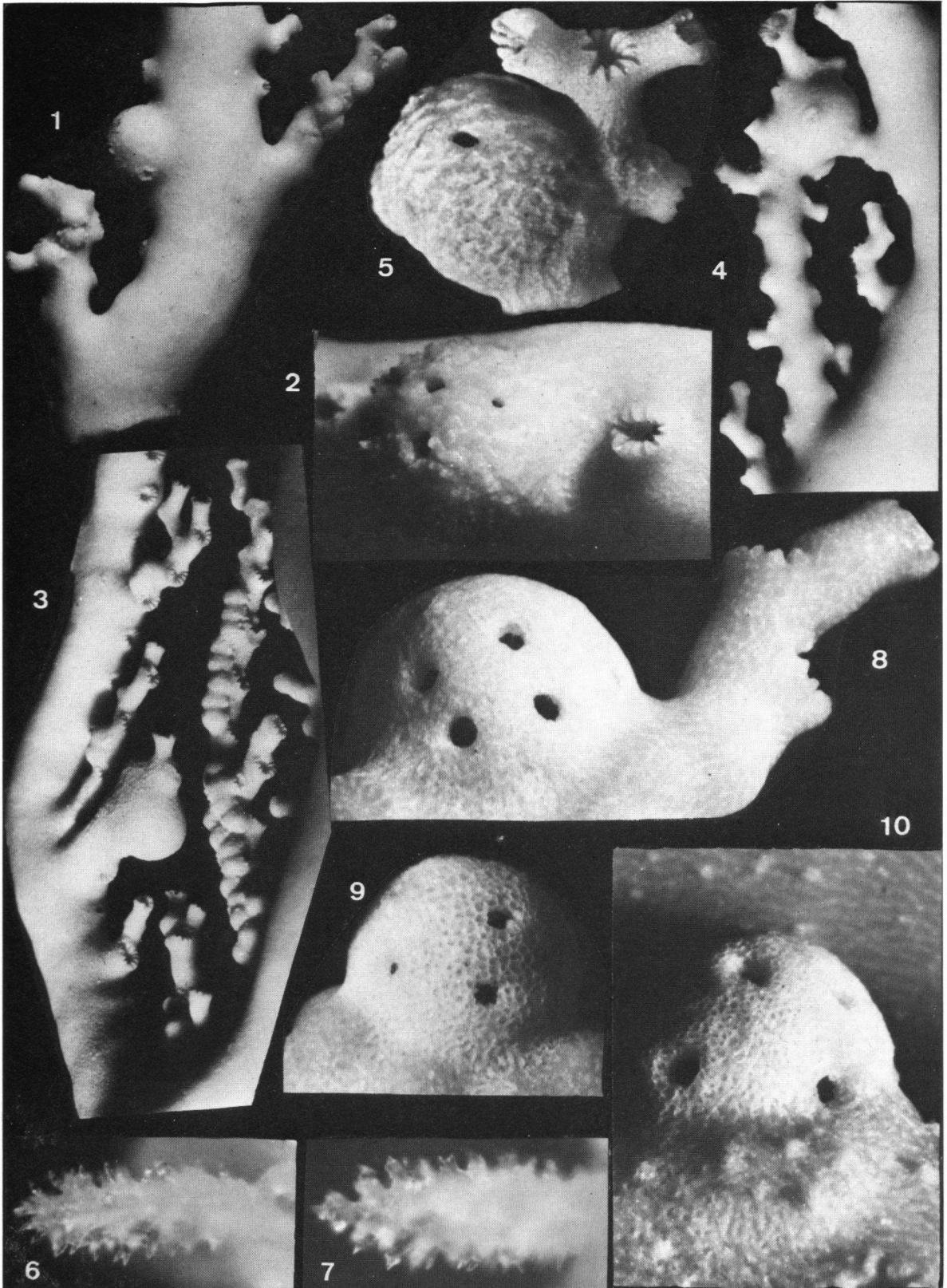


PLATE I

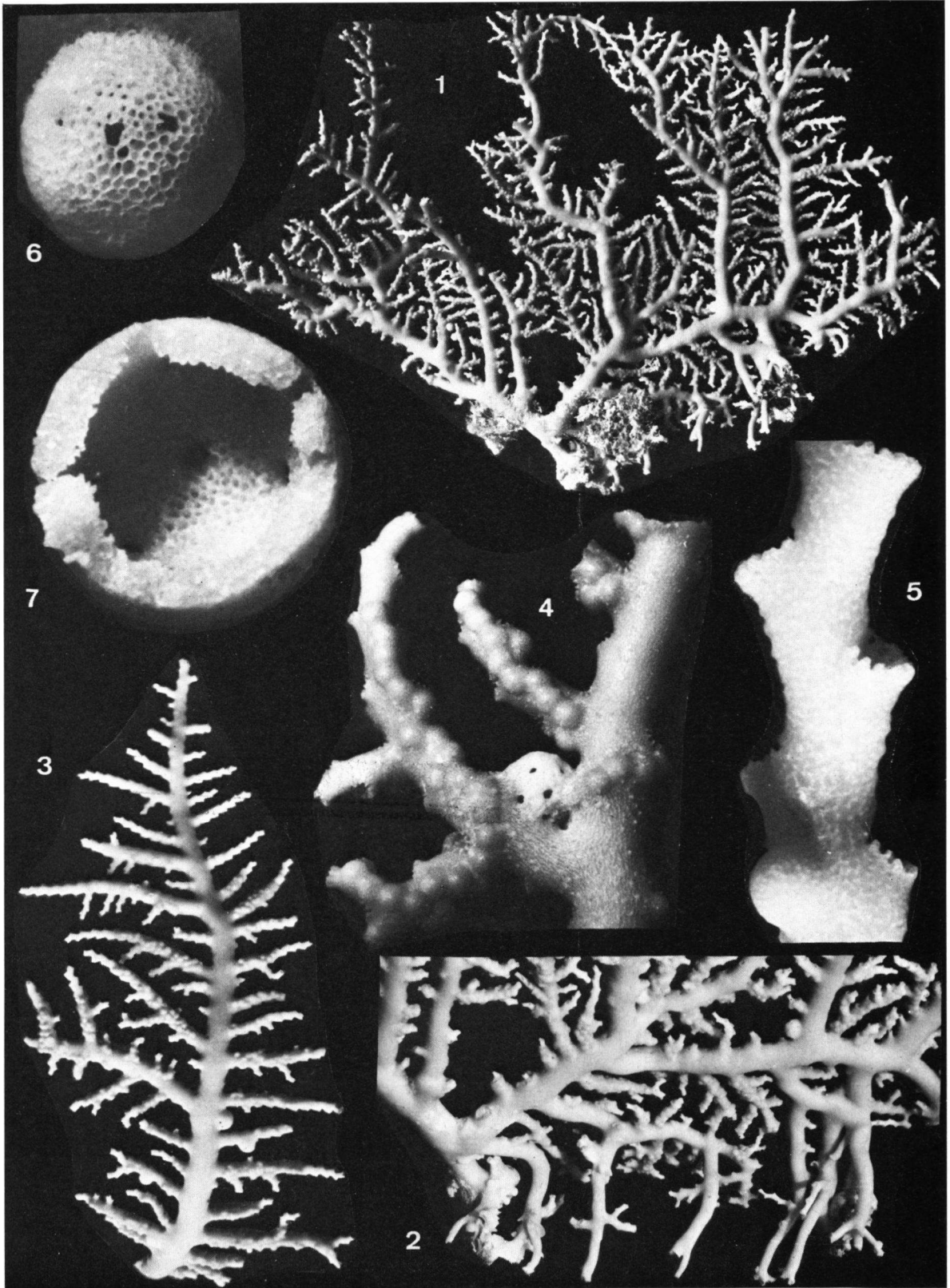


PLATE II



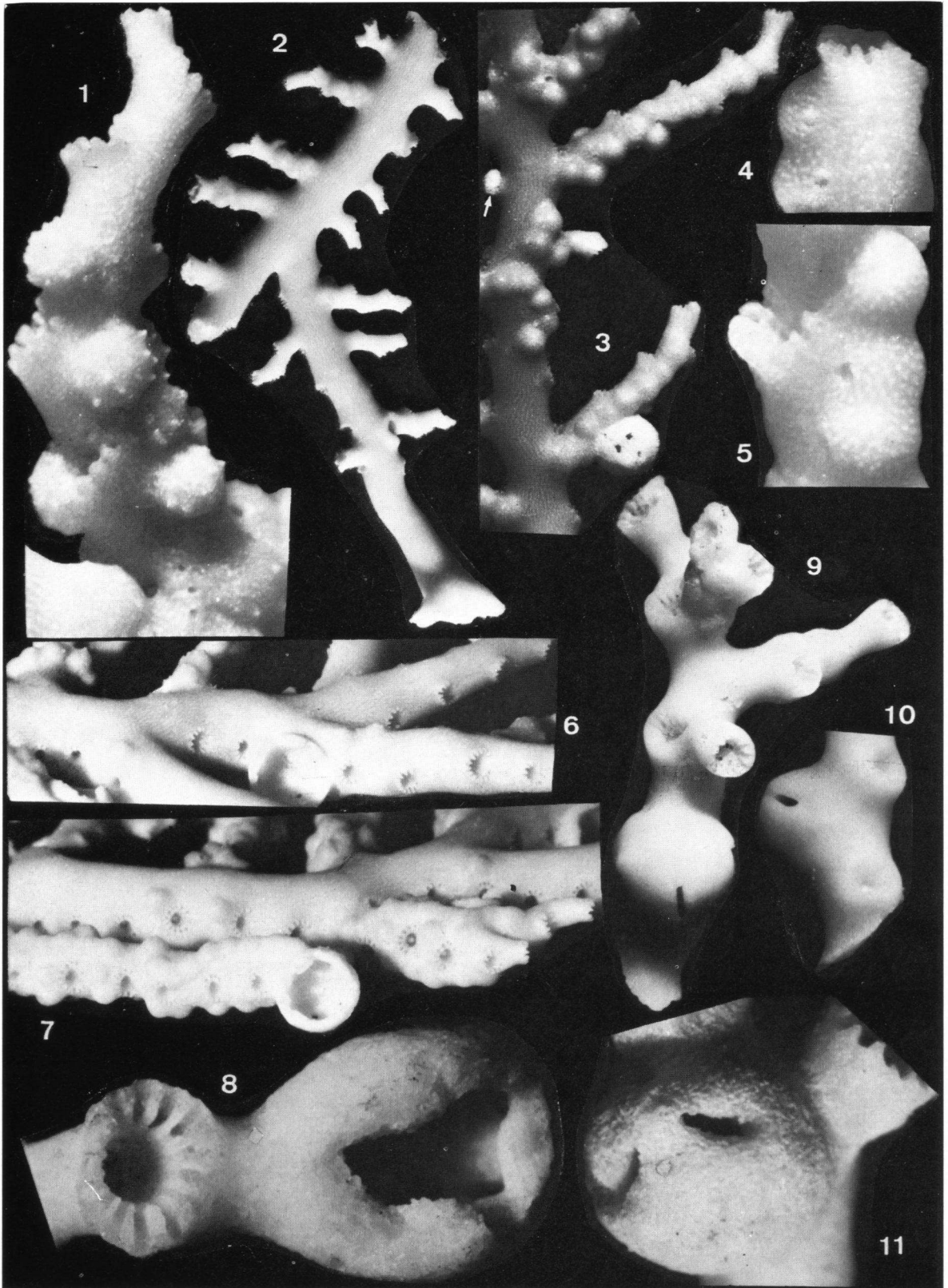


PLATE III

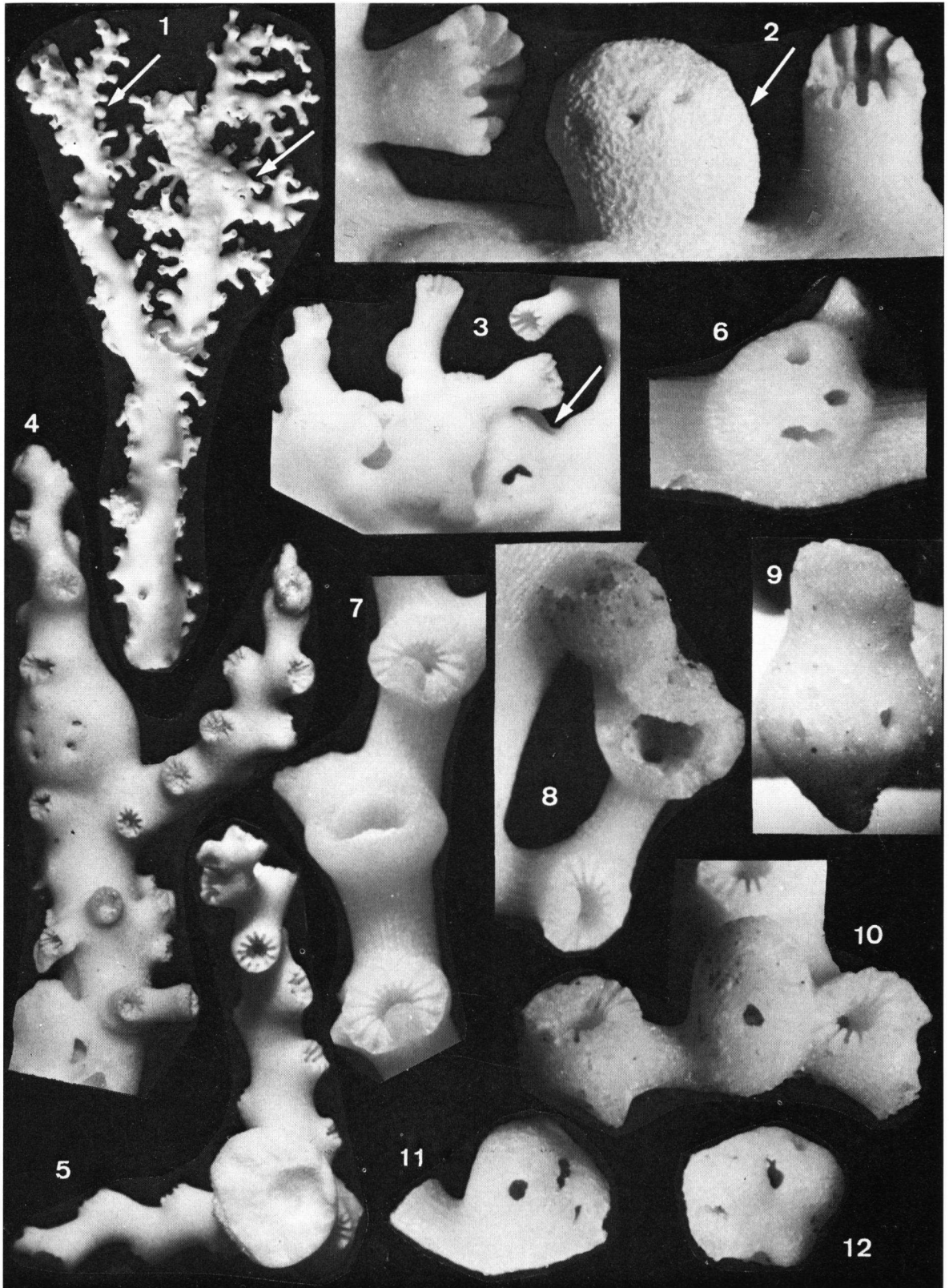


PLATE IV

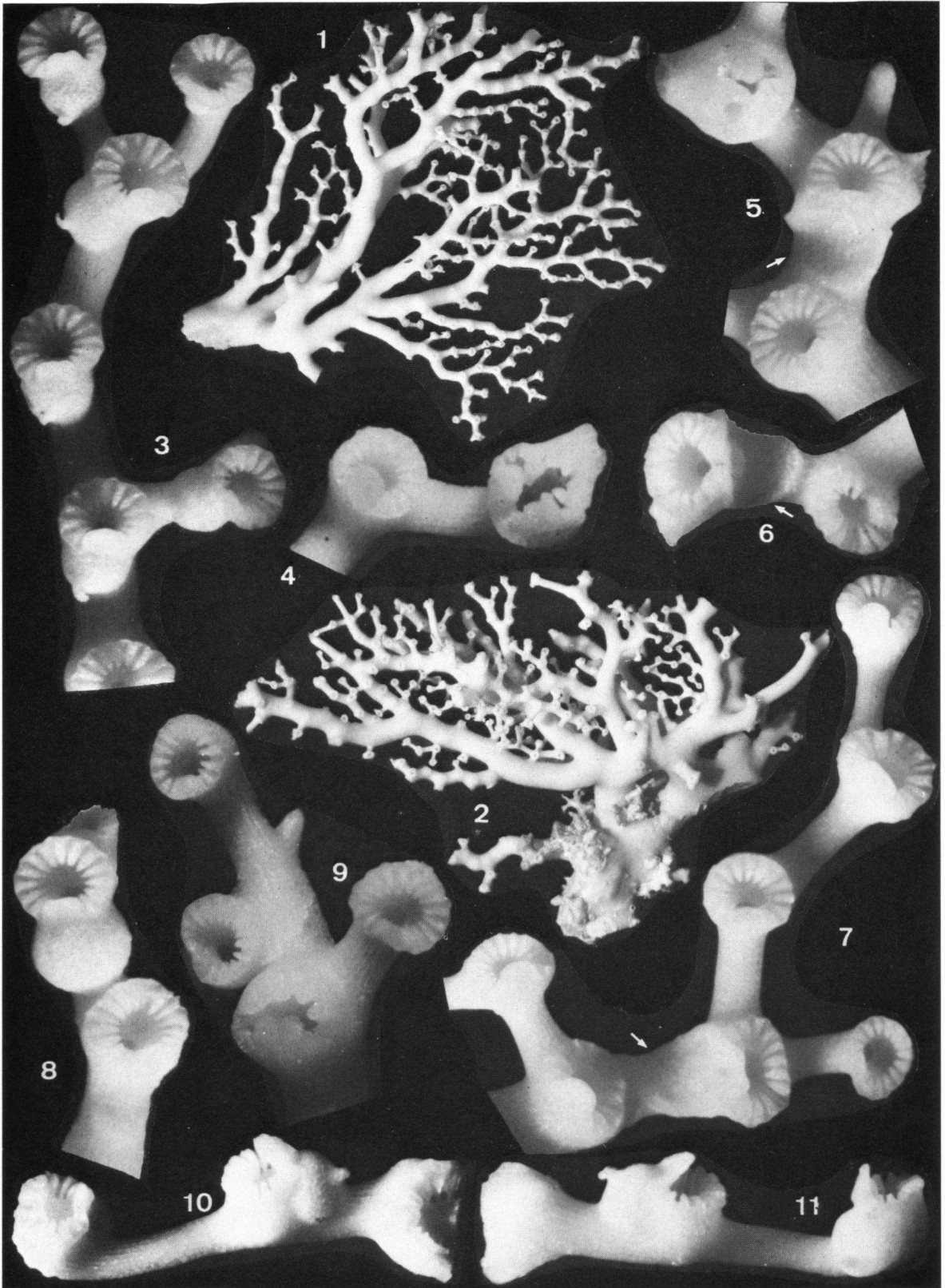


PLATE V