

CORALS FROM AN ELEVATED MARL OF TALAUD (EAST INDIES)

by

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With 7 textfigures

As a member of the Expedition on board H.M. „Willebrord Snellius” Dr. Ph. H. Kuenen had the opportunity to collect a suite of corals from a marine marl, deposited in an old valley now elevated above sea level, near Mahammanale, on the island Talaud, to the North of Celebes. He kindly entrusted to me the identification of the collection, which is now in the National Museum of Geology at Leiden.

The following list shows the 15 species, which could be identified, and their stratigraphical distribution.

1. *Flabellum rubrum* (Q. et G.), Miocene, Pliocene, Pleistocene, Recent.
2. *Flabellum pavoninum* Less. var. *paripavoninum* (Alcock), Recent.
3. *Acanthocyathus grayi* E.H., Miocene?, Pliocene, Pleistocene, Recent.
4. *Caryophyllia* spec. (probably the recent species *C. clavus* Sacchi).
5. *Heterocyathus aequicostatus* E.H., Miocene, Pliocene, Pleistocene, Recent.
6. *Seriatopora hystrix* (Dana), Pliocene, Pleistocene, Recent.
7. *Antillophyllia constricta* (Brüggem.), Miocene?, Pliocene, Pleistocene, Recent.
8. *Fungia patelliformis* Boschma, Neogene, Recent.
9. *Fungia cyclolites* Lam., Miocene?, Pliocene, Pleistocene, Recent.
10. *Fungia concinna* Verrill, Plio-Pleistocene, Recent.
11. *Fungia* spec. (probably a recent species).
12. *Balanophyllia imperialis* Sav. Kent, Recent.
13. *Balanophyllia parallela* (Semper), Recent.
14. *Balanophyllia redivivus* Moseley, Recent.
15. *Goniopora stokesi* E.H., Pliocene, Pleistocene, Recent.

The corals are excellently preserved (only nos. 4 and 11 are damaged and for that reason the species is not identified) and they all belong to still living species.

They might be subrecent, Holocene possibly Pleistocene but certainly not older.

Most of the species are usually found in rather deep water, *Fungia concinna* and *Seriatopora hystrix* being the only species that are common in shallow water on coral reefs. It may be, however, that the special conditions

of environment (light, sedimentation) in the now elevated valley of Talaud were favourable to the corals that were found, although the depth was only moderate.

Below follows a systematic description of the collection.

Class ANTHOZOA
Subclass HEXACORALLIA Haeckel
Order MADREPORARIA Verrill
MADREPORARIA IMPERFORATA
Family FLABELLIDAE Bourne

Flabellum Lesson

Flabellum rubrum (Quoy et Gaimard)

1872. *Flabellum irregulare* Semper, p. 242, Taf. 16 figs. 7—17.
1902. *Flabellum rubrum* (Q. et G.), Gardiner, p. 125 seq. (synonymy), plate 4 figs. 22—34.
1913. *Flabellum rubrum* (Q. et G.), Felix, p. 363 (synonymy).
1924. *Flabellum irregulare* Semper, Umbgrove, p. 5, plate 1 fig. 11.
1927. *Flabellum rubrum* (Q. et G.), Faustino, p. 50, plate 3 figs. 1—9 (synonymy).
1931. *Flabellum irregulare* Semper, Gerth, p. 131 (synonymy).

Flabellum irregulare Semper has been described from Miocene, Pliocene and Pleistocene strata of the East Indies (vide Gerth, op. cit.). It belongs, however, in the synonymy of *Fl. rubrum*.

Eight specimens from Talaud are well preserved and could be exactly identified on the basis of Gardiner's detailed description (see also Faustino, op. cit.). Three specimens have wings near the base, one specimen shows two root-like processes. Small Ostreae and Serpulae are attached to the corals.

Flabellum pavoninum Lesson var. **paripavoninum** (Alcock)

For synonyms see Faustino 1927, p. 46.

One specimen. Identification is based on the original description of Alcock (1898).

Family CARYOPHYLLIDAE Verrill

Acanthocyathus Milne Edwards et Haime

Acanthocyathus grayi Milne Edwards et Haime

1848. *Acanthocyathus grayi* M. Edwards et Haime, p. 293, plate 9 figs. 2, 2a.

With six specimens from Talaud I studied the species at the same time from twelve Upper Neogene localities of Java and I compared these fossils

with the types of Felix's *Trochocyathus laterocristatus* E. H. and *Acanthocyathus malayicus* Gerth, which have to be placed among the synonymy of the present species. I will discuss the Talaud specimens in detail in a paper on the Javanese fossils, to be published in the near future.

From that paper it will be clear that *Acanthocyathus grayi* has been found in Upper Neogene of Borneo, Java (Ngembak and Ngampel), Pliocene of Timor, Plio-Pleistocene of Ceram and Recent.

Carophyllia Lamarck

Carophyllia spec. indet.

The inner side of the calyx is badly damaged. Thus, identification is impossible. The species seems, however, probably the recent *C. clavus* Sacchi.

Heterocyathus Milne Edwards et Haime

Heterocyathus aequicostatus Milne Edwards et Haime

1904. *Heterocyathus aequicostatus* E.H., Gardiner, p. 105, plate 3 figs. 1—43 (with synonymy).

I studied about two hundred specimens from Upper Neogene strata of Java. A detailed discussion will be published in another paper, describing those Javanese collections. Here I will only say that *Heterocyathus elberti* Felix, *H. rembangensis* Gerth, *H. sandalinus* Gerth and *H. rousseaui* Gerth have to be placed in the synonymy of *H. aequicostatus* E. H. as I will point out in that paper, the manuscript of which is ready for the press.

According to that synonymy the recent well known species *H. aequicostatus* occurs also in Neogene strata of Nias, Miocene of Java, Pliocene of Ceram, Obi, Java (Sondé) and Sumatra (Atjeh); Pleistocene of Borneo.

Family SERIATOPORIDAE Milne Edwards et Haime

Seriatopora Lamarck

Seriatopora hystrix (Dana)

For synonyms see Gerth 1931, p. 142.

A few well preserved branchlets of this well known recent species which was mentioned also from Pliocene strata of Java by Felix (1913) and from Plio-Pleistocene of Ceram by Umbgrove (1924).

Family TRACHYPHYLLIDAE (Verrill)

Antillophyllia Vaughan 1932

In the year 1931 Yabe and Sugiyama discussed the recent and fossil corals which at that time were included in the genus *Antillia* Duncan 1864. A year later Vaughan corrected the confusion and errors in the taxonomy of *Antillia* and he defined the genus *Antillophyllia*, as the name *Antillia* was invalid. Moreover he pointed out, that *Antillia japonica* and *A. no-maensis*, described by Yabe and Sugiyama, are mussoid corals and do not belong to the genus *Antillophyllia* and he added: they "look as if they probably represent the young stages of one or more species of mussoid corals which are compound in the adult stages". For these corals Yabe and Sugiyama (Revised List of Reef Corals from the Japanese Seas, Journ. Geol. Soc. Japan, vol. 42, p. 382, 1935) proposed the new generic name *Protolobophyllia* (see also Yabe c.s. 1936, p. 45).

Vaughan (1932, p. 509) made some comments on a few Indo-Pacific living species which, according to his opinion, "obviously belong to *Antillophyllia*", e.g., *A. constricta* (Brügg.). On the other hand Matthai (1928, p. 96) was of opinion that "the recent Indo-Pacific species of *Antillia* are very probably only early stages in the growth of *Trachyphyllia Geoffroyi*."

I am convinced, that the solitary "*Antillia*-type" occurs as the adult growth stage of some corals, though Matthai may be correct in pointing out that early stages in the growth-type of *Trachyphyllia* may show a striking resemblance to "*Antillia*".

There is, however, no doubt, that a solitary non-maeandroid coral with a calicular diameter of 80 mm as described by me from Ceram belongs to a different genus than *Trachyphyllia*. It is also remarkable in the fossil material studied by me (about 50 specimens) that notwithstanding the occurrence of different growth-stages from very youthful up to apparently adult ones, no *Trachyphyllia*-type is present.

Thus I consider *Trachyphyllia* and *Antillia* as two allied but separate genera, though the generic identification of the early growth-stages of the coralla may be very difficult or even impossible.

Therefore, as I am doubtful whether *Turbinolia Geoffroyi* Audouin is a young specimen of *Trachyphyllia* (as supposed by Matthai) or an "*Antillia*", I prefer the application of Brüggemann's specific name "*constricta*".

In consequence of these consideration I refer the non-maeandroid Indo-Pacific Trachyphyllidae to *Antillophyllia* Vaughan. A study of the polyps can only settle the question whether the Indo-Pacific and West-Indian corals referred to *Antillophyllia* really belong to one and the same genus.

A study of more than fifty specimens of *Antillophyllia* from the Indo-Pacific region, including the types of Gerth's species, leads me to summarize my results as follows:

1. *Antillophyllia constricta* (Brüggemann). As will be explained in extenso below, when describing my material, among the synonyms of this species should be placed: *A. constricta* var. *maldivensis* Gardiner, *A. constricta* var. *küensis* Yabe et Sugiyama, *A. orientalis* Gerth, *A. turbinata* Gerth and *A. flabelliformis* Yabe et Sugiyama. Perhaps also *A. duncani* Yabe et Sugiyama (= *A. lonsdaleia* Duncan, pro parte) belongs to the present species and *A. geoffroyi* (Audouin).

2. *Antillophyllia grandiflora* (Gerth). I feel doubtful whether this is a valid species, as it is not separated from *A. constricta* by well defined characteristics. *Antillia* cf. *ponderosa* as described by me from Ceram in 1924 probably belongs in its synonymy too. I studied a suite of fossils of this type from Timor collected by Dr. Wichmann near Koepang, Timor, now in the Geological Institute of the Utrecht University.

3. *Antillophyllia cristata* (Gerth) may be regarded a well defined species. The specimen figured by Gerth is in Basle, Switzerland; a good syntype is in the Geological Museum at Leiden. Its principal characteristics are as follows: (1) some of the septa and costae are very strongly developed, (2) distant thorns on the costae, (3) a linear arrangement of small crowded granulae on the septa.

***Antillophyllia constricta* (Brüggemann) (figs. 1—7).**

- ? 1826. *Turbinolia geoffroyi* Audouin, Descr. Egypt (Hist. Nat. 1) p. 233, Pl. 4 fig. 1.
 ? 1876. *Antillia lonsdaleia* Duncan, Proc. Zool. Soc. London 1876 II, p. 438, Pl. 3 fig. 4.
 1877. *Antillia constricta* Brüggemann, p. 309.
 1906. *Antillia constricta* Brüggemann var. *maldivensis* Gardiner, p. 758, Pl. LIX figs. 4, 5.
 1921. *Antillia orientalis* Gerth, Java, p. 408, Taf. LVI fig. 2.
 1921. *Antillia infundibiliformis* Gerth, Java, p. 408, Taf. LV fig. 10.
 1923. *Antillia constricta* Brügg., Gerth, Borneo, p. 66, Taf. IV figs. 2, 3.
 1923. *Antillia orientalis* Gerth, Borneo, p. 67, Taf. IV, fig. 1.
 1925. *Antillia turbinata* Gerth, Borneo, Nias, p. 43, Taf. 7 figs. 2, 2a, 2b.
 1926. *Antillia turbinata* Gerth, Umbgrove, Sumatra, p. 32, Pl. I fig. 4.
 1927. *Antillia constricta* Brügg., Faustino, p. 152, Pl. 37 figs. 2, 3.
 1929. *Antillia constricta* Brügg., Umbgrove, Borneo, p. 38.
 1931. *Antillia constricta* Brügg., var. *kiensis*, Yabe et Sugiyama, p. 125, Pl. 38 figs. 6, 7.
 1931. *Antillia flabelliformis* Yabe et Sugiyama, p. 127, Pl. 38 figs. 8—10.
 1932. *Antillophyllia constricta* (Brüggemann), Vaughan, p. 509.
 1936. *Antillophyllia constricta küensis*, Yabe et Sugiyama, p. 21.
 1936. *Antillophyllia flabelliformis*, Yabe et Sugiyama, p. 21.

I studied material from:

- (1) Talaud islands, Mahammanale, Snellius Expedition Nr. 718 (coll. Dr. Ph. H. Kuenen), 2 specimens.
- (2) Java, coll. Dr. J. Cosijn, nos. 37 and 49, 10 specimens.
- (3) Java, coll. Geol. Survey Bl. II, A. 80, Tji Sande limestones, 1 specimen.
- (4) Java, coll. Geol. Survey Bl. 93B, nos. 252, 260, 6 specimens.
- (5) Java, coll. Geol. Survey Bl. 110A, 89, 128, 3 specimens.
- (6) Java, coll. Geol. Survey Bl. 110B, 176, 2 specimens.
- (7) Java, coll. Geol. Survey Bl. 116A, 219, 1 specimen.

Some authors were of opinion that the shape of the calice might be considered of value in distinguishing *Antillophyllia* species. Thus Gerth (1923) wrote: "In Bezug auf die Gestalt des Polypars lassen sie sich in zwei Gruppen trennen. Die einen besitzen ein schüsselformiges Polypar mit gerundeter Basis, die anderen dagegen sind nach unten trichterförmig verjüngt und der stark querverlängerte und ausgebuchtete Kelch erinnert an *Trachyphyllia*." Yabe and Sugiyama (1931, p. 125) considered a specimen of *A. constricta* a "varietas" and gave it a special name because it "is conical in the basal one third of the height of the corallum and cylindrical in the upper part and thus is quite different in general shape from the others; this specimen being otherwise indistinguishable from the typical *constricta*....."

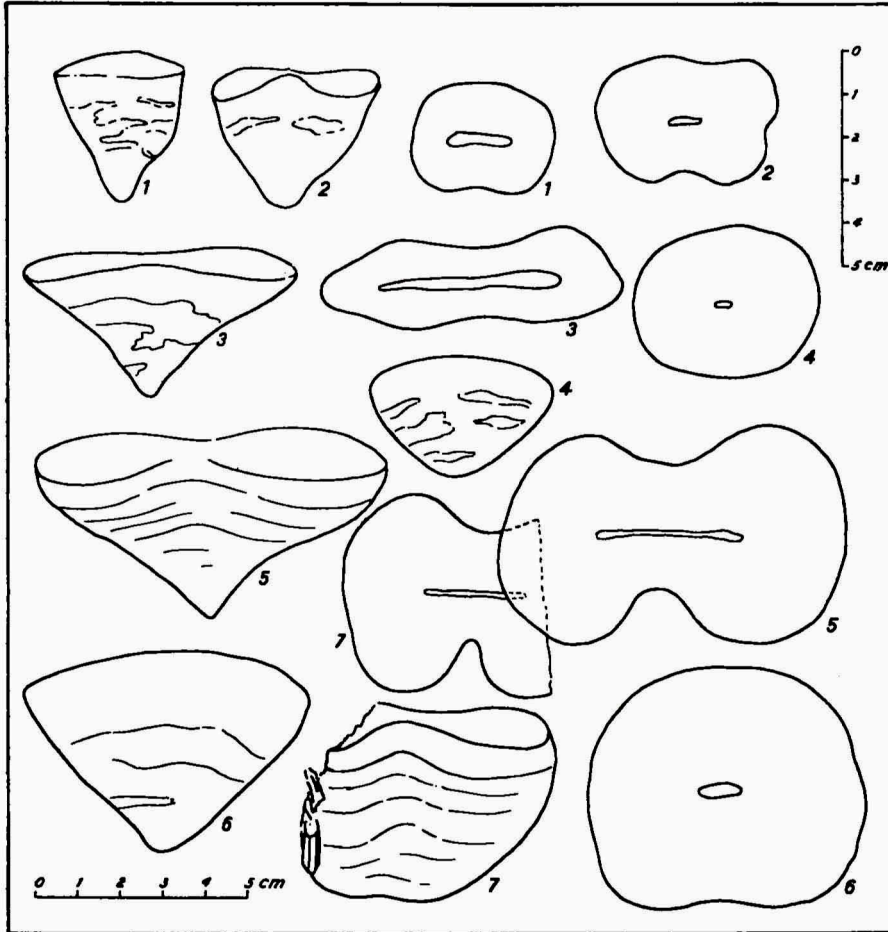
From my material which is not large but consists anyhow of 24 specimens of *A. constricta*, it is obvious that some characteristics are variable in a high degree; viz. (a) shape and diameter of the calice, (b) shape of the calice "en profil", (c) size and shape of the columella, (d) development and height of epitheca, as is shown in figs. 1 to fig. 7. Although the extremes may differ widely, they are connected by a transitional series of forms, apparently belonging to one and the same species.

One of the specimens from Talaud (diam. 75 to 50 mm) is constricted, the other one is a conical calice with an elliptical diameter (diam. 60 to 65 mm). Transitional forms occur also in the Javanese specimens, agreeing with the type described as *Antillia infundibuliformis* by Gerth from the Pliocene strata of Sondé (Java). The specimens from locality 37 (coll. Cosijn) are much damaged by boring Lamellibranchs (? *Lithodomus*). In these calices the columella is often poorly developed or even rudimentary. The same was seen in a specimen from the Tjisande limestone.

Among Gerth's types of *A. orientalis* a turbinate specimen is present together with a calice showing a semicircular profil. According to Gerth's opinion the species is different from *A. constricta* on account of its strongly dentated septa. This characteristic, however, cannot stand the test of a comparison with some recent specimens of *A. constricta* and my fossil material from Java. In his paper on the fossil corals from Borneo (1923)

Gerth mentions *A. orientalis* from G. Batoe; the specimen is, however, labelled "Kari Orang, coll. Rutten".

According to my opinion the points of difference with *A. constricta*, which induced Gerth to constitute his *Antillia turbinata* (viz., "Form des



Figs. 1—7. *Antillophyllia constricta* (Brügg.). Fig. 1 from Java, coll. Dr. J. Cosijn no. 49; figs. 2, 3, 5 and 7 from Java, coll. Geolog. Survey Bl. 93B, 260; fig. 4, ibidem, Bl. 116 A 219; fig. 6 from Talaud, coll. Dr. Ph. H. Kuenen.

Polypars, entfernter stehenden Septen und die verschieden starke Entwicklung derselben") do not hold as specific characteristics. Moreover, a careful study of his types from Nias convinced me that part of the supposed differences are due to strong damage and a rather bad state of preservation of the specimens.

A form resembling *A. constricta* var. *kiensis* Y. et S. occurs among the Javanese fossils. There are no terms to maintain a special variety name as it is based only on the growth-type, which is a widely varying morphological characteristic. The same holds good for *A. flabelliformis* Y. et S.

Duncan's *A. lonsdaleia* from Japan was renamed *A. duncani* by Yabe and Sugiyama. From Duncan's description and figures it seems to me not improbable that here again we are dealing with the same species, *A. constricta*.

In his original description of *A. constricta*, Brüggemann mentions that it "differs from *A. geoffroyi* and *A. lonsdalei* in the shape of its calicle, the regular development of the septal cycles and the strong paliform lobes; from the former besides, in its strictly symmetrical form in its narrow costae and in the structure of its columella, the latter being in *A. geoffroyi* truly spongy and consisting of irregularly branched and coalescing lamellar trabeculae". When describing *A. constricta* he mentions, however, a specimen with "paliform lobes less pronounced" and a young specimen "without paliform lobes", while he wrote in his discussion of *A. geoffroyi*: "There are indications of paliform lobes" and moreover: "The coral is exceedingly variable. The calicle is rounded in the youngest specimens, afterwards it becomes either broad explanate (and then the coral is always very short) or compressed, even linear, much more so than in the species of *Flabellum*." From these quotations it seems to me very probable that *A. geoffroyi* and *A. constricta* belong to one and the same variable species, which should be named *Antillophyllia geoffroyi* (Audouin).

In some of the specimens examined by me an endotheca is poorly developed and may be seen only in the deeper part of the calice, in other specimens a strongly developed endotheca is present.

The number of septa varies from five up to seven cycles; primary, secondary and tertiary ones subequal. Septa finely granulate. Granulae in linear arrangement, especially along the inner edge of the septa in oblique rows.

Costae subequal, prominent and crowded with acute and small granular teeth, in alternating or double arrangement. Exceptionally only a single series of small acute basements may be noticed, about 25 in one centimeter.

Distribution of *A. constricta* and of its synonyms as discussed above (apart from the localities of the present material):

Recent: Indo-Pacific; Pleistocene; Borneo, Talaud.

Upper-Neogene: Java: Sondé (Pliocene), Ngembak (Upper Miocene?);

Nias (Pliocene); Sumatra (Pliocene); Borneo: S. Menoeban (? Pliocene), Kari Orang (? Miocene).

In addition I am giving here a description of *A. grandiflora* Gerth.

Antillophyllia cf. **grandiflora** Gerth

1911. *Antillia grandiflora* Gerth, Java, p. 409, Pl. 55 figs. 8, 9.

1924. *Antillia* cf. *ponderosa* Umbgrove, Ceram, p. 7, Pl. 2 figs. 3, 4.

Most of the fossils collected by Dr. A. Wichmann near Koepang (Timor), between Tabenoë and Bakanassi (coll. Utrecht 1890, no. 715), are not in a good state of preservation. They resemble *Antillia grandiflora* as described by Gerth from the Pliocene of Java. The specimens from Timor are, however, smaller, the diameter of the largest calicle being 40 to 45 mm.

The upper part of both the type specimens in the Leiden Museum is broken off; so nothing is known about the original height of the corallum, the dentation of the septa, etc. The septa are in six cycles, even more in the larger specimen. Septa finely granulate and in linear arrangement (visible in the smaller specimen only). The structure of the larger specimen has suffered from diagenetic processes. According to my opinion there are no well defined differences from *A. constricta* (Brüggem.). I therefore feel doubtful whether *A. grandiflora* is a valid species. The coral described by me from the Plio-Pleistocene of Ceram is different only by its more conical shape.

MADREPORARIA FUNGIDA

Family FUNGIIDAE Dana

Fungia Lamarck

Fungia patelliformis Boschma

1923. *Fungia patelliformis* Boschma, p. 8, plate 7 figs. 9, 11, 13—16a.

1925. *Fungia patelliformis* Boschma, p. 192, plate 5 figs. 12—14 and 21.

Only one fragment of a well preserved specimen showing all characteristics of this species.

Distribution. Recent: East Indies, Indo Pacific; Neogene: Nias (Gerth 1925).

Fungia cyclolites (Lamarck)

For synonyms see Döderlein 1902, and Gerth 1931, p. 139.

Distribution: Miocene, Borneo; Pliocene, Java, Sumatra; Plio-Pleistocene, Timor, Pliocene Borneo; Recent, Indo-Pacific.

Fungia concinna Verrill

For synonyms see Thiel 1932.

The lower surface of a flat disc is well preserved and allows a determination of the species. The septa are badly damaged. As far as can be seen they were rather coarsely dentate as in typical *F. concinna*. Serpulae and many small brachiopods are attached on the underside of this specimen.

Distribution: Plio-Plistocene, Ceram. Recent, Indo-Pacific.

Fungia spec. indet.

A few fragments of a disc having a slightly convex lower surface. The costae corresponding to the major thickened septa are very prominent and bear coarse and irregular granulated spines.

Between each pair of prominent costae three very low costae occur, distinct and bearing very fine granules near the periphery, rather indistinct in the central part of the disc. The centre is not preserved; so it cannot be established whether a scar of attachment occurred or not and a conclusive identification is not possible. It shows points of resemblance to *F. acutidens* Studer but the dental ridges on the septa are not so strongly developed in the Talaud specimen. Perhaps we have to do with *F. klunzingeri* Döderlein, although the thinner costae are more conspicuous than in the specimen figured by Döderlein (1902, Pl. XV fig. 13). Serpulae, Bryozoa and Brachiopoda have grown on the lower surface of the specimen.

MADREPORARIA PERFORATA

Family EUPSAMMIDAE Milne Edwards et Haime

Balanophyllia S. Wood**Balanophyllia parallela** (Semper)

For synonyms see Van der Horst 1922, p. 62, and Faustino, 1927, p. 225.

Most of the nine specimens agree with Semper's *Rhodopsammia carinata*, a few resemble his *Rhodopsammia amoena*.

Balanophyllia imperialis Saville Kent

For synonyms see Van der Horst 1922, p. 60.

Diameter of calyx 17 by 14 mm. Septa of first and second cycle equal. As to further details the description of Van der Horst's is applicable to the present specimen, which strongly resembles his plate 8 fig. 25.

Balanophyllia redivivus Moseley

1881. *Balanophyllia redivivus* Moseley, p. 193, plate 15 figs. 10, 11.

Two specimens showing an elongate conical shape (40, respectively 45 mm long). Calice slightly elliptical; diameter 10 to 12 mm, and 8 to 10 mm. One of the specimens is slightly curved. Six equally strongly developed septa reach the columella. Columella spongioid, elongated according to the longer axis of the calice (4 to 2 mm and 5 to 2 mm). Second cycle of septa slightly thinner and shorter. Septa of third and fourth cycle much thinner, fusing deep in the calice and there also reaching the columella. Calicular wall very porous, especially its upper part. Costae subequal, beset with small acute spines. In this respect the specimens differ from Moseley's type as he writes: "secondary costae much finer", although it cannot be seen in his figure 10. The rest of Moseley's description applies, however, entirely to the specimens from Talaud. Thus, I have no doubt that it is the same species. The specimen described by Moseley was derived from a depth of 129 fathoms near the Kei-islands.

Family PORITIDAE

Goniopora Quoy et Gaimard**Goniopora stokesi** M. Edwards et Haime

1907. *Goniopora Stokesi* E.H., Bedot p. 264, plate 43 figs. 240, 241, 243—245; plate 44 figs. 246, 247.

1924. *Goniopora Stokesi* E.H., Umbgrove, Ceram, p. 18 (with synonyms).

1927. *Goniopora Stokesi* E.H., Faustino, p. 287, plate 96 figs. 2, 3.

Two excellent hemispherical growths, the one grown on top of the other. The larger one has a diameter of 110 mm and is 70 mm high. A description of this well known species seems unnecessary.

Distribution: Plio-Pleistocene of Ceram; Recent: Indo-Pacific.

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