Fossil Corals from Eniwetok Atoll

By JOHN W. WELLS

BIKINI AND NEARBY ATOLLS, MARSHALL ISLANDS

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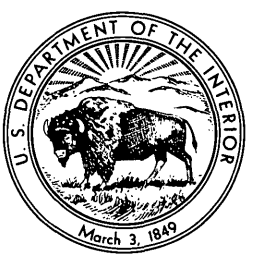
A description of corals from drill holes on Eniwetok Atoll



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ABSTRACT

Fossil corals were recovered from the cores and cuttings of the drill holes made on Eniwetok Atoll, Marshall Islands, in 1951–52. The corals occur more or less continuously from near the surface to a depth of 1,260 feet, in small numbers between 1,720 and 1,980 feet, in some abundance between 2,720 and 3,110 feet, and again in a core from 4,078 to 4,100 feet. Above 620 feet few corals could be identified beyond the genus, and the age range is probably from Pliocene to Recent. Between 620 and 1,260 feet is a well-preserved nonsurface reef or lagoonal assemblage identical with that found at approximately the same depths in the drill holes on Bikini Atoll and related to the coral faunas of the Miocene of Indonesia. This assemblage is of Miocene age and consists of at least 27 species representing 18 genera. The corals from 1,720 to 1,980 feet and 2,720 to 3,110 feet, mostly poorly preserved, suggest the same fauna. Four species indicative of a surface-reef environment, from the deep core, probably represent a horizon approximating that of the Eocene of Borneo.

INTRODUCTION

In a previous report (Wells, 1954a), the writer described the fossil corals recovered from drill holes on Bikini Atoll that reached a depth of 2,556 feet. Two faunal zones were recognized: (1) The Pliocene and Pleistocene from near the surface to about 700 feet and (2) the middle and upper Miocene from 725 to 1,100 feet. Below 1,100 feet, corals were scarce, poorly preserved, and indeterminable. The lowest rock in these drill holes, below 2,070 feet, was considered of Oligocene age by Cole (1954, p. 572), who later, however, modified this to lower Miocene (1957, p. 745).

The Eniwetok drill holes of 1951–52, about 200 miles west of Bikini, that penetrated to a depth of 4,553 feet (Ladd and others, 1953), therefore, are of the greatest interest for comparison with the earlier holes in confirming or modifying the general geological column of this part of the Pacific. On a priori grounds it was to be expected that the Eniwetok sections down to about 2,500 feet would be essentially the same as at Bikini, and this was so. It was also to be expected that if the Bikini section ended somewhere in the lower Miocene, the even deeper and older section at Eniwetok would find older strata, presumably of Oligocene and Eocene age. According to Cole (1957) on the basis of the larger Foraminifera, the Oligocene is absent and the Eocene first appears at 2,780 feet and extends downward to 4,553 feet.

In the four drill holes at Eniwetok (E–1, F–1, K–1, K–1B), corals (table 1) occurred in most of the cuttings and cores from near the surface down to 1,260 feet, and the first Miocene forms appeared at 620–630 feet. In the interval of rock from 620 to 1,260 feet the fossils were well preserved as original pale brown material. Between 1,260 and 2,720 feet corals were very scarce, only three specimens were found in this interval, which is included in the Miocene (*e*) by Cole (1957, p. 745). From 2,720 to 3,040 feet, corals were fairly common and occurred mostly as molds in cream-colored limestone. They represent the same fauna as the upper zone (620–1,260 ft.), although Cole placed the uppermost Eocene horizon at 2,840–2,850 feet, with Eocene strata continuing in the deepest hole to 4,553 feet. Corals were present again only in the core from 4,078 to 4,100 feet; they were badly preserved as molds and calcite replacements and indicate a fauna distinct from the upper ones and evidently of Eocene age.

POST-MIOCENE CORALS

From near the surface down to 620 feet, the corals were very scarce, fragmentary, and mostly preserved as molds. Of 13 indicated species (table 1), only 6 are specifically identifiable, and no forms were diagnostic of any particular age between Miocene and Recent. All were reef forms.

MIOCENE CORALS

At Bikini the Miocene coral fauna first appears at a depth of about 725 feet (Wells, 1954b, p. 609) and extends to at least 1,000 feet. At Eniwetok the same fauna, marked especially by *Seriatopora ornata*, *Alveopora polyacantha*, and *Dictyaraea micrantha*, appears about 100 feet higher, at 620 feet, and extends, including two intervals barren of corals (1,300–1,700 ft, 2,000–

2,700 ft), to at least 3,100 feet. Beyond this depth, no corals were recovered until 4,078 feet where a different fauna, believed to be Eocene, was found.

As previously noted, the larger Foraminifera indicate that the Eocene part of the section appears at 2,850 feet, but the scarce and badly preserved corals at this depth give no indication of this. *Heliopora coerulea*, a Recent species, occurs between 2,880 and 3,040 feet. *Seriatopora ornata*, a Miocene form occurs down to 3,040 feet, and indeterminable fragments of *Acropora*, *Stylophora*, and *Astreopora* were noted down to 3,100 feet. In the absence of other data, the coral fauna from 2,700 to 3,100 feet indicates only Miocene or older.

At Eniwetok, the well-developed Miocene coral fauna between 620 and 1,260 feet is the same, both in species and preservation, as that found at about the same depth at Bikini (Wells, 1954b, fig. 167). The larger sampling from Eniwetok added several more species to the fauna, notably *Actinastrea minutissima*, *Dendracis pacificus*, *Leptoseris sp. cf. L. floriformis*, and *Stylophora sokkohensis*, all of which emphasize the Miocene aspect of the fauna, which has its closest affinities with the Miocene of Borneo and Java. Because a detailed comparison with the Indonesian Miocene f_3–g faunas was made in the report on the Bikini corals (Wells, 1954b, p. 609–611), and as the Eniwetok material does not modify the stratigraphic and faunal relations, further analysis appears unnecessary.

This Miocene assemblage, including as it does many delicately branched species of *Stylophora*, *Seriatopora*, *Dendracis*, *Acropora*, *Millepora*, and several genera rarely found on surface reefs (*Acanthophyllia*, *Cycloseris*, and *Leptoseris*), indicates a moderately deep hermatypic environment such as that of reef lagoon or seaward slope below wave base—depths certainly less than 200 feet.

EOCENE CORALS

The third and oldest coral horizon was found in the core from drill hole E–1, between 4,078 and 4,100 feet, in which corals were abundant, in places constituting the bulk of the core but in very small variety. Only four forms could be determined:

Actinastrea sp. cf. A. minutissima (Gerth)
Stylophora stellata (v. Fritsch)
Favia sp. cf. F. oligophylla (v. Fritsch)
Platygyra sp.

Two other genera were present but are very poorly preserved. All are hermatypic forms; *Stylophora*, *Favia*, and *Platygyra* are abundant, represented by fragments of sizable colonies indicative of either shallow lagoonal environments or reef-flank detritus.

There is no reason to doubt the Eocene age of these corals, occurring as they do within a sequence of limestones assigned to Tertiary *b* on the basis of the Foraminifera, but there is little evidence from the corals themselves as to the horizon. *Actinastrea minutissima* is a Miocene and lower Pliocene species, and there is no detectable difference between Miocene specimens of this species and the molds found in the deep Eniwetok core. *Stylophora stellata* and *Favia oligophylla* are known elsewhere only from the Eocene of Borneo, but neither species can be said to be well known and clearly distinguishable from younger forms. The *Platygyra* specimens could well be *P. lamellina*, the common Recent Indo-Pacific species known to occur in the Pliocene; better preserved material might reveal real differences.

Few Eocene coral faunas are known from the Indo-Pacific region. The principal faunas are from eastern Africa (Somaliland, Latham, 1929), India (Duncan, 1880; Gregory, 1930a), Java (Gerth, 1921, 1933), Borneo (von Fritsch, 1875), and New Guinea (Gregory and Trench, 1916). These are mainly reef-coral assemblages, although not apparently associated with reef structures. The two faunas nearest geographically to Eniwetok, which might be expected to show similarities as is the case with the Miocene corals, are those from Borneo and New Guinea. The three localities are listed as follows:

	New Guinea	*Borneo*	*Eniwetok*
Feddenia sp. Gregory and Trench	×		
Circophyllia sp. Gregory and Trench	×		
Stylophora papuensis Gregory and Trench	×		
Stylina macgregori Gregory and Trench	×		
Leptoria carnei Gregory and Trench	×		
Dachiardia macgregori Gregory and Trench	×		
Kobya hemicribriformis Gregory and Trench	×		
Actinacis maitlandi Gregory and Trench	×		
sumatrensis (Tornquist)	×		
Porites deshayesana Michelin	×		
Montipora antiqua Gregory and Trench	×		
Heliopora böttgeri von Fritsch		×	
Smilotrochus? brevis von Fritsch		×	
Stylophora sp. cf. S. italica d'Achiardi		×	
Trochosmilia? discoides von Fritsch		×	
Stephanosmilia? humilis von Fritsch		×	
Montlivaltia sp. von Fritsch		×	
Leptophyllia sp. von Fritsch		×	
Ceratophyllia flabelloides von Fritsch		×	
hippuritiformis von Fritsch		×	
Heliastrea? verbeekiana von Fritsch		×	
Favia oligophylla (von Fritsch)		×	×
Astrocoenia? foliacea von Fritsch		×	
immersa von Fritsch		×	
Stylophora stellata (von Fritsch)		×	×
Latimeandra discus von Fritsch		×	
Astrangia? foliacea von Fritsch		×	
Rhizangia? agglomerata von Fritsch		×	
Cycloseris sp. cf. C. perezi Haime		×	
Lophoseris hospes von Fritsch		×	
Acropora lavendulina (Michelin)		×	
Dendracis geyleri von Fritsch		×	
Actinacis digitata von Fritsch		×	
Polyaraea gemmans von Fritsch		×	
Dictyaraea elegans Leymerie?		×	
Platygyra sp.			×
Actinastrea sp. cf. A. minutissima (Gerth)			×

Both von Fritsch's and Gregory and Trench's identifications are largely suspect and badly in need of revision, which cannot be attempted here in the absence of their actual specimens, except to point out some of the more obvious rectifications. The Fly River, New Guinea, fauna of Gregory and Trench, obtained from rounded pebbles of uncertain origin, includes specimens from several different horizons. Some of the pebbles are Eocene, some Miocene (Newton, 1918), and some may be Upper Cretaceous (*Actinacis sumatrensis*). *Stylina macgregori* is probably *Plesiastrea; Dachiardia macgregori* seems to be *Galaxea*, a genus unknown before the Miocene. *Kobya hemicribriformis* is *Diploastrea. Montipora antiqua* is markedly like the Recent *M. foveolata*, which it might well be, and it may be doubted that *Porites* has anything to do with *P. deshayesana* of the European Eocene. Except for the last, all the New Guinea species are as yet unknown elsewhere, and the fauna as a whole has nothing in common with that of Eniwetok.

The Eocene corals described by von Fritsch, also dated largely by Foraminifera, show only slight relationships with Eniwetok: two of the four species from Eniwetok are related to or identical with Borneo forms. Notably absent from the Eniwetok Eocene, but present in Borneo, is *Actinacis*, a nearly ubiquitous genus everywhere in tropical reef faunas from the Late Cretaceous into the Oligocene.

Scattered Eocene or Paleogene corals have been described from Saipan (*Saipania*, Yabe and Sugiyama, 1935) and Palau (*Eomontipora? palauensis*, Yabe and Sugiyama, 1939). Larger coral faunas from these areas may prove to be closer to the Eniwetok corals. The Eocene corals of New Zealand, recently monographed by Squires (1958), represent an ahermatypic cooler water fauna with no relationship to the Eniwetok fauna. The same is generally true for the late Eocene coral fauna of southern Australia.

The corals from the deepest part of the Eniwetok drill holes thus appear to represent a small sample of an isolated shallow-water surface-reef fauna, having, so far as known, little connection with other Eocene coral faunas.

SYSTEMATIC DESCRIPTIONS

Class ANTHOZOA Ehrenberg, 1834
Subclass ZOANTHARIA de Blainville, 1830
Order SCLERACTINIA Bourne, 1900
Suborder ASTROCOENIIDA Vaughan and Wells, 1943
Family ASTROCOENIIDAE Koby, 1890
Genus ACTINASTREA d'Orbigny, 1849

Actinastrea minutissima (Gerth), 1921

Plate 296, figures 1–4; plate 300, figure 1

Astrocoenia minutissima Gerth, 1921, Geol. Reichs-Mus. Leiden Samml., new ser., v. 1, p. 419.
Gerth, 1923, Geol. Reich-Mus. Leiden Samml., ser. 1, v. 10, p. 94, pl. 7, figs. 2–4.
Umbgrove, 1929, Dienst Mijnb. Ned–Indië Wetensch. Mededeel., no. 9, p. 61.
?*Stylophora minutissima* Gerth, 1933, Dienst Mijnb. Ned.-Indië Wetensch. Mededeel., no. 25, p. 38.
Stylocoeniella? minutissima Umbgrove, 1946. Jour. Paleontology, v. 20, p. 523.

Two well-preserved fragments of small nodular colonies from 650 to 700 feet agree very closely with Gerth's original description and later figures. The species, the youngest member of this genus, is marked by very small corallites, rarely more than 0.75 mm in diameter. The specimen described by Gerth (1933) and placed by him in *Stylophora* but unfortunately not figured may not be this species; it could be either *Stylophora* or *Stylocoeniella*. Umbgrove's reference of the species to *Stylocoeniella* is not surprising, as can be seen by comparison of thin sections of *A. minutissima* (pl. 296, fig. 4) and *Stylocoeniella armata* (pl. 296, fig. 5). The trabecular structure of both is similar and like that of typical *Actinastrea* as recently illustrated by Alloiteau (1957, figs. 3–5), but in *A. minutissima* the corallite walls are relatively thin and closely fused; in *Stylocoeniella* they are thickened with a few lacunae, as in some species of *Actinastrea*. *Stylocoeniella*, moreover, is distinguished by the intercorallite pillars, which are not aborted or juvenile corallites as supposed by Alloiteau. Alloiteau's (1957, p. 59) placing of *Stylocoeniella* in a grouping with *Stylocoenia*, which has quite different trabecular and mural structure, is not supported by the microstructure on which he places so much reliance.

A poorly preserved mold (pl. 300, fig. 1) from a core sample (E–1–3–33) in the Eocene at 4,078–4,100 feet is referred to this species on the basis of the very small calices and two cycles of septa.

Age: Miocene from Java and Borneo. Lower Pliocene from Java.

Locality: Eniwetok core E–1–3, depth 4,078–4,100 ft. F–1, 650–660 ft., 690–700 ft.

Genus STYLOCOENIELLA Yabe and Sugiyama, 1935

Stylocoeniella sp.

Plate 296, figures 6, 7

A fragment of the stubby terminal part of a branch with calices 1 mm in diameter and flush with the granulated perithecal surface is referred with some doubt to this genus. It suggests an aberrant *Stylophora pistillata*, but the six septa are dentate and composed of several loosely fused trabeculae as in *Stylocoeniella*, and the intercorallite pillars or effusions instead of develop-

ing on the distal calicular margins as in *Stylophora* and *Seriatopora*, in which they commonly expand to form hoods, are irregularly placed away from and on the proximal sides of the calices as in *Stylocoeniella*. The general aspect is like that of the specimen of *Stylocoeniella armata* (pl. 296, fig. 5) from a depth of 22 fathoms in the Bikini lagoon (Wells, 1954a, pl. 96, fig. 2), in which the calices are widely separated with low intercalicular protuberances.

If this specimen be *Stylocoeniella*, it is distinct from the widespread Recent *S. armata* which has two cycles of well-developed septa.

Locality: Eniwetok F–1, depth, 670–680 ft.

Family POCILLOPORIDAE Gray, 1842
Genus STYLOPHORA Schweigger, 1819

Stylophora pistillata (Esper), 1797

Stylophora pistillata Wells, 1954b, U.S. Geol. Survey Prof. Paper 260–P, p. 612, pl. 223, fig. 1.

Specimens of this common species were fairly abundant from 210 to 1,080 feet, and one mold occurred in a core at 1,725 feet.

Age: Middle Miocene and Recent from Indo-Pacific.
Locality (depths in ft.): Eniwetok E–1, 620–630. F–1, 670–680, 700–730, 860–870, 940–950, core at 1,725. K–1, 210–240. K–1B, 570–590, 610–630 core and cuttings 850–860, 905–960, 970–980, 1,010–1,020, 1,070–1,080.

Stylophora sp. cf. S. sokkohensis Gerth, 1921

Plate 297, figure 1

Stylophora sokkohensis Gerth, 1921, Geol. Reichs-Mus. Leiden Samml., new ser., v. 1, p. 420.
1923, Geol. Reichs-Mus. Leiden Samml., ser. 1, v. 10, p. 98.
1933, Dienst Mijnb. Ned.-Indië Wetensch. Mededeel., no. 25, p. 38, pl. 4, figs. 5, 5a.

A fragment of the tip of a blunt branch, 5 by 8 mm, with flush calices 0.5–0.7 mm in diameter, set in a granulated peritheca, is referred to this species.

Age: Miocene from Borneo and Java.
Locality: Eniwetok F–1, depth 940–950 ft.

Stylophora stellata (von Fritsch), 1875

Plate 300, figure 2

Holocoenia stellata von Fritsch, 1875, Palaeontographica, supp. v. 3, p. 109, pl. 16, fig. 6; pl. 19, fig. 2.

Several corals in cores from about 4,100 feet are assigned to this species. The preservation is extremely poor; recrystallization and solution have generally left only coarse molds. No trace of the external surface can be found, but in a few sections some corallites can be distinguished. The corallum appears to have been massive; at least some core fragments show vertical breaks through corallites 4 or 5 cm in length with little divergence. The corallites are about 1 mm in diameter, cylindrical, less than half their diameter apart, and united by tabular exotheca. The wall is thin and has 12 short costae. There are 12 thin septa, 6 of which reach the axis to form a small styliform columella; the other 6 are short and extend not more than a third of the distance to the axis. Endothecal dissepiments are tabular.

On the basis of the size of the corallites, as seen in section, and the number and disposition of the septa, this form is placed in von Fritsch's *Holocoenia stellata* from the Eocene of Borneo. Von Fritsch stated that the colony is ramose to laminar, often in laminated masses. His reference to *Holocoenia*, the type species of which is *H. micrantha* Reuss, a thamnasterioid, cannot be maintained. Colonies of most species of *Stylophora* are ramose, but a few massive or laminar growth forms are known, particularly from the older Tertiary, such as *S. ponderosa* Vaughan (Oligocene, United States and West Indies), *S. vaughani* Gregory (Lower Eocene, India) which has much larger calices and only 1 cycle of septa, and *S. farquharsoni* Latham (Eocene, Somaliland) with 12 septa (arrangement not indicated) and corallites 1–2 mm in diameter.

Age: Eocene from Borneo.
Locality: Eniwetok core E–1–3, depth 4,078–4,100 ft.

Stylophora sp.

Plate 297, figure 2

Specifically indeterminable fragments of this genus, commonly preserved as external molds, occurred in a number of samples from 450 to 3,110 feet. Several fragments from 840 to 850 feet (pl. 297, fig. 2) resemble *S. coalescens* Gerth (1923, p. 98, pl. 7, figs. 5, 6) from the Miocene of Borneo, but the calices are larger (0.7 mm) and are not elevated above the granulated peritheca. In most calices the second cycle of septa is well developed, a most unusual condition in *Stylophora* or other pocilloporids.

Locality (depths in ft): Eniwetok E–1, 2,960–2,970, 2,980–2,990, 3,020–3,040, 3,100–3,110. F–1, 840–850, 1,970–1,980. K–1B, 450–460, 900–910.

Genus SERIATOPORA Lamarck, 1816

Seriatopora ornata Felix, 1921

Plate 297, figures 3, 4

Seriatopora ornata Wells, 1954b, U.S. Geol. Survey Prof. Paper 260–P, p. 612, pl. 223, figs. 3–5.

As at Bikini, this species was very common and occurred in nearly all samples from 620 to 1,260 feet, at 1,930–1,940 feet, and sparsely from 2,720 to 3,040 feet.

One specimen (pl. 297, fig. 4), from 880 to 890 feet, is a variant of this form—the calices are relatively shallow, and six well-developed septa fuse axially to form a large columellar mass on which a small columellar style is weakly developed.

Age: Middle Miocene to lower Pliocene from Java, Borneo, and Palau.

Locality (depths in ft.): Bikini 2A, 731–988, 2,524–2,535. 2B, 1,020–1,100. Eniwetok E–1, 620–630, 880–890, 1,930–1,940, 2,720–2,730, 2,780–2,800, 2,980–2,990, 3,030–3,040. F–1, 650–690, 700–720, 730–740, 760–770, 820–830, 840–850, 860–870, 880–890, 940–950. K–1B, 640–650, 770–780, 840–850, 860–870, 890–920, 930–940, 970–1,080, 1,090–1,100, 1,130–1,140, 1,150–1,160, 1,180–1,260.

Seriatopora micrommata Felix, 1921

Seriatopora micrommata Wells, 1954b, U.S. Geol. Survey Prof. Paper 260–P, p. 612, pl. 223, figs. 6, 7.

This species was abundant in nearly all samples from 650 to 720 feet and from 820 to 1,240 feet. Among the many specimens all of which were fragments in every stage of wear, the writer was unable to distinguish between Felix' two species, *S. micrommata* and *S. delicatula*, and noted in Wells (1954b) they are not positively distinguishable from the common *S. hystrix* (Dana) when one takes into account they great individual variation of this species.

Age: Middle Miocene to lower Pliocene from Java and Borneo.

Locality (depths in ft.): Bikini 2A, 726–967. Eniwetok E–1, 880–890. F–1, 650–710, 810–830, 840–850, 860–870, 880–890, 940–950. K–1B, 900–910, 930–940, 950–960, 970–990, 1,000–1,020, 1,030–1,050 (cove and cuttings), 1,060–1,080, 1,090–1,120, 1,130–1,170, 1,210–1,240.

Seriatopora hystrix (Dana), 1846

Seriatopora hystrix Wells, 1954a, U.S. Geol, Survey Prof. Paper 260–I, p. 411, pl. 96, figs. 6, 7; pl. 92, figs. 1, 2.

Specimens from 60 to 930 feet have been identified with this species on the basis of slender branchlets (to 2 mm) and small (0.5 mm) protuberant hooded calices, but many specimens of *S. micrommata* are much the same.

Age: Pliocene to Pleistocene from Java and Ceram. Recent from Indo-Pacific.

Locality (depths in ft.): Eniwetok E–1, 60–70. F–1, 60–70, 90–100, 110–120, 160–170, 610–620, 680–690. K–1, 200–210, 230–240. K–1B, 390–400, 420–440, 520–550, 570–580, 600–650, 770–780, 830–840, 850–860, 870–900, 920–930.

Genus POCILLOPORA Lamarck, 1816

Pocillopora damicornis (Linnaeus), 1758

Plate 297, figure 5

Procillopora damicornis Wells, 1954a, U.S. Geol. Survey Prof. Paper 260–I, p. 412, pl. 99, fig. 2.

Several fragments of this common widespread surface-reef species came from 670 to 730 feet. As near as can be determined from such fragments, they are in no way different from Recent coralla.

Other species of the genus that have been reported from the Indo-Pacific Miocene are: *P. eydouxi* Milne-Edwards and Haime, a Recent species, by Gerth (1923) from Nias; *P. jenkinsi* Reuss (1867) from Borneo and Nias; and *P. solida* Umbgrove (1929) from Sumatra; all of them seem to differ from *P. damicornis* by growth form and septal development.

Specifically indeterminable fragments of *Pocillopora* occurred scatteringly from 630 to 3,010 feet.

Age: Recent from Indo-Pacific.

Locality (depths in ft.): Eniwetok E–1, 620–630, 2,850–2,860, 2,880–2,890, 2,970–3,010 (all indet.). F–1, 670–730. K–1B, 840, 1,250 (both indet.).

Family ACROPORIDAE Verrill, 1902
Genus ACROPORA Oken, 1815

As in the Bikini drill holes (Wells, 1954b, p. 612), fragments of branches of this genus were common at Eniwetok in cuttings from 75 to 1,140 feet and again from 2,870 to 2,990 feet. Most of them were unidentifiable with the exception of the following:

Acropora humilis (Dana), 1846

Plate 297, figures 6, 7

Acropora humilis Wells, 1954a, U.S. Geol. Survey Prof. Paper 260–I, p. 425, pl. 100, fig. 1; pl. 126, figs. 1–6; pl. 127, fig. 3; pl. 128, figs. 3–5.

Six fragments from 720 to 740 feet can be placed with some certainty in this widespread surface-reef species. The two best preserved fragments are tips of branches about 17 mm in diameter and show thick-walled echinulate radial corallities.

Age: Recent from Indo-Pacific.

Locality: Eniwetok F–1, 720–740 ft.

Acropora sp. cf. A. microphthalma Verrill, 1902

Plate 297, figure 8

Acropora microphthalma Wells, 1954a, U.S. Geol. Survey Prof. Paper 260–I, p. 429, pl. 126, figs. 7–9.

One specimen, a tip of a branch 5 mm thick with the very small corallites characteristic of *A. microphthalma*, is referred to this species.

Age: Recent from Southwest Pacific.

Locality: Eniwetok E–1, 620–630 ft.

Genus DENDRACIS Milne-Edwards and Haime, 1849

Dendracis pacificus n. sp.

Plate 298, figures 2–5

Corallum dendroid or ramose, with gently tapering branches from 2 to 6 mm in diameter. New branches

budded at angles from 45° to 90°. Corallites in four rows parallel to axis of branch, regularly alternating in position. Calices small (1 mm), protuberant, and inclined toward tip of branch, but on older parts of branches the calices are immersed, elongate oval in outline, larger (1.5 by 2.5 mm) and spaced vertically about a diameter apart. In the smaller calices (pl. 298, fig. 5) there are six weakly developed laminar slightly exsert septa, two of which (directives?) lie in the direction of the longer calicular diameter. In the large mature calices (pl. 298, figs. 2, 3), which are open to the internal tissue, the septa have completely disappeared, and the flared margin is smooth and has a ring of short spines. The coenosteum between the calices is nearly solid to a depth of about 0.5 mm with a few scattered very small perforations and sinuous rows of small flattened spines over the surface. The interior of the branches (pl. 298, fig. 4) is a complex of anastomosing elongate elements among which doubtless extended a canaliculate extension of the coelenteron connecting the polyps.

There is strong superficial resemblance of this coral to the associated specimens of *Seriatopora ornata* in the suppression of the septa, the deep oval calices, and the spinose coenosteum; but in *S. ornata* the mature calices are rarely more than 1 mm in longer diameter, the coenosteal surface is not perforated, and the interior of the stems is nearly solid. *Dendracis* is like *Acropora* (*cf.* pl. 298, fig. 1) in the tendency toward reduction of septa, perforate-echinulate intercorallite coenosteum, and internal canaliculate interconnecting tissue. The only significant difference is in the absence in *Dendracis* of leading axial corallites.

The type species of *Dendracis*, *D. gervillei* (Defrance) occurs in the middle Eocene of Europe and some other species have been described from the Eocene, Oligocene, and Miocene of Eurasia. All of them differ from the present form by their more highly developed septa. Two species have been reported from the Tertiary of Indonesia: *D. geyleri* von Fritsch from the Eocene of Borneo with protuberant calices on older parts of branches and *D. haidingeri* Reuss from the Miocene of Java (Reuss, 1867, p. 171, not figured). *D. haidingeri* was originally described by Reuss (1864, p. 27, pl. 8, figs. 2–5) from the Oligocene of Austria; in the *Novara* report he merely mentioned that the Javanese specimens, badly preserved, agreed with his Oligocene types. If this was so, the Javanese form is quite different from *D. pacificus*. *Dendracis bifaria* Gregory (1930b, p. 199, pl. 18, fig. 4) from the lower Miocene of Kenya has calices 1–2 mm in diameter with well-developed septa in two cycles and parts of the third and does not appear to be related to *D. pacificus*.

Locality (depths in ft.): Eniwetok F–1, 810–820, 830–850, 860–870, 880–890. E–1, 1,925–1,935. K–1B, 957–967, 1,038–1,049 (core and cuttings), 1,059–1,080.

Genus ASTREOPORA de Blainville, 1830

Astreopora sp.

Specimens, all small fragments, of this common Indo-Pacific coral were noted from 120 to 220, 840 to 850, 1,220 to 1,230, and 3,020 to 3,110 feet. One or two showed parts of corallites and could well be the type species, *A. myriophthalma* (Lamarck), which has been reported from the Miocene of Java, younger Tertiary ("Neogene") of Java, and the Pliocene to Pleistocene of Timor.

Locality (depths in ft): Bikini 2–A, 120–310. Eniwetok E–1, 3,020–3,030, 3,090–3,110. F–1, 110–120, 160–170, 840–850. K–1, 200–210. K–1B, 1,220–1,230.

Genus MONTIPORA de Blainville, 1830

Montipora sp.

Species of this genus, like those of *Acropora* and *Porites*, are very difficult to identify and fragments can rarely be placed with confidence even in species groups. The material from Eniwetok is no exception especially as the surface ornamentation, so rich and varied in *Montipora*, is generally worn away.

Fragments representing laminar and ramose forms were recorded from depths between 260 and 820 feet.

Locality: Eniwetok F–1, 250–270, 650–660, 810–820 ft.

Family AGARICIIDAE Gray, 1847
Genus LEPTOSERIS Milne-Edwards and Haime, 1849

Leptoseris sp. cf. L. floriformis Gerth, 1923

Plate 298, figure 6

Leptoseris floriformis Gerth, 1923, Geol. Reichs-Mus. Leiden Samml., ser. 1, v. 10, p. 107, pl. 8, fig. 2.

One worn fragment from 880 to 890 feet may belong to this species. The septa appear subequal and thick and number about 12 in 5 mm, but on a less worn part they alternate in thickness with granulated sides and margins. The centers are 5 mm apart, with 10–12 septa around each center which has several columellar papillae. The under surface is encrusting and cannot be seen.

In *L. floriformis* the septa are said to alternate in thickness and to number 10–12 in 5 mm, and the centers apparently lack a columellar structure.

Age: Miocene from Borneo.
Locality: Eniwetok F–1, 880–890 ft.

Genus PAVONA Lamarck, 1801

Pavona sp.

Two small fragments of an indeterminable unifacial species of this common reef form were found in cuttings.

Age: Oligocene to Recent from Indo-Pacific.
Locality: Eniwetok E–1, 2,960–2,970 ft. K–1, 200–210 ft.

Family FUNGIIDAE Dana, 1946
Genus CYCLOSERIS Milne-Edwards and Haime, 1849

Cycloseris sp.

As in the Bikini drill holes, specimens of this genus were all fragments or juvenile individuals and could not be satisfactorily referred to any of the several described Tertiary or Recent species.

Locality: (depth in ft); Bikini 2–A, 935–967. Eniwetok E–1, 880–890. F–1, 800–810, 850–860, 880–890, 940–950. K–1B, 925–936, 940–950, 1,038–1,049.

Genus DISCOTROCHUS Milne-Edwards and Haime, 1848

Discotrochus sp. cf. D. orbignyanus Milne-Edwards and Haime, 1848

Plate 298, figures 7, 8

Discotrochus orbignyanus Milne-Edwards and Haime, 1848, Annals sci. nat. (3), v. 9, p. 252, pl. 7, figs. 6, 6a.
Vaughan, 1900, U.S. Geol. Survey Mon. 39, p. 79, pl. 5, figs. 13–19b (with synonymy).
Wells, 1937. Bull. Am. Paleontology, no. 79, p. 240, pl. 35, figs. 19–22.
?*Discotrochus asteriscus* Squires, 1958, New Zealand Geol. Survey Paleontology Bull. 29, p. 33, pl. 3, figs. 3, 4.

Eight small discoidal corals from depths between 830 and 1,217 feet, ranging in diameter from 3 to 6.5 mm with a maximum height of 3 mm and with four complete cycles of septa even in the smallest specimens, are distinguishable from the American Middle Eocene *D. orbignyanus* solely by their smaller size; in all other respects they are identical.

The single worn coral from the early Eocene (Bortonian) of New Zealand, made the type of a new species by Squires, is apparently the same except for the slightly larger columella and fewer synapticulae, which, like size, are features of doubtful value.

Other species referred to this genus were discussed by the writer (Wells, 1937): *D. duncani* Krejci (=*Kionotrochus*), *D. duncani* Reuss (=*Kionotrochus*), *D.? alternans Sokolow* (imperfectly known), *D. michelottii* Milne-Edwards and Haime (indistinguishable from *D. orbignyanus* according to its authors but not figured), and *D. investigatoris* and *D. dentatus* Alcock (both are *Anthemiphyllia*). At that time *D. orbignyanus*, type of the genus, was the only definitely known species. The writer added a second species, *D. californicus* (Wells, 1940, p. 375), from the Eocene of California, a form marked by the absence of half of the fourth cycle septa, again a distinction that may not prove valid. Now, with Squires' unique specimen from New Zealand and the present material from the Eniwetok Miocene, the geographic and stratigraphic range of *Discotrochus* is considerably extended.

Age: Eocene from United States Coastal Plain, California, and New Zealand.
Locality (depths in ft): Eniwetok E–1, 840–950. F–1, 830–840. K–1B, 873–894, 915–925, 936–946, 957–967, 1,047–1,059, 1,206–1,217.

Family PORITIDAE Gray, 1842
Genus DICTYARAEA Reuss, 1867

Dictyaraea micrantha Reuss, 1867

Dictyaraea micrantha Wells, 1954b, U.S. Geol. Survey Prof. Paper 260–P, p. 614, pl. 224, fig. 2.

Fragments of branches of this curious poritid coral were common at depths from 640 to 1,260 feet. A single specimen was found at 2,720–2,730 feet.

Age: Middle Miocene to lower Pliocene from Indonesia and Palau.
Locality (depths in ft): Bikini 2A, 857–967. Eniwetok E–1, 880–890, 2,720–2,730. F–1, 680–690, 700–710, 760–770, 840–870, 880–890. K–1B, 640–650, 740–750, 890–1,260.

Genus PORITES Link, 1807

Specifically indeterminable fragments of this genus occurred at 160–170 feet and scatteringly from 840 to 3,010 feet. In some cuttings there were several very small well-preserved colonies with only four to six corallites.

Porites sp. cf. P. capricornis Rehberg, 1892

Porites capricornis Wells, 1954b, U.S. Geol. Survey Prof. Paper 260–P, p. 613, pl. 224, figs. 1, 1a.

Several fragments are identical with those previously reported from Bikini.

Age: Recent from southwestern Pacific.
Locality (depths in ft.): Bikini 2–A, 925–967. Eniwetok F–1, 670–680, 700–710, 730–740.

Genus ALVEOPORA Quoy and Gaimard in de Blainville, 1830

Alveopora polyacantha Reuss, 1867

Plate 299, figure 3

Alveopora polyacantha Wells, 1954b, U.S. Geol. Survey Prof. Paper 269–P, p. 613, pl. 224, fig. 3.

This species was abundant at depths from 620 to 960 feet, and there was one occurrence at 1,230–1,240 feet. The growth form, as indicated by fragments, was ramose with thick (10–17 mm) stubby branches and

calices 1–1.5 mm in diameter, very much like the living *A. viridis* Quoy and Gaimard of the Pacific (pl. 299, figs. 1, 2). In *A. viridis* there are commonly only six septal spines; in *A. polyacantha* some short spines of the second cycle are generally developed.

Age: Middle Miocene to lower Pliocene from Java and Borneo.
Locality (depths in ft.) : Bikini 2–A, 914–956. Eniwetok E–1, 620–630. F–1, 680–720, 730–740, 760–770, 840–850, 880–890. K–1B, 850–870, 900–910, 950–960, 1,230–1,240.

Family FAVIIDAE Gregory, 1900
Subfamily FAVIINAE Vaughan and Wells, 1943
Genus PLESIASTREA Milne-Edwards and Haime, 1848

Plesiastrea versipora (Lamarck), 1816

Plesiastrea versipora Wells, 1954a, U.S. Geol. Survey Prof. Paper 260–I, p. 460.
Wells, 1954b, U.S. Geol. Survey Prof. Paper 260–P, p. 610.

One large fragment of a nodular colony of this common reef coral was recorded from the upper part of Eniwetok drill hole E–1.

Age: Late Tertiary to Recent from Indo-Pacific.
Locality: Bikini 2–A, 70–160 ft. Eniwetok E–1, 18 ft.

Genus FAVIA Oken, 1815

Favia sp. cf. F. oligophylla (von Fritsch), 1875

Plate 300, figures 3, 4

Solenastrea? oligophylla von Fritsch, 1875, Palaeontographica, supp. v. 3, p. 117, pl. 15, fig. 8.
Cyphastrea? oligophylla Gerth, 1931, Leidsche Geol. Mededeel., v. 5, p. 137.

Pieces of faviid corals in cores from about 4,100 feet may pertain to von Fritsch's species. The preservation is very poor and only internal sections can be studied. The growth form is massive with cylindrical corallites about 2 mm in diameter separated about 1 mm. Increase is mostly by intratentacular budding, and many corallites are elongate or deformed in cross section. Costae are very short and do not extend between adjacent corallites, which are united by subtabular exothecal dissepiments spaced 0.5–0.8 mm apart. Corallite walls are thick. Septa are thick, scarcely tapering internally and irregularly arranged cyclically. From 8 to 12 major septa extended nearly to the axis where they partly fuse to form a very weak columella, and from 8 to 12 shorter septa extend about halfway to the axis. Endothecal dissepiments are sparse, subtabular, and 0.8–1.0 mm apart.

From what can be distinguished in section, the resemblance of this form to the common Pleistocene and Recent *F. stelligera* (*Dana*) is very close; the main difference is in the slightly smaller corallites of the Eniwetok specimens.

Age: Eocene from Borneo.
Locality: Eniwetok core E–1–3, depth 4,078–4,100 ft.

Genus PLATYGYRA Ehrinberg, 1834

Platygyra sp.

Plate 300, figures 5, 6

A number of fragments of a submeandroid coral in cores from a depth of about 4,100 feet may represent a new species of this genus. As in *Favia sp. cf. F. oligophylla*, the structures are shown only in sections and the preservation is very poor. The corallum is cerioid with a few meandroid series, as in the living *Platygyra lamellina, forma stricta*, and *forma sinensis*. The cerioid corallites are 2.5–3 mm in diameter. The meandroid ones, with two or three centers, are as much as 8 mm in length. Corallite walls are thin and closely fused. Septa are thin (secondarily thickened in some places), laterally nearly smooth, 24–26 in cerioid corallites, and about 12 extend to the axis where 6 of them meet to form a very weak columella, the others fusing to each other short of the axis. The remaining shorter thinner septa more or less alternate with the principal septa, their inner ends free or fused to lower cycle septa. In vertical section the dissepiments appear nearly horizontal and regularly spaced about 0.5 mm apart.

Nothing of the character of the septal margins can be distinguished, and the reference to *Platygyra* is thus weakened, but comparison with corresponding sections of *P. lamellina* reveals no notable difference except in the thicker walls, larger corallites, and slightly more developed columella in the Recent species.

There seems to be no coral comparable to this now known in the Eocene or early Tertiary of the Indo-Pacific region.

Locality: Eniwetok core E–1–3, depth 4,078–4,100 ft.

Subfamily MONTASTREINAE Vaughan and Wells, 1943
Genus CYPHASTREA Milne-Edwards and Haime, 1848

Cyphastrea microphthalma (Lamarck), 1816

Plate 299, figure 6

Cyphastrea microphthalma Yabe, Sugiyama, and Eguchi, 1936, Tōhoku Imp. Univ. Sci. Repts., 2d ser., spec. v. 1, p. 23, pl. 17, figs. 7–8.

Several small bits of colonies are identified with this species. The calices are widely spaced in a coarsely spinose coenosteum, a condition characteristic of species of this genus from deep water.

Age: Miocene to Recent from Indo-Pacific.
Locality: Eniwetok F–1, 710–720, 760–770 ft. K–1B, 780–790, 1,020–1,030 ft.

Family MUSSIDAE Ortmann, 1890
Genus ACANTHOPHYLLIA Wells, 1937

Acanthophyllia sp.

Plate 299, figures 4, 5

Three small corals are referred with some doubt to this genus, which includes large solitary turbinate to subtrochoid mussids with very large coarse lobulate septal dentations. The largest corallum (figured) is 14 mm high with calicular diameters 12 by 14 mm. The exterior is covered by a thin epitheca to within about 3 mm of the calicular margin. The costae are thin, alternate, and finely granulate. There are 66 septa, 4 complete cycles and part of the fifth, the latter best developed in the "dorsal" systems. The septa regularly decrease in height and thickness, those of the first two cycles being equal and thick with six relatively large lobulate teeth. Those of the third cycle are thinner with lower teeth, and so on, with septa of the fourth and fifth cycles regularly uniting with those of the preceding cycle. The columella is well developed and composed of interlaced flattened trabecular processes. The next smaller specimen is 4 mm in height and 7 mm in diameter with about 36 septa, and the smallest is 2.5 mm high and 4 mm in diameter with 26 septa, the larger of which have tall dental spines.

These specimens are almost certainly juvenile individuals of a larger form. At this stage specific identification is hardly possible. Other than the Recent type species, *Acanthophyllia deshayesiana* (Michelin),[1] from the Philippine seas, which has been reported by Yabe and Eguchi (1941, p. 213, figs. 2a, b) from the Pliocene and Pleistocene Sumagui Formation, Philippines, two other occurrences of the genus, both of which may pertain to *A. deshayesiana*, have been noted: *A. grandiflora* (Gerth, 1921, p. 409, pl. 55, figs. 8, 9) from the Pliocene of Java and *Antillia sp. cf. A. ponderosa* (Milne-Edwards and Haime) (Umbgrove, 1924, p. 7, pl. 2, figs. 3, 4) from the Pliocene of Ceram. The only other recorded occurrence of the genus from the Miocene is *A. ampla* (Reuss) from Europe and Asia Minor.

Age: Pliocene and Recent from Indo-Pacific.
Locality: Eniwetok E–1, 860–870, 880–890 ft. K–1B, 915–925 ft.

Family OCULINIDAE Gray, 1847
Genus GALAXEA Oken, 1815

Galaxea sp.

Two fragments referable to this genus occurred in Eniwetok cuttings. *Galaxea clavus* (Dana) was found also at Bikini in material studied after the report (Wells, 1954b) was prepared.

[1] Including *Protolobophyllia sinica* Ma (1959, p. 73, pl. 1), Recent, Philippines.

Age: Miocene and Recent from Indo-Pacific and Caribbean.
Locality: Bikini 2, 180–185 ft. Eniwetok F–1, 260–270 ft. K–1, 210–220 ft.

Genus ACRHELIA Milne-Edwards and Haime, 1849

Acrhelia sp.

Plate 299, figure 7

A worn fragment from 650 to 660 feet apparently is the first recorded fossil occurrence of this genus which is known only from the living *Acrhelia horrescens* (Dana), with the possible exception of the coral referred with doubt to this genus by Umbgrove (1929, p. 65, pl. 1, figs. 25–27; pl. 2, figs. 30–32, Miocene of Borneo). It is part of the blunt tip of a branch bearing small (1.5 mm), protuberant corallites set in solid coenosteum, in which the corallites are persistent, with few dissepiments. The surface of the coenosteum appears pitted as a result of the ramification of the septacostae into a vermiculate meshwork. The septa are in two cycles with part of the third; they barely extend to the corallite axis but do not form a distinct columella. Several of the corallites are deformed by intraentacular budding, an uncommon mode of increase in this genus.

No specific assignment is warranted on the basis of this one specimen.

Age: Recent from Indo-Pacific (*A. horrescens*).
Locality: Eniwetok F–1, 650–660 ft.

Subclass ALCYONARIA de Blainville, 1830
Order STOLONIFERA Hickson, 1883
Family TUBIPORIDAE Milne-Edwards and Haime, 1857
Genus TUBIPORA Linnaeus, 1758

Tubipora musica Linnaeus, 1758

Tubipora musica Wells, 1954a. U.S. Geol. Survey Prof. Paper 260–I, p. 474.

Two fragments retaining the typical red color of this common surface reef form occurred at 60–70 feet.

Age: Recent from Indo-Pacific.
Locality: Eniwetok F–1, 60–70 ft.

Order COENOTHECALIA Bourne, 1900
Family HELIOPORIDAE Moseley, 1876
Genus HELIOPORA de Blaineville, 1830

Heliopora coerulea (Pallas), 1766

Plate 299, figure 8

Heliopora coerulea Wells, 1954a, U.S. Geol. Survey Prof. Paper 260–I, p. 474, pl. 167, fig. 5; pl. 169, figs. 3, 4; pls. 181, 182.

Small bits of colonies of this common eutropical surface reef alcyonarian were fairly common in many samples from 160 to 3,040 feet. The autopores average 0.4 mm in diameter, with 12–14 short pseudosepta. The species is uncommon in the Indo-Pacific Tertiary, and

the only other pre-Pleistocene occurrence appears to be a specimen identified by the writer from the Miocene of Saipan in material collected by Cloud (1959, p. 420). *Heliopora sparsipora* Felix (1921, p. 58, pl. 142, fig. 15) the only other species known from the Indo-Pacific Miocene, has larger autopores (0.7–0.8 mm) with more pseudosepta (18–22). Other Miocene species from outside this region are marked by still larger autopores.

Age: Pleistocene to Recent from Indo-Pacific and Miocene from Saipan.

Locality (depths in ft): Eniwetok E–1, 2,880–2,890, 2,910–2,920, 2,980–2,990, 3,030–3,040. F–1, 160–170 (retains traces of blue color), 650–660, 670–680, 710–720, 830–840. K–1B, 870–890, 900–920, 1,010–1,020, 1,030–1,040 (core and cuttings), 1,060–1,070, 1,140–1,150, 1,210–1,230, 1,250–1,260.

Class HYDROZOA Huxley, 1856
Order MILLEPORINA Hickson, 1899
Family MILLEPORIDAE Fleming, 1828
Genus MILLEPORA Linnaeus, 1758

Millepora sp.

Small fragments were abundant between 660 and 940 feet. Those from 660 to 670 and 830 to 840 were pieces of small branchlets 3–4 mm thick, and these resembled *Millepora murrayi* Quelch, a Recent Pacific species (Boschma, 1948, p. 40).

Locality (depths in ft): Eniwetok F–1, 660–680, 820–830. K–1B, 780–790, 830–840, 860–870, 1,250–1,260.

Order STYLASTERINA Hickson, 1899
Family STYLASTERIDAE Gray, 1847
Genus DISTICHOPORA Lamarck, 1816

Distichopora sp. cf. fisheri Broch, 1942

Distichopora fisheri Wells, 1954a, U.S. Geol. Survey Prof. Paper 260–I, p. 476, pl. 185, figs. 1, 2.

Two fragments, tips of branchlets, from 110 to 120 feet probably pertain to this species.

Another piece of the same form was recently found in cuttings from Bikini drill hole 2–A, 852–857 feet.

Age: Recent from Pacific.

Locality: Bikini 2–A, 825–827 ft. Eniwetok E–1, 110–120 ft.

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PLATES 296–300

PLATE 296

FIGURES 1–4. *Actinastrea minutissima* (Gerth) (p. 1103).

1. Calicular surface, × 10. F–1, 690–700 ft. USNM 648089.
2. Calicular surface, × 10. F–1, 650–660 ft. USNM 648090.
3. Natural longitudinal section, × 10, of previous specimen.
4. Transverse section, × 10, of previous specimen (reflected light).

5. *Stylocoeniella armata* (Ehrenberg) (p. 1104).
   Transverse section, ×10 (reflected light), of Recent specimen from Arno Atoll, Marshall Islands. USNM 44705.

6, 7. *Stylocoeniella sp.* (p. 1103).
   Two views of part of corallum, ×4. F–1, 670–680 feet. USNM 648091.

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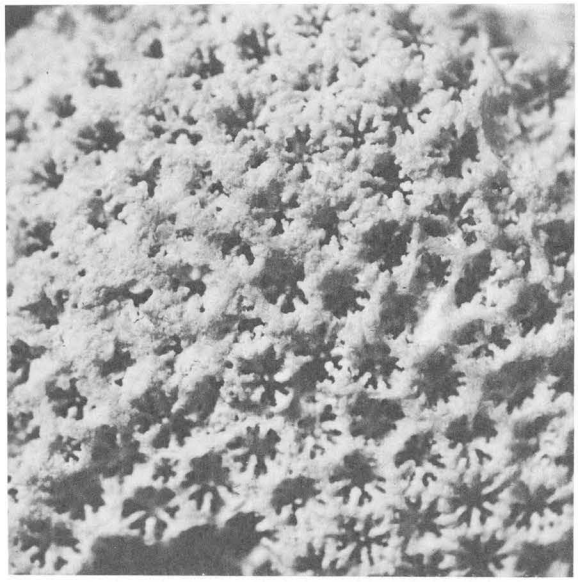

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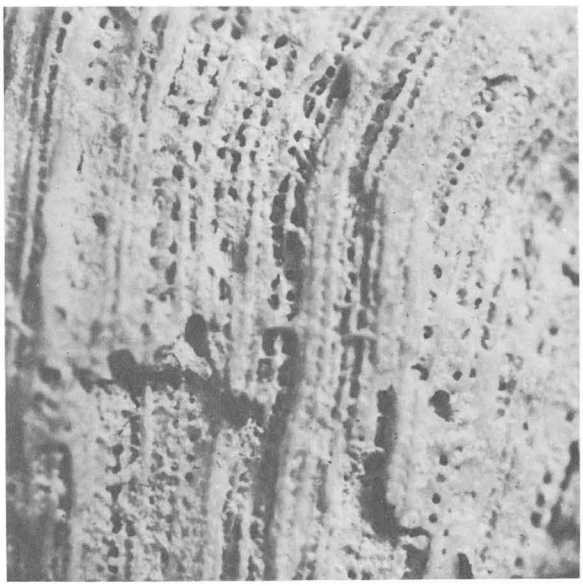

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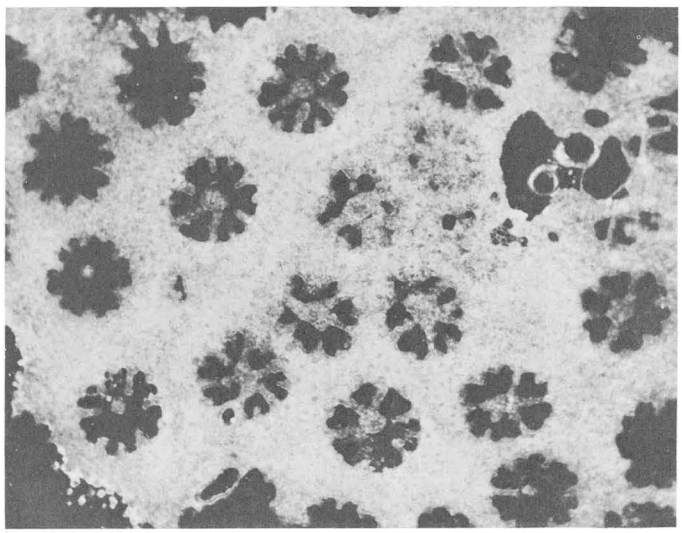

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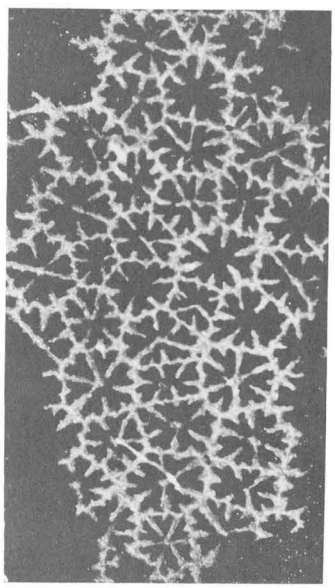

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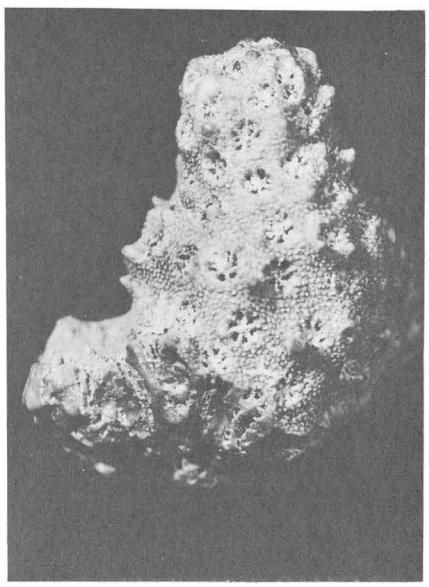

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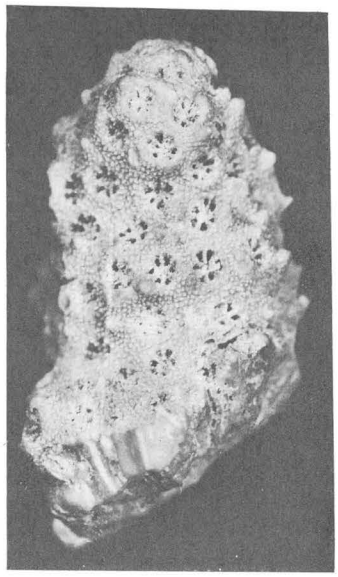


7

MIOCENE CORALS: *ACTINASTREA* AND *STYLOCOENIELLA*

PLATE 297

FIGURE 1. *Stylophora sp. cf. S. sokkohensis* Gerth (p. 1104).
Calicular surface, × 8. F–1, 940–950 ft. USNM 648092.

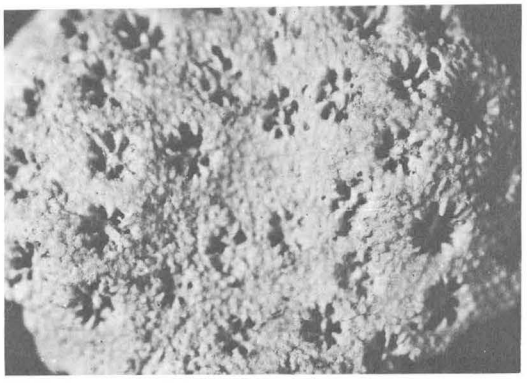
2. *Stylophora sp.* (p. 1104).
Calicular surface, × 10. F–1, 840–850 ft. USNM 648096.

3, 4. *Seriatopora ornata* Felix (p. 1104).
3. Part of branch of typical form, × 10. F–1, 700–710 ft. USNM 648094.
4. Part of branch of variant, × 10. F–1, 880–890 ft. USNM 648095.

5. *Pocillopora damicornis* (Linnaeus) (p. 1105).
Part of branch, × 2. F–1, 720–730 ft. USNM 648097.

6, 7. *Acropora humilis* (Dana) (p. 1105).
6. Tips of two branchlets, × 1. F–1, 730–740 ft. USNM 648098, 648099.
7. Calices, × 5, of preceding right-hand figure. USNM 648099.

8. *Acropora sp. cf. A. microphthalma* Verrill (p. 1105).
Tip of branchlet, × 3. E–1, 620–630 ft. USNM 648100.



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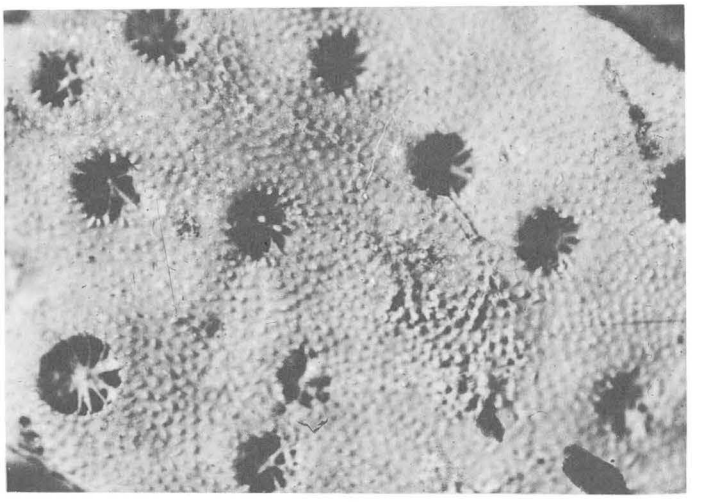

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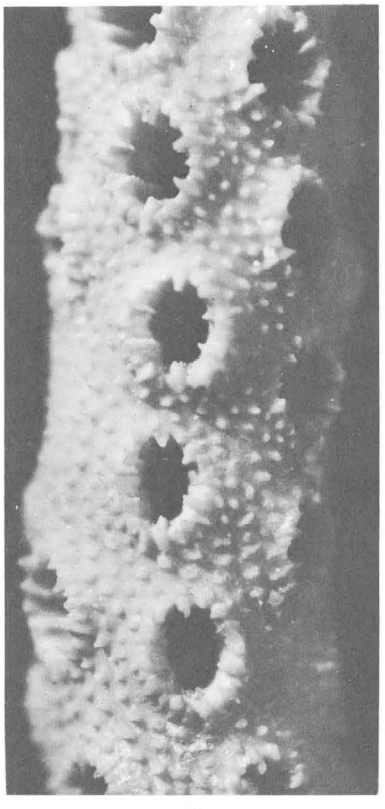

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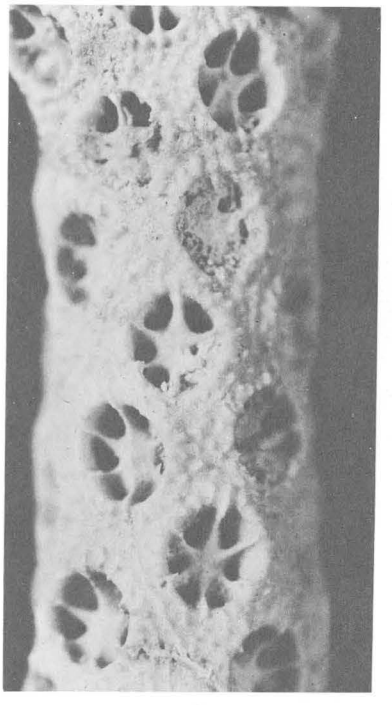

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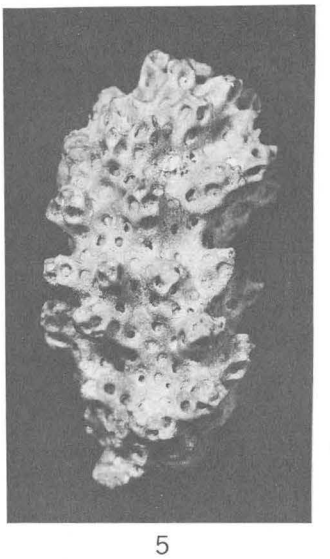

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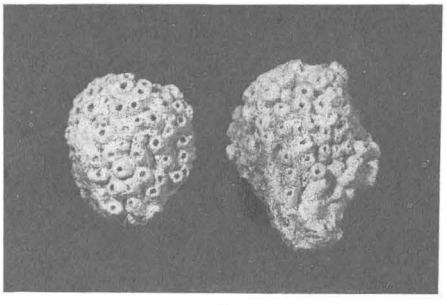

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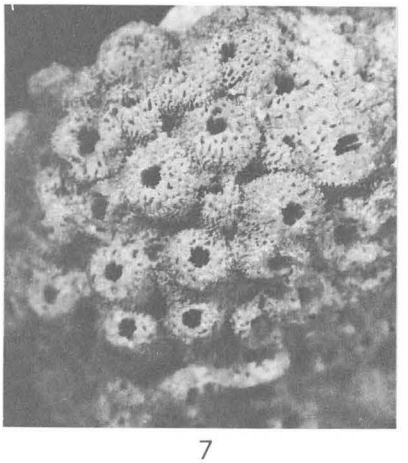

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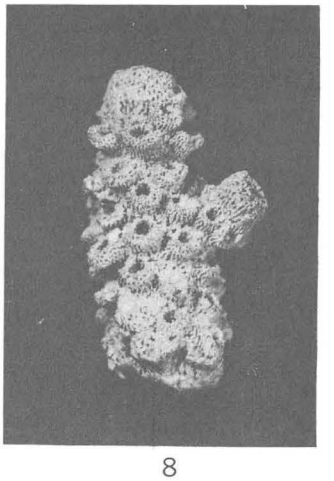


8

MIOCENE CORALS: *STYLOPHORA*, *SERIATOPORA*, *POCILLOPORA*, AND *ACROPORA*

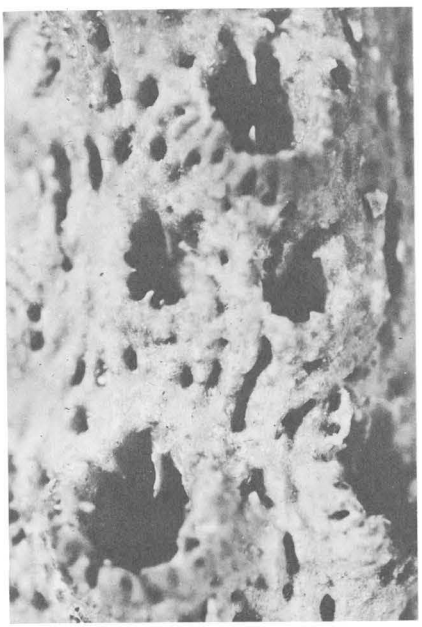
PLATE 298

FIGURE 1. *Acropora sp.* (p. 1106).
Surface of branch, × 10. F–1, 820–830 ft., introduced for comparison with *Dendracis pacificus*. USNM 648115.

2–5. *Dendracis pacificus n. sp.* (p. 1105).
2. Part of paratype, × 10. F–1, 840–850 ft. USNM 648102.
3. Part of holotype, × 10. F–1, 860–870 ft. USNM 648101.
4. Cross section of branch of paratype, × 10. F–1, 860–870 ft. USNM 648103.
5. Part of immature branch (paratype), showing well-developed septa, × 10. E–1, 1,925–1,935 ft. USNM 648104.

6. *Leptoseris sp. cf. L. floriformis* Gerth (p. 1106).
Calicular surface, × 4. F–1, 880–890 ft. USNM 648105.

7, 8. *Discotrochus sp. cf. D. orbignyanus* Milne-Edwards and Haime (p. 1107).
Basal and calicular aspects, × 10. K–1B, 915–925 ft. USNM 648106.



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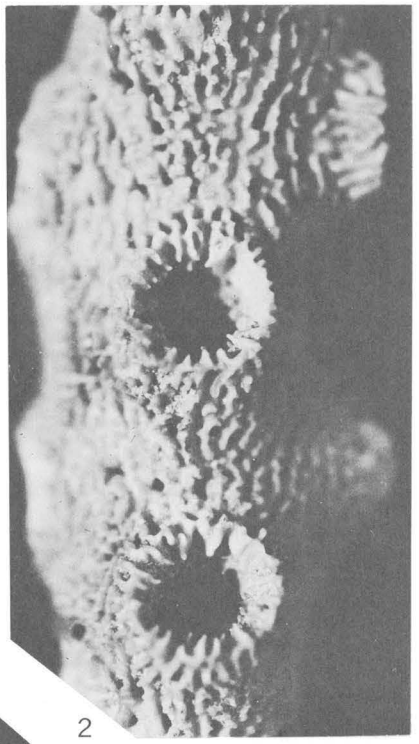

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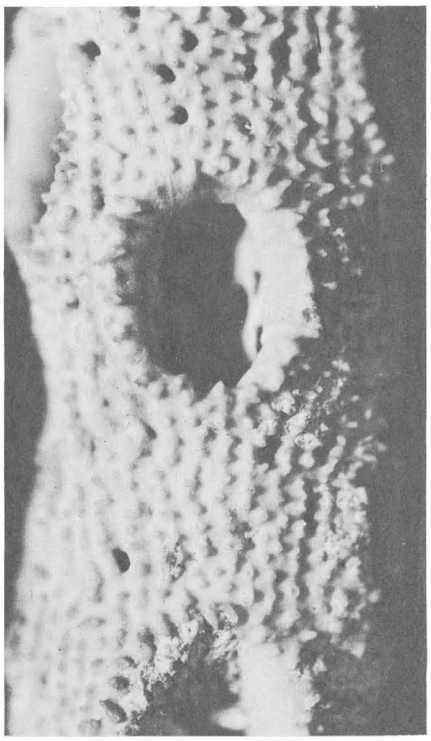

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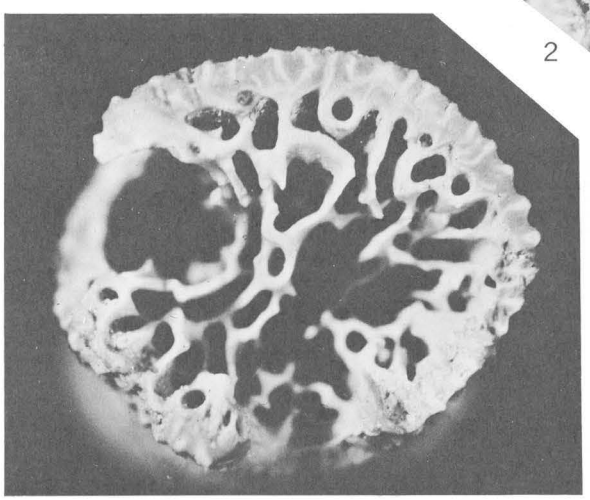

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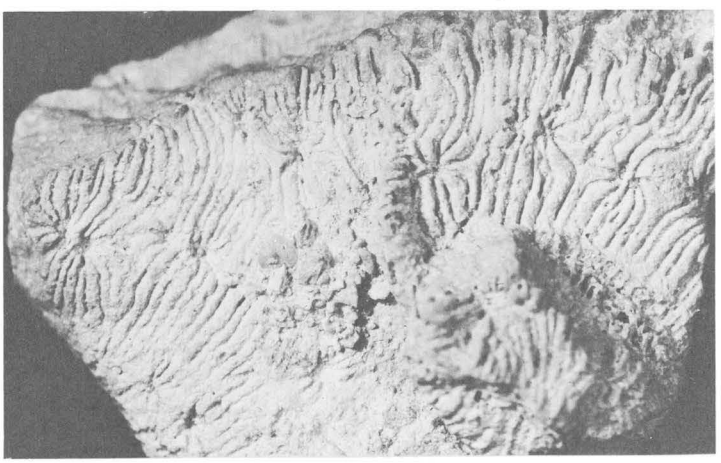

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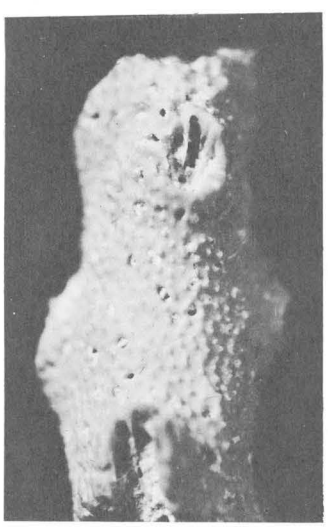

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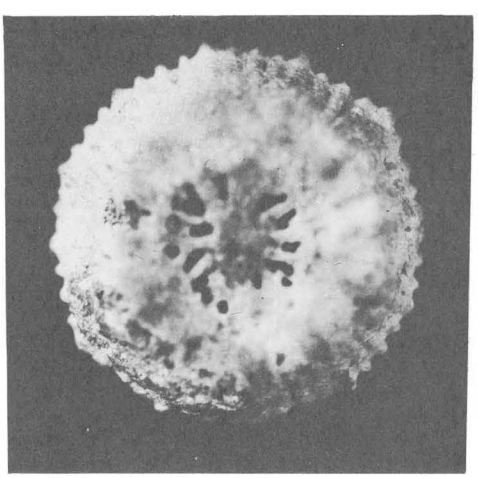

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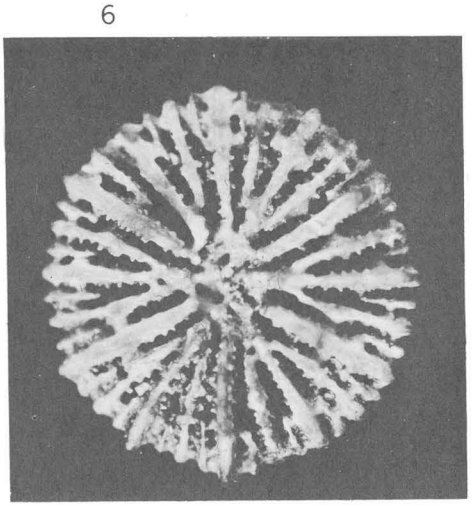


8

MIOCENE CORALS: *ACROPORA, DENDRACIS, LEPTOSERIS,* AND *DISCOTROCHUS*

PLATE 299

FIGURES 1, 2. *Alveopora viridis* Quoy and Gaimard (p. 1108).
Corallum, × ½, and calices, × 4. Recent, shallow water, Ifaluk Atoll, Caroline Islands (collected by F. M. Bayer, 1953). Compare with fig. 3, *A. polyacantha*.

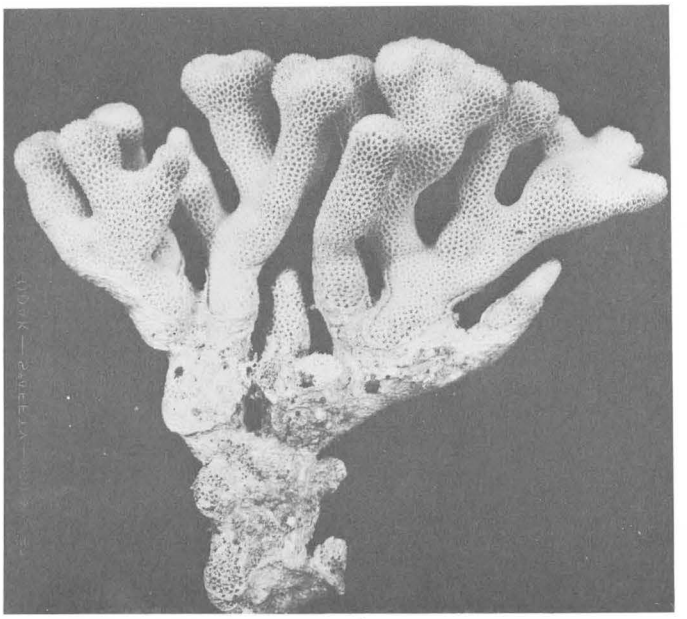
3. *Alveopora polyacantha* Reuss (p. 1107)
Calices, × 4. F–1, 700–710 ft. USNM 648107.

4, 5. *Acanthophyllia sp.* (p. 1109).
Calicular and lateral aspects of immature corallum, × 4. F–1, 860–870 ft. USNM 648111.

6. *Cyphastrea microphthalma* (Lamarck) (p. 1108).
Fragment of calicular surface, × 4. F–1, 710–720 ft. USNM 648110.

7. *Acrhelia sp.* (p. 1109).
Worn tip of branch, × 4. F–1, 650–660 ft. USNM 648112.

8. *Heliopora coerulea* (Pallas) (p. 1109).
Calicular surface near tip of branch, × 10. F–1, 710–720 ft. USNM 648113.



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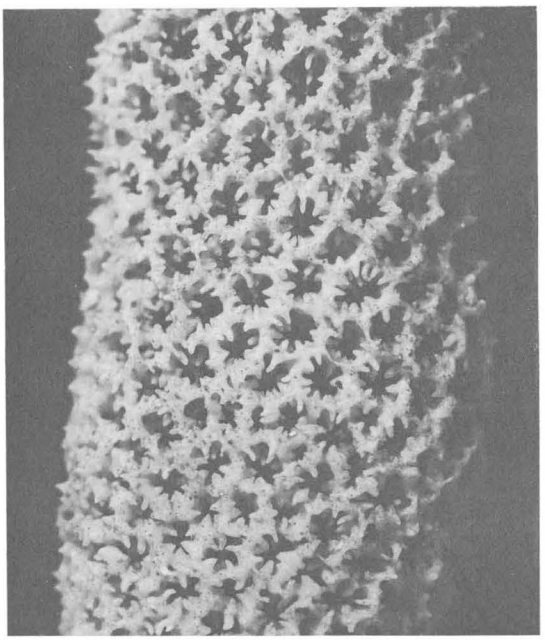

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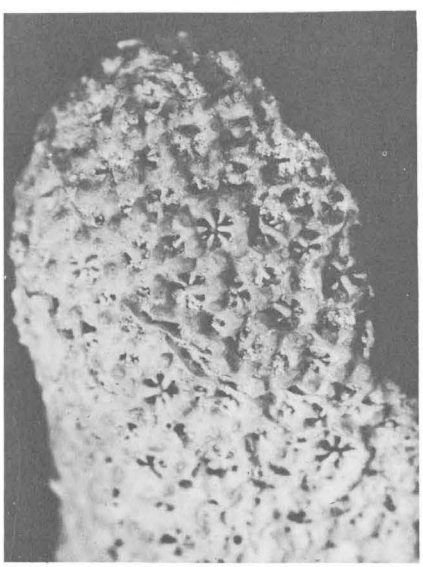

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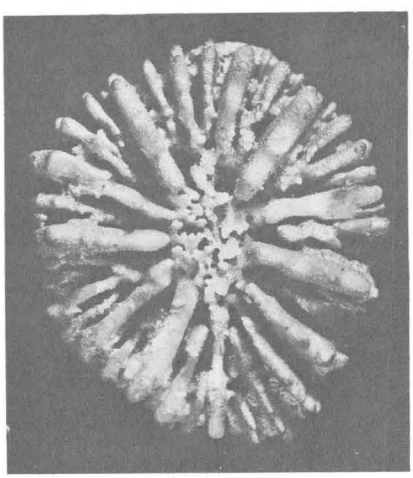

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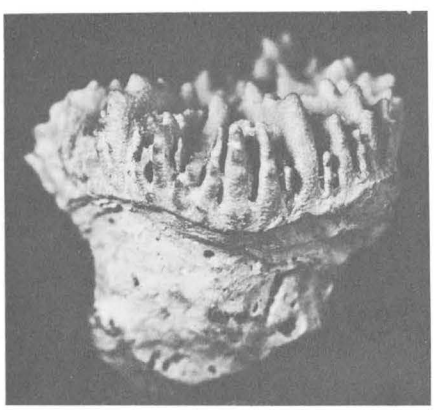

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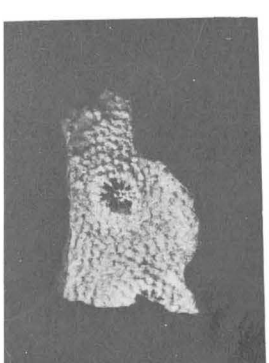

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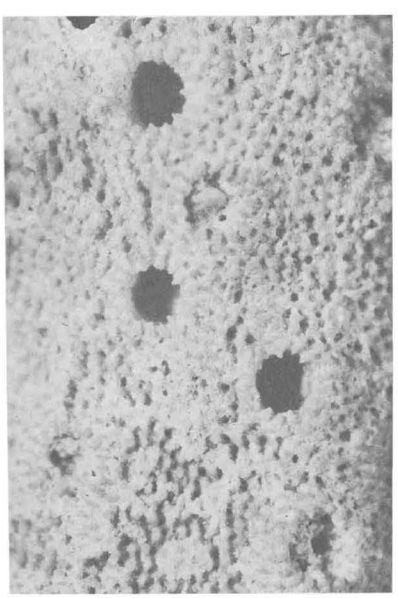

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MIOCENE CORALS: *ALVEOPORA, ACANTHOPHYLLIA, CYPHASTREA, ACRHELIA*, AND *HELIOPORA*

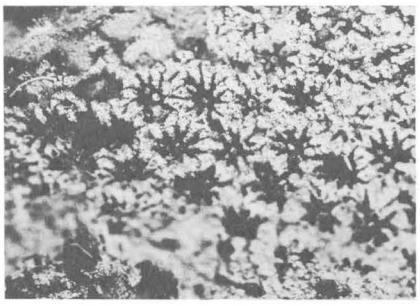
PLATE 300

FIGURE 1. *Actinastrea sp. cf. A. minutissima* (Gerth) (p. 1103).
Latex cast of calicular surface, × 10. Core E–1–3–33, 4,078–4,100 ft. USNM 648114.

2. *Stylophora stellata* (von Fritsch) (p. 1104).
Transverse section, × 10. Core E–1–3–29, 4,078–4,100 ft. USNM 648093.

3, 4. *Favia sp. cf.* F. *oligophylla* (von Fritsch) (p. 1108).
Transverse and longitudinal sections, × 4. Core E–1–3–23, 4,078–4,100 ft. USNM 648108.

5, 6. *Platygyra sp.* (p. 1108).
Longitudinal and transverse sections, × 4. Cores E–1–3–6 and E–1–3–3, 4, 078–4, 100 ft. USNM 648116, 648109.



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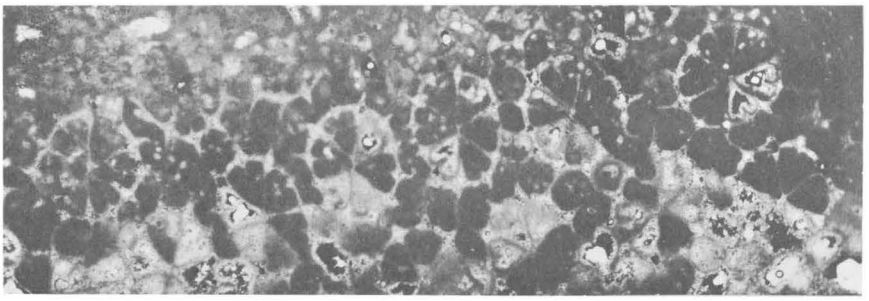

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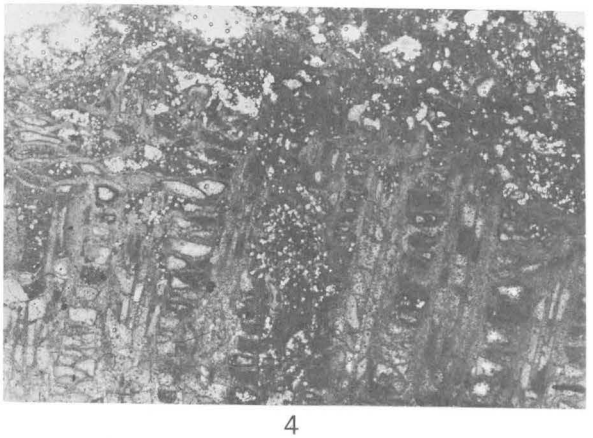

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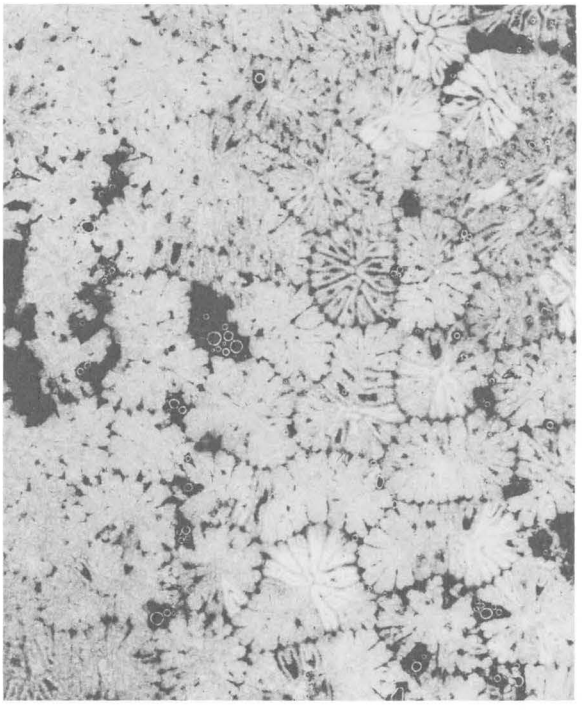

6

EOCENE CORALS: *ACTINASTREA, STYLOPHORA, FAVIA,* AND *PLATYGYRA*