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Mesozoic Invertebrate Faunas of Peru
Part 3.[1] Lower Jurassic Corals from the Arequipa Region

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The specimens described in this note were collected between 1942 and 1946 by William F. Jenks in the course of his survey of the Arequipa Quadrangle. All came from the same locality, a quarry in the Liassic Chocolate formation, about 20 kilometers northwest of the city of Arequipa. Since the corals are about the only identifiable fossils in the Chocolate formation, their significance in the problem of the age of this unit is considerable.

Details of the stratigraphy have been given by Jenks (1948) and need not be repeated here. The Chocolate formation comprises a sequence of some hundreds of meters of andesite and basalt flows and tuffs, with some interbedded limestones and shales with local coral patches or reefs. It overlies Paleozoic or Pre-Cambrian gneisses and is overlain by the Socosani limestone of Jurassic age. It was first presumed to be of late Paleozoic age (Jenks, 1945, p. 18; 1946, p. 368). But Norman D. Newell's determination of the presence of brachiopods and mollusks of Jurassic type and the writer's identification of *Astrocoenia* and *Oppelismilia* (Jenks, 1948, p. 131) clearly indicated post-Paleozoic and probable lower Jurassic (Liassic) age. Further study of the corals confirms this view.

All the specimens came from a gray to chocolate-colored limestone lens in the volcanics in a quarry where the limestone is quarried for

[1] For parts 1 and 2, see the Bulletin of the American Museum of Natural History, volume 101 (1953).

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building and ornamental purposes. The limestones are more or less recrystallized to marble, but corals, bryozoans, spiriferoids, and gastropods are fairly well preserved. The lenses evidently represent local patch reefs similar to those of the Liassic Pabba shale in the Hebrides.

Eight small, square-cut, polished slabs showing sections of corals are reported on here. Three others, sent by Jenks and Newell to the United States National Museum, were examined by the writer in 1946. Unfortunately recent efforts to find these three again have been unavailing. The determinations are not wholly satisfactory, being based exclusively on sections. Recrystallization in one or two cases has masked the septal structure, giving it a deceptively fenestrate appearance (see fig. 9).

The Liassic corals of South America are still poorly known, and indeed corals of this part of Jurassic time are everywhere scarce. Including the present material, they are distributed in South America as follows (species marked by an asterisk are discussed in the present note):

Species	Liassic, Peru	Lower Liassic, Argentina	Upper Liassic, Chile	Elsewhere
Scleractinia				
Astrocoenia lissoni Tilmann, 1917	Ninacaca			
Astrocoenia cf. *lissoni* Tilmann*	Arequipa			
Astrocoenia sp. Tilmann, 1917	Oroya			
Thamnasteria sp. Tilmann	Ninacaca; Yanamarca			
Thamnasteria sp.*	Arequipa			
Cyathophora decamera Gerth, 1928		Neuquen		
"*Latimaeandra*" cf. *sinuosa* Koby, Jaworski, 1916		Mendoza		"Corallian," Europe
"*Latimaeandra*" sp. Möricke, 1894			Copiapó	
Anabacia andina Gerth, 1926		Mendoza		
Oppelismilia cf. *victoriae* (Duncan)*	Arequipa	Mendoza		Pliensbachian, Great Britain

Species	Liassic, Peru	Lower Liassic, Argentina	Upper Liassic, Chile	Elsewhere
Oppelismilia cf. *haimei* (Chapuis and Dewalque)		Mendoza		Hettangian, Europe
Oppelismilia cf. *sarthacensis* (Milne-Edwards and Haime)		Mendoza		Bathonian, France
Lepidophyllia cf. *hebridensis* Duncan*	Arequipa			Pliensbachian, Great Britain
Lepidophyllia peruviana, new species*	Arequipa			
Lepidophyllia chocolatensis, new species*	Arequipa			
Thecosmilia sp. Tilmann, 1917	Yanamarca			
?Margarastraea jenksi, new species*	Arequipa			
Incertae Sedis:				
Andenipora liasica Gerth, 1926		Mendoza		
Cladocoropsis cf. *mirabilis* Felix, 1907*	Arequipa			Upper Jura, eastern Mediterranean; Japan

ASTROCOENIIDAE

Astrocoenia Milne-Edwards and Haime, 1848

Astrocoenia sp. cf. *A. lissoni* Tilmann, 1917

Figure 1

Astrocoenia lissoni Tilmann, 1917, Neues Jahrb. Min., Beilage Band, vol. 41, p. 701, pl. 26, figs. 4a, b.

Figured Specimen: A.M.N.H. No. 27806.

Remarks: One specimen shows a section transverse to the calicular surface of an irregular colony whose growth form is uncertain but was probably irregularly encrusting or submassive. The mature corallites are subpolygonal, from 2 to 2.25 mm. in internal diameter, with walls 0.75 to 1.0 mm. thick, appearing porous in places, and evidently the corallites were more or less separated with some development of costae

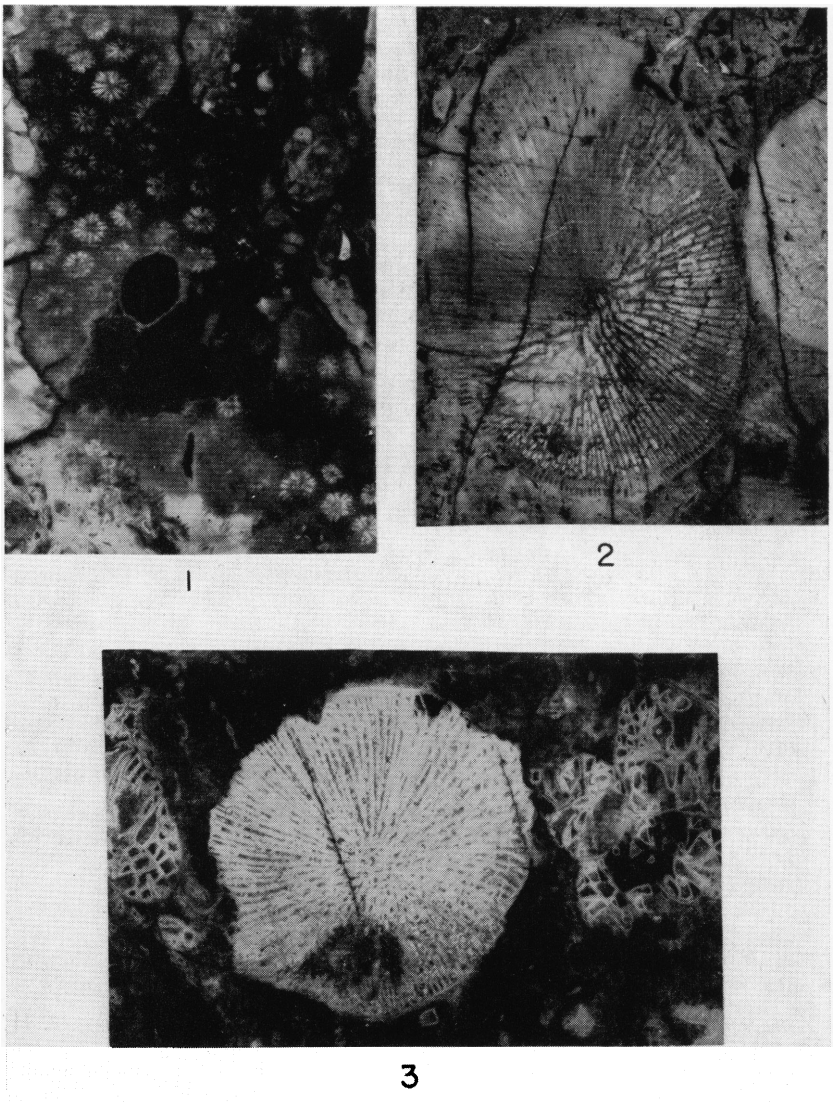


FIG. 1. *Astrocoenia* sp. cf. *A. lissoni* Tilmann, A.M.N.H. No. 27806, transverse section, × 2.

FIG. 2. *Oppelismilia* sp. aff. *O. victoriae* (Duncan), A.M.N.H. No. 27808, transverse section, slightly oblique, × 1.

FIG. 3. *Oppelismilia* sp. aff. *O. victoriae* (Duncan), A.M.N.H. No. 27807, transverse section, × 1, with sections, on either side, of *Lepidophyllia chocolatensis*, new species.

in the interspaces. The septa are irregularly developed, but the full number is 24 in three complete cycles. The first two cycles are subequal and usually extend to the columella, but some appear to end in paliform swellings. The third-cycle septa are either short and free or fused to the second-cycle septa to form a small trident structure. The columella is styliform.

Two *Astrocoeniae* have been reported from the Liassic of South America: *A. lissoni* Tilmann from the middle Lias at Ninacaca, central Peru, and *A.* sp. Tilmann (1917, p. 702) from the same horizon at Oroya, central Peru. The specimen from the Chocolate formation is much like *A. lissoni*: the number of septa is the same and the figures of *A. lissoni* show a similar costal development between corallites. The only observable difference is the smaller corallites (1.5 mm.) in Tilmann's material. The large septa of *A. lissoni* are said to show pali-like internal thickening, and the third-cycle septa are also indicated as being swollen internally. More precise evaluation of the Chocolate and Ninacaca specimens is difficult because the former is known only from sections and the latter only from external surfaces of silicified specimens. The other species mentioned by Tilmann is poorly known. It has calices 2 to 2.5 mm. in diameter but the septa are only 12 in number.

Many species of *Astrocoenia* (including *Cyathocoenia*) were described by Duncan from the Lias of Great Britain. In fact, practically all the known Liassic species of this genus come from a few localities in that area, but all were incompletely described from badly preserved material and comparisons are of little value. However, as pointed out by Tilmann, one notable point is that nearly all of these have a decameral rather than hexameral septal arrangement.

THAMNASTERIIDAE

Thamnasteria Lesauvage, 1823

Thamnasteria sp.

SPECIMENS: A.M.N.H. Nos. 27814 and 27815.

REMARKS: Two small fragments, poorly preserved, evidently represent this genus. The corallite centers are about 3 mm. apart; the septa number about 20 in 5 mm. One of the specimens indicates a ramose colony with branches about 6 mm. in thickness.

Tilmann (1917, p. 702) mentioned *Thamnastraea* species from the middle Liassic of Ninacaca and Yanamarca, central Peru, but his specimens were silicified and equally indeterminable. According to him the centers are 2 to 2.5 mm. apart, each with 18 to 24 thick septa.

STYLOPHYLLIDAE

Oppelismilia Duncan, 1867

Oppelismilia sp. cf. *O. victoriae* (Duncan), 1868

Figures 2, 3

Montlivaltia victoriae DUNCAN, 1868, Supplement to the British fossil corals, pt. 4, no. 2, p. 63, pl. 17, figs. 1–10.

Montlivaltia cf. *M. victoriae* JAWORSKI, 1916, Neues Jahrb. Min., Beilage Band, vol. 40, p. 408

Stylophyllopsis victoriae STRAW, 1925, Geol. Mag., vol. 62, p. 358, fig. 2.

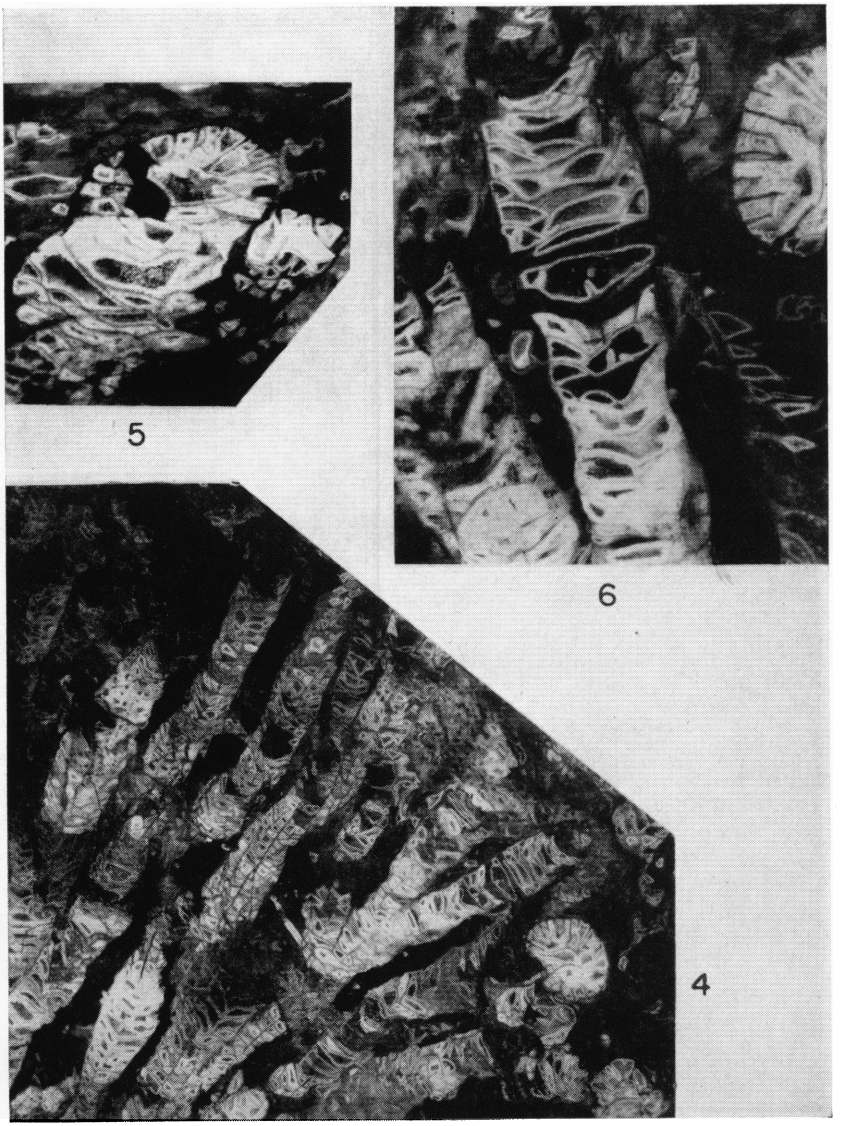
FIGURED SPECIMENS: A.M.N.H. Nos. 27807 and 27808.

REMARKS: Four individuals of a very large form of *Oppelismilia* are represented by four transverse sections. These indicate elongate turbinate corallites 3 to 4 cm. in diameter and probably 8 to 12 cm. in height. A specimen 4 cm. in diameter has about 180 septa, indicative of six cycles, of which the last-cycle septa appear to be very short but actually are represented inwardly by rows of stout trabecular spines which may extend one-half or two-thirds of the distance to the axis.

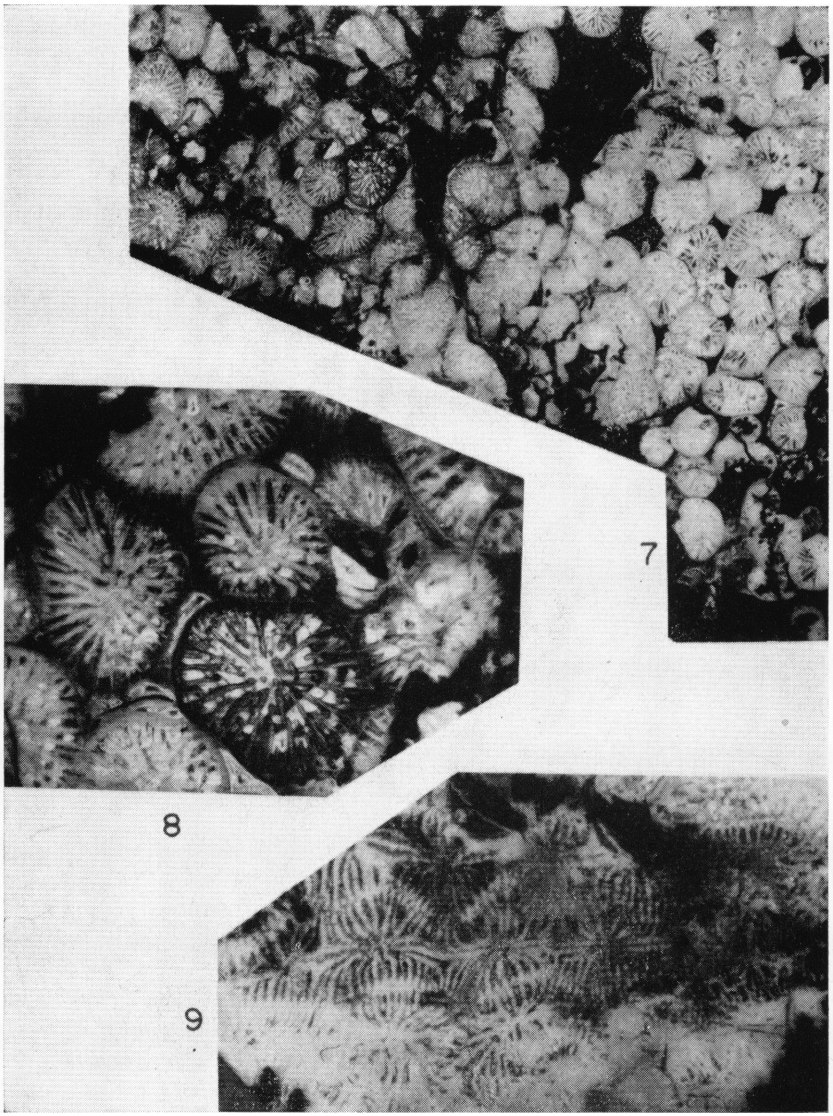
Another corallite, also 4 cm. in diameter, has about 200 septa which are more wholly laminar, because the section happened to fall nearer the base. In both specimens there is no distinct columella, but there is centrally a tangle of trabecular processes from the inner ends of the septa. Vesicular endothecal dissepiments form a distinct peripheral zone extending about one-third of the distance to the axis. The corallite wall is epithecal, and neither septotheca nor paratheca is developed.

Vertical sections to determine the development of a central tabularium were not successful, but they did show the form of the calicular region. The calice is regularly concave, the epitheca forming a sharp margin, and the septa are non-exsert. The floor of the calice is 1 cm. below the walls in a calice 4 cm. in diameter.

Many early Jurassic solitary stylophyllids have been originally placed in *Montlivaltia,* but their septal structure is quite different and a septotheca or paratheca is not developed, the only mural structure being epitheca. Duncan's *Montlivaltia victoriae* from the middle Liassic of Great Britain is one of these and is unusual among the stylophyllids for its comparatively great size. From Duncan's description and figures there seems to be no difference between the British and Peruvian specimens, and there is little doubt that Jaworski's specimens from the lower Liassic of Argentina (Neuquen and Mendoza) are the same. The comparatively well-developed septa and their trabecular extensions to form a weak columella are, as pointed out by Straw, indicative of a late stage in this stylophyllid line.



FIGS. 4–6. *Lepidophyllia chocolatensis*, new species, A.M.N.H. No. 27810. 4. Vertical section of holotype colony, × ½. 5. Section of corallite with extratentacular offset or bud, × 2. 6. Vertical (left) and transverse (upper right) section of corallites, × 2.



FIGS. 7, 8. *Lepidophyllia* sp. aff. *L. hebridensis* Duncan, A.M.N.H. No. 27809, transverse sections: 7, × $\frac{1}{2}$, 8, × 2.

FIG. 9. *?Margarastraea jenski*, new species, A.M.N.H. No. 27812, transverse section of holotype corallum, × 2. Note beaded or fenestrate appearance of septa, an effect of fossilization.

Lepidophyllia Duncan, 1868

Lepidophyllia sp. aff. *L. hebridensis* Duncan, 1868

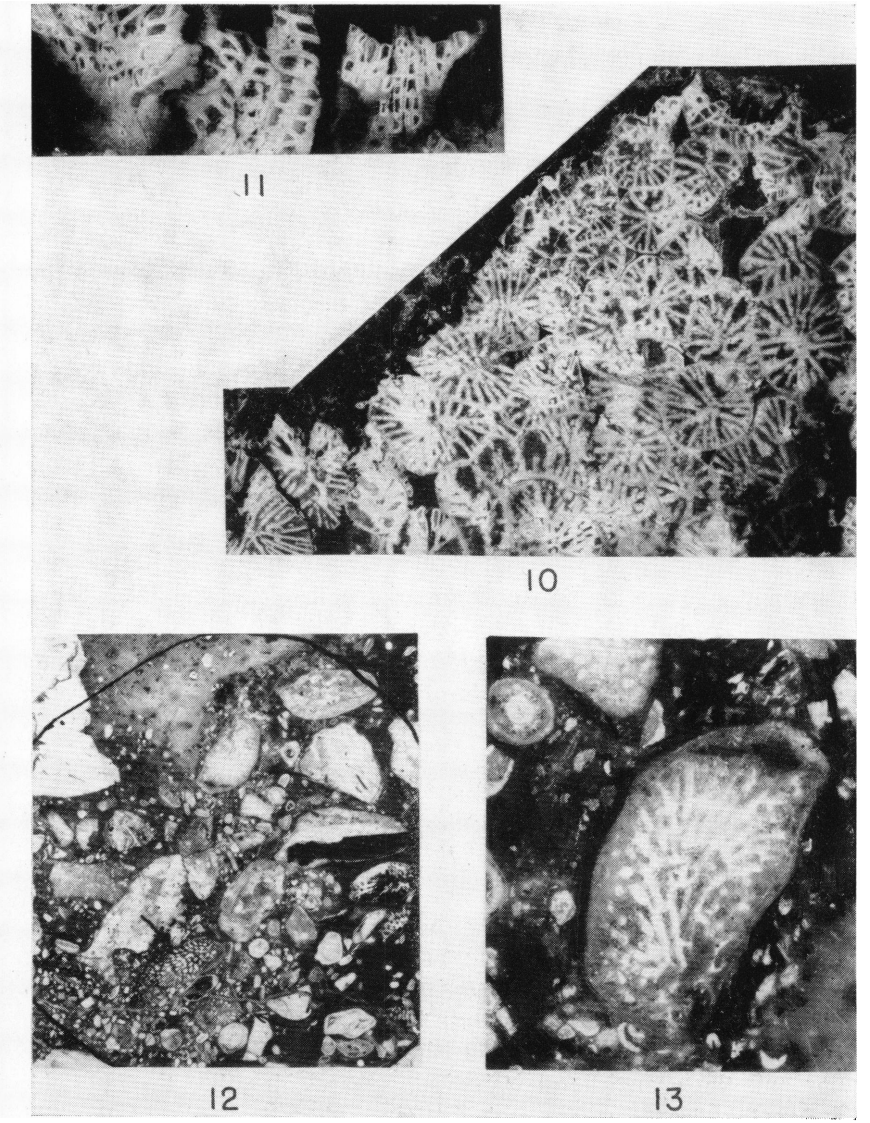
Figures 7, 8

Lepidophyllia hebridensis DUNCAN, 1868, Supplement to the British fossil corals, pt. 4, no. 2, p. 62, pl. 16, figs. 1–4.

FIGURED SPECIMEN: A.M.N.H. No. 27809.

DESCRIPTION: Phaceloid, corallites cylindrical, often oval or subpolygonal as a result of very close crowding, 10 to 13 mm. in diameter when fully grown. Mode of colony formation not distinctly evident but apparently extratentacular and intracalicular ("peripheral increase"). The sole mural structure is a stout epitheca. Septa about 48 in number, of which about 12 extend nearly to the axis, 12 are shorter, and 24 extend less than one-fifth of the distance from wall to axis. In most septal systems there are traces of septa of the fifth cycle, very short. All septa free on inner ends, which are often blunt or slightly swollen when seen in transverse section. In section the septa are laminar, thickened by stereome, typically stylophyllid, formed by laterally united compound trabecular spines with the innermost spine tending to stand isolated. No columella, but the axial space is more or less filled by several of the isolated inner trabecular spines. Endotheca of vesicular dissepiments inwardly inclined from the wall, forming roughly inverted-conical layers, about four in 5 mm., and appearing as three or four roughly concentric rings in transverse section.

REMARKS: The two described species of *Lepidophyllia* are *L. hebridensis* Duncan from the *jamesoni* zone (lower Pliensbachian, Isle of Pabba, Hebrides) and *L. stricklandi* Duncan (1868, p. 53, pl. 12, fig. 15) from the *bucklandi* zone (Sinemurian) at Chalbury, Worcester. The latter is based on a few fragments and is insufficiently known. *Lepidophyllia hebridensis,* which occurs in abundance at Pabba (even forming patch reefs) in the Liassic shales, is based upon well-preserved but commonly flattened coralla (holotype: Geological Museum, London, No. 37052). The type has been studied by the writer. Duncan's figures are poor and the growth-form is basically phaceloid rather than plocoid. The septal structures are stylophyllid of the advanced oppelismiliid laminar type, and the genus is simply *Oppelismilia* in which the colonial, phaceloid habit is dominant rather than occasional. *Lepidophyllia hebridensis,* with corallites of the same size and with the same number of septa, is clearly very closely related to the Peruvian material.



FIGS. 10, 11. *Lepidophyllia peruviana*, new species, A.M.N.H. No. 27811. 10. Transverse section of holotype colony, × ½. 11. Vertical sections of corallites, × 1.

FIGS. 12, 13. *Cladocoropsis* sp. cf. *C. mirabilis* Felix, A.M.N.H. No. 27813. 12. Part of slab with several fragments, × 1. 13. Oblique section of branch seen in lower center of figure 12, × 4. (Above is part of transverse section.)

Lepidophyllia peruviana, new species

Figures 10, 11

HOLOTYPE: A.M.N.H. No. 27811.

DESCRIPTION: Like *L.* sp. aff. *L. hebridensis,* but mature corallites are larger (15–17 mm. diameter) with proportionally fewer (30–40) septa of which barely 12 reach the axis, and no trace of very small higher cycle septa. Septal structure as in *L.* sp. aff. *L. hebridensis* except that axially there are usually two to three free trabecular spines on the longer septa. Dissepiments vesicular but more distant (two to three in 5 mm.).

REMARKS: On the basis of available material *L.* sp. aff. *L. hebridensis* and *L. peruviana* appear to be distinct, but more specimens may indicate that the two represent only individual variants of a single species.

Lepidophyllia chocolatensis, new species

Figures 4–6

HOLOTYPE: A.M.N.H. No. 27810.

DESCRIPTION: Phaceloid, forming heads 15 cm. or more in height and thickness, apparently by extra-tentacular intracalicular budding. Corallites cylindrical, 10 to 15 mm. in diameter, branching at low angles (20°–25°). Wall epithecal. Endotheca in two zones: an outer peripheral vesicular zone and an inner zone of incomplete tabulae about 1 mm. apart, the inner zone about one-third of the corallite diameter. Septa short, alternating in length, equal in thickness, free inwardly, thin and laminar in structure, with no trace of trabecular spines. The longer septa extend about halfway to the axis, the shorter half as far. The number of septa is difficult to ascertain, but about 24, arranged roughly 12/12, can be made out in a corallite 12 mm. in diameter, and about 30 in a corallite 15 mm. in diameter. Only the larger ones appear to be continuous vertically, the shorter ones usually being discontinuous from one dissepimental platform to the next.

REMARKS: This coral is quite different from the other two *Lepidophylliae* found in the Chocolate formation, having proportionally fewer and shorter septa without detached trabecular spines, and a tabular axial endothecal zone. It is strikingly similar internally to *Stylophyllopsis* [= *Oppelismilia*] *romerloana* Volz (1896, p. 88, pl. 11, figs. 5-8) from the upper Triassic (Karnian of the southern Alps, except that the latter has much smaller corallites which appear to increase intratentacularly ("durch regelmässige Zweitheilung") at greater angles.

MONTLIVALTIIDAE

Margarastraea Frech, 1896

?Margarastraea jenksi, new species

Figure 9

HOLOTYPE: A.M.N.H. No. 27812.

DESCRIPTION: Meandrine, forming irregularly laminate expansions. Series 5 to 7 mm. wide, with simple collines. Calicular centers distinct, 6 to 12 mm. apart in series, with lamellar linkage. Septa 10 in 5 mm. along collines, irregularly alternating in length, 30 to 35 around each center, of which half extend to the axis where there is a weak trabecular columella. In structure the septa appear fenestrate, but this is an effect of granular calcitic replacement or recrystallization, and in a few places they are distinctly faviid in structure: laminar, thick at the wall, and tapering rapidly towards the centers.

REMARKS: Two species show strong resemblance to this coral: *"Isastrea" eucystis* Frech (1890, p. 26, pl. 6, figs. 10, 10a; pl. 7, figs. 11-12a) from the upper Triassic Zlambach beds (Norian) in the Gosau Valley, Austria, and *"Latomeandra" orthogrammica* Crickmay (1933, p. 903, pl. 23, figs. 1-3) from the early middle Jurassic (Bajocian) of Mt. Jura, California. Both of these may be referable to *Margarastraea,* which is a meandrine *Elysastraea,* and both differ from *?M. jenksi* in width of the valleys: 2.5 mm. in *?M. eucystis* and 4 mm in *?M. orthogrammica.* All three, however, are alike in having well-differentiated calicular centers with lamellar linkage and laminar septa.

Two species of *"Latomeandra"* previously reported from the lower Jurassic of South America may also prove to be *Margarastraea: Latomeandra* sp. Möricke (1894, p. 68) from the upper Liassic of Chile, with about 50 septa to the center and "very large" calices; and *L.* sp. cf. *L. sinuosa* Koby (Jaworski, 1916, p. 410), insufficiently described but if actually close to Koby's upper Jurassic species, quite different from *?M. jenksi.*

INCERTAE SEDIS

Cladocoropsis Felix, 1907

Cladocoropsis sp. cf. *C. mirabilis* Felix, 1907

Figures 12, 13

Cladocoropsis mirabilis FELIX, 1907, Sitzber. Naturf. Gesell. Leipzig, vol. 33, pp. 3–10, figs. 1–5. YABE AND TOYAMA, 1927, Japanese Jour. Geol. Geogr., vol. 27, p. 107, pls. 8, 9. RENZ, 1930, Abhandl. Schweizerischen Pal. Gesell., vol. 50, p. 1, pl. 1 (with further references).

FIGURED SPECIMEN: A.M.N.H. No. 27813.

REMARKS: On one of the slabs are several sections of a form indistinguishable from Felix' *Cladocoropsis,* a coral-like organism of uncertain affinities but probably a spongiomorphid. The sections represent fragments of branches 4 to 6 mm. in diameter, formed by porous trabecular elements diverging from the axis of the branch and fusing peripherally to produce a more or less solid mural structure. The trabecular elements are about 0.25 mm. thick, and appear as more or less continuous, ramifying rods in vertical section, and as a loose reticulum normal to the external surface. No septal structure or calicular centers can be discerned. The microscopic structure is not preserved.

The dimensions of branches and trabecular elements accord closely with Felix' description of specimens from the upper Jurassic of Dalmatia. This curious fossil, very similar to, if not the same as, *Lovcenipora* of the Triassic, is widespread in the upper Jurassic ("Cladocoropsiskalke") of Dalmatia, Greece, Syria, and Cyprus and has been recognized in the upper Jurassic Torinosu limestone of Japan.

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