

# A REVIEW OF THE FAMILIES OF TETRACORALS.

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## PART II.

### 8. Family LACCOPHYLLIDAE A. W. Grabau, 1928.

Family Laccophyllidae A. W. Grabau, 1928.

FAMILY DESCRIPTION.—*Habit* solitary; *form* conical, curved to straight; *calyx* of moderate depth to deep; *theca* distinct.

*Septa* continuous; *symmetry* nearly radial; *primary septa* present, indistinguishable from the secondary septa; cardinal septum sometimes aborted; *secondary septa* abundant; principal septa reaching partially to the center; *tertiary septa* present, short; *fossulae*, cardinal fossula may or may not be present; *tabulae*, horizontal tabulae generally present in the central area within the inner wall; *dissepiments* sparse to extensive, in peripheral area; *axial structure* lacking; *inner wall* present, a conspicuous inner wall in the form of a cylindrical tube, formed by the bending and fusion of the inner ends of the principal septa, thickened by stereoplasm in some; *inner zonation*, outer zone of septa and dissepiments, inner wall, inner zone, open or crossed by tabulae.

GEOLOGIC RANGE.—Silurian to Permian.

INCLUDED GENERA.—*Laccophyllum* Simpson, 1900=1) *Alleynia* (*Nicholsonia*) Pocta, 1902 (fide Grabau, 1928)=2) ? *Syringaxon* Lindström, 1882 (fide Butler, 1935); *Permia* Stuckenberg, 1896; *Barrandeophyllum* Pocta, 1902; and *Retiophyllum* Pocta, 1902 (fide Grabau, 1928).

COMMENTS.—There is very little difference between this family and the Hapsiphyllidae. The cardinal fossula is absent or poorly developed in the former in contrast to the latter and the inner walls are different in character.

### 9. Family LOPHOPHYLLIDAE A. W. Grabau, 1928.

Family Lophophyllidae A. W. Grabau, 1928; followed by: C. C. Yü, 1933; Y. S. Chi, 1931, 1935; F. Heritsch, 1936.

FAMILY DESCRIPTION.—*Habit* solitary; *form* conical to cylindrical; *calyx* moderate, with a prominent calicular boss and a pit; *theca* distinct.

*Septa* continuous, in rare cases interrupted peripherally by cystopsepiments; *symmetry* tetrameral to radial; *acceleration*,

counter quadrants accelerated; *primary septa* present, cardinal septum usually short and undeveloped, counter septum long and prominent, alar septa well developed or short; *secondary septa* well developed, reaching nearly to the center, counter laterals appearing early in the coral development; *tertiary septa* may be present; *fossulae*, cardinal fossula usually present;

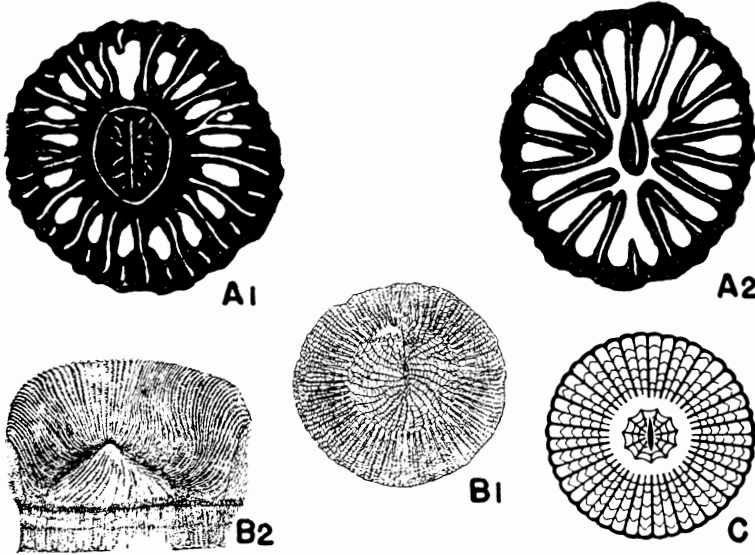


Fig. 11. FAMILY LOPHOPHYLLIDAE (after Duerden).

A. *Lophophyllum proliferum*.

A<sub>1</sub> and A<sub>2</sub>—Diagrams of transverse sections.

FAMILY CLISIOPHYLLIDAE.

B. *Clisiophyllum* (after Thomson and Nicholson).

B<sub>1</sub>—Diagram of a transverse section.

B<sub>2</sub>—Diagram of longitudinal section through the center.

C. *Dibunophyllum*. Diagram of a transverse section. (after Wedekind).

*tabulae* usually well developed, uparching in the center; *dissepiments* sparse to abundant, cystosepiments present in the peripheral region in rare cases; *axial structure* a compact columella, almond shaped in cross section, formed by the thickened end of the prolonged counter septa with or without small lamellae and stereoplasm. Columella may or may not be connected directly with the counter septum; *inner wall* commonly lacking, inner ends of the principal septa may be fused by stereoplasm.

## GEOLOGIC RANGE.—Mississippian to Permian.

INCLUDED GENERA.—*Lophophyllum* Edwards and Haime, 1850; *Lophophyllidium* Grabau, 1928; *Lophocarinophyllum* Grabau, 1922; *Sinophyllum* Grabau, 1928; *Rossophyllum* Stuckenberg, 1888 (fide Grabau, 1928); *Koninckophyllum* Nicholson and Thomson, 1876 = 1) *Lophophyllum* Carruthers, 1913 = 2) ? *Eostroton* Vaughan, 1915; *Timorphyllum* Gerth, 1921 (fide Grabau, 1928); *Histiophyllum* Thomson, 1883 (fide Chi, 1931); ? *Thysanophyllum* Nicholson and Thomson, 1876 ? (fide Yü, 1933); *Yuanophyllum* Yü, 1933; ? *Arachnolasma* Grabau, 1922 (fide Yü, 1933).

Other genera conditionally placed here: *Lophophylloides* Stuckenberg, 1904; *Hettonia* Hudson and Andersson, 1928 (non *Hattonia* Jones, 1927—a tabulae coral); *Malonophyllum* Okulitch and Albritton, 1937 (is this distinct from *Lophophyllum*?); ? *Carruthersella* Garwood, 1912 (placed here); ? *Rylstonia* Hudson and Platt, 1927 (placed here).

COMMENTS.—Although this group of corals is placed by many in the family Streptelasmaidae, it represents an advanced group with special characteristics deserving family rank. The two families are closely related.

## 10. Family CLISIOPHYLLIDAE H. A. Nicholson and J. Thomson, 1883.

Family Clisiophyllidae Nicholson and Thomson, 1883; H. A. Nicholson, 1889; A. Vaughan, 1905; A. Salée, 1913; H. Gerth, 1921; C. C. Yü, 1933.

FAMILY DESCRIPTION.—*Habit* solitary to compound; *form* conical to fasciculate to prismatic; *calyx* shallow to moderately deep, with a large calicular boss; *theca* present in solitary forms, may be suppressed in compound forms.

*Septa* continuous to acanthine, may be weak or interrupted in the peripheral region; *symmetry* usually radial; *acceleration* not pronounced; *primary septa* present, commonly of same length as secondaries, cardinal septa may be short; *secondary septa* well developed, reaching to or nearly to the center and often continuous with the lamellae; *tertiary septa* lacking or poorly developed; *fossulae*, cardinal fossula may be distinct, indistinct, or lacking; *tabulae* well developed in the central zone, uparching about the pseudocolumella; *dissepiments* abundant in the peripheral area, cystosepiments may be well developed, interrupting the septa; *axial structure* a complex pseudocolumella formed of lamellae (radiating usually from a medial lamella) and sparse to abundant interconnecting tabulae; *inner wall*, one or two inner walls may be present, formed by a fusion of dissepiments, thickening of the septa or an arching of the tabulae; *inner zonation* three to four zones: peripheral zone of septa and tabulae (zone of tabulae), complex pseudocolumella.

## GEOLOGIC RANGE.—Mississippian to Permian.

INCLUDED GENERA.—*Clisiophyllum* Dana, 1846; *Cyathoclisia* Dingwall, 1926; *Clisaxophyllum* Grabau and Yü, 1933; *Carcinophyllum* Thomson (fide Yü, 1933); *Dibunophyllum* Nicholson and Thomson, 1876; *Carinthiaphyllum* Heritsch, 1936; *Protolonsdaleiastraea* Gorsky, 1932; *Lonsdalia* Edwards and Haime, 1851; *Lonsdaleoides* Heritsch, 1936; *Lonsdaleiastraea* Gerth, 1921; *Polythecalis* Yabe and Hayasaka, 1916 (fide Huang, 1932); *Nagatophyllum* Ozawa, 1925; *Avophyllum* Edwards and Haime, 1850; and *Stylidophyllum* Fromental, 1861 (fide Chi, 1931); *Waagenophyllum* Hayasaka; *Yatsengia* Yoh and Huang, 1932; *Corwenia* Smith and Ryder, 1926; *Kionophyllum* Chi, 1931; *Verbeeckella* Penecke, 1908 (fide Chi, 1931); *Wentzelella* Grabau, 1927; *Rhodophyllum* Thomson, 1876; *Kumatiophyllum* Thomson, 1876; *Alberti* Thomson, 1878 (fide Vaughan, 1905); *Arachniophyllum* Smyth, 1915; *Cravenia* Hudson, 1928; *Carniaphyllum* Heritsch, 1936; *Verbeekia* Penecke, 1908? (fide Soshkina, 1928); *Cystophorastrea* Stuckenbergh (fide Soshkina, 1936); *Ivanovia* Dobroljubova, 1935; *Geyero-phyllum* Heritsch, 1936; ? *Zeliaphyllum*, Heritsch, 1936; ? *Cyclophyllum* Duncan and Thomson, 1882?; *Aulophyllum* Edwards and Haime, 1850 (fide Smith and Lang, 1930); ? *Symplectophyllum* Hill, 1934; ? *Clisiophyllites* Löweneck, 1932; *Centrophyllum* Thomson, 1880; *Centrocellulosum* Thomson, 1883; *Scenophyllum* Simpson, 1900; *Auloclisia* Lewis, 1927; *Aspidophyllum* Thomson, 1875.

COMMENTS.—The family, as presented in this paper, includes the Clisaxophyllidae of Grabau and Yü, 1933 and the Lonsdaleidae of (Grabau and) Chi, 1931. The former is considered invalid, being based upon characters too detailed for family distinction—the independence of the lamellae from the septa and the presence of an inner wall. The latter family agrees in all the main features with the Clisiophyllidae as diagnosed here.

11. Family LITHOSTROTIONTIDAE A. W. Grabau, 1927<sup>1</sup>.

Family Lithostrotiontidae A. W. Grabau, 1927; Y. S. Chi, 1931, 1935; C. C. Yü, 1933.

FAMILY DESCRIPTION.—*Habit* compound; *form* fasciculate to prismatic; *calyx* shallow; *theca* present except in rare specialized forms.

*Septa* continuous, may be interrupted in the peripheral area; *symmetry* radial; *primary septa* well developed, the alars equal in size to the secondaries; the cardinal septum may be short; the counter may be long; *secondary septa* well developed, reaching to or nearly to the center, may be secondarily shortened; *tertiary septa* may be present, short; *fossulae*, obscure cardinal fossula in rare cases; *tabulae* numerous, well developed, in central region especially, commonly uparching in center—less commonly horizontal; *dissepiments* commonly well developed in

<sup>1</sup>Grabau, A. W., 1927. Syllabus in Paleontology, National Univ. of Peking—printed but not published.

peripheral zone, may interrupt the septa; cystosepiments present in specialized forms; *axial structure* usually present, made up of a single lamella slightly to strongly thickened and continuous with, or independent of, the counter septum; the columella may be secondarily reduced to spines or lacking; *inner walls*, phyllotheca or cyathotheca may be present; *inner zonation*, dissepimentarium and tabularium present in some forms.

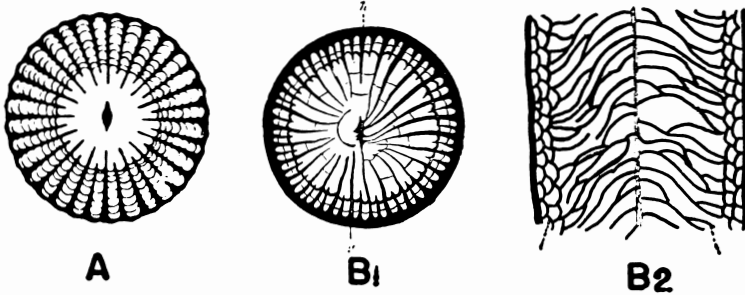


Fig. 12. FAMILY LITHOSTROTIONTIDAE.

- A. *Lithostrotion*. Diagram of a transverse section. (after Grove).  
 B. *Lithostrotion martini*, X 3. (after Nicholson and Lydekker).  
 B<sub>1</sub>, transverse, and B<sub>2</sub>, longitudinal section.

**GEOLOGIC RANGE.**—Silurian to Carboniferous.

INCLUDED GENERA (see Comments).—*Lithostrotion* Lhwyd, 1699, Fleming, 1828 = 1) *Stylastraea* Lonsdale, 1845 (fide Smith and Lang, 1930) = 2) *Siphonodendron* M'Coy, 1849 (fide Yü, 1933).

Doubtful synonyms—? *Azinura* Castelnau, 1843; *Stylaxis* M'Coy, 1849; *Nemaphyllum* M'Coy, 1849; *Nematophyllum* M'Coy, 1849 = *Petalaxis* Edwards and Haime, 1850; *Acrocyathus* D'Orbigny, 1850; and ? *Lasmocyathus* D'Orbigny, 1850 (fide Lindström, 1833).

Genera or subgenera or genomorphs (Smith and Lang, 1930): *Diphyphyllum* Lonsdale, 1845; *Depasophyllum* Grabau, 1933; *Diphystrotion* Smith and Lang, 1930; *Lithostrotionella* Yabe and Hayasaka, 1916; *Cionodendron* Benson and Smith, 1923; *Arachnium* Keyserling, 1846.

Genera: *Eridophyllum* Edwards and Haime, 1850 = *Craspedophyllum* Dybowski, 1873 (fide Smith and Lang, 1927, 1935); *Nemistium* Smith, 1908 (fide Chi, 1935); *Stylostrotion* Chi, 1935; *Cystophora* Yabe and Hayasaka, 1916 (fide Chi, 1935); *Orionastraea* M'Coy, (fide Smith, 1917); *Lithodendron* Phillips, 1835; *Chonaxis* Edwards and Haime, 1851; *Schoenophyllum* Simpson, 1900; and *Dorlodotia* Salée, 1913 (placed here).

COMMENTS.—There are a great number of forms closely allied to the genus *Lithostrotion* which have been regarded differently by many workers. Lindström (1883) considered the genus to be a broad one and treated the great number of types as synonyms and subgenera. Salée (1913) formed two subgroups of the corals similar to *Lithostrotion*: the compact prismatic corals, genus *Nematophyllum*, and the branching cylin-

dricul ones, *Siphonodendron*. Lang and S. Smith (1930) believed the genus underwent a development in a number of different directions to form *genomorphs* and *diphymorphs*. D. Hill (1933) added to this work by outlining these common potential trends in *Lithostrotion* which gave rise to the end genera, *Cionodendron*, *Lithostrotionella*, and *Diphyphyllum* and all intermediate types. Grabau and Yü (1933) (Grabau, 1936) placed *Diphyphyllum* and *Depasophyllum* in a separate family, the Diphyphyllidae, on the basis of the absence of the columella. This family is much in doubt. The forms are treated as genera in this paper.

The tribes Lithodendroninae and Axophyllinae of Edwards and Haime (1850) contained many of the above genera. The latter tribe was adopted by Salée, Gerth, and others, and was given family rank, but it proved to be too general a group. The creation of subfamilies by Gerth (1921) placed *Lithostrotion* in the subfamily Stylaxinidae along with *Lophophyllum*. His system is not followed.

## 12. Family ZAPHRENTIDAE M. Edwards and J. Haime, 1850.

Family Zaphrentidae Edwards and Haime, 1850, 1851; F. Roemer, 1883; H. A. Nicholson, 1889; F. Frech, 1890; K. von Zittel, 1876, 1900; L. M. Lambe, 1901; P. Pocta, 1902; H. Gerth, 1921; E. Soshkina, 1928; A. W. Grabau, 1922, 1928; Y. S. Chi, 1931; E. C. Stumm, 1937; O. H. Schindewolf, 1938.



Fig. 13. FAMILY ZAPHRENTIDAE.

A. *Caninia*. Diagram of a transverse section. (after Grove).

B. *Triptophyllum dalii*.

B<sub>1</sub> and B<sub>2</sub>—Diagrams of transverse sections. (after Simpson).

**FAMILY DESCRIPTION.**—*Habit* solitary; *form* conical to cylindrical; *calyx* of moderate depth with a prominent calicular pit; *theca* distinct.

*Septa* generally tetrameral; *acceleration* present in the cardinal quadrants except in primitive forms; *primary septa*, cardinal septum short and weak, alars may or may not be

aborted, counter septum much like the secondaries; *secondary septa* well developed, reaching the center and, in some cases, twisting. Specialized forms, such as *Amplexus*, with septa secondarily shortened. *Tertiary septa* present; *fossulae*, well developed cardinal fossula, alar fossulae may be present; *tabulae* well developed, usually complete, lacking in early forms; *dissepiments* not abundant, in peripheral region; *axial structure* lacking; *inner wall* generally lacking.

GEOLOGIC RANGE.—Silurian (?) to Carboniferous.

INCLUDED GENERA.—*Zaphrentis* Rafinesque and Clifford, 1820; *Amplexi-Zaphrentis* Vaughan, 1906; *Caninia* (*Siphonofossula*) Michelin, 1840; *Pseudocaninia* Stuckenberg, 1896; *Heterophrentis* Billings, 1874?; *Homalophyllum* Simpson, 1900; *Zaphrentoides* Stuckenberg, 1896 = *Triplophyllum* Simpson, 1900 (fide Schindewolf, 1938); *Siphonophrentis* O'Connell, 1914; *Siphonophyllia* Scouler, 1844; and *Heliophrentis* Grabau, 1911 (fide O'Connell, 1914); *Amplexus* Sowerby, 1850; *Cyathopsis* D'Orbigny (fide Dybowski, 1873), (Nicholson and Thomson, = *Amplexus*); ? subgenus *Synamplexus* Grabau, 1922; *Amplexocarinia* Soshkina, 1928; ? *Paralleynia* Soshkina, 1936; *Coelophyllum* Roemer, 1833 (*Calophyllum* Dana, 1845—Schlüter); *Aspasmophyllum* Roemer, 1879 (fide Lindström, 1883); *Menophyllum* Edwards and Haime, 1850; *Anisophyllum* Edwards and Haime, 1850; *Hallia* Edwards and Haime, 1850; *Trochophyllum* Edwards and Haime, 1850; *Pinacophyllum* Frech, 1890; *Euryphyllum* Hill, 1937; *Pselophyllum* Poeta, 1902; *Nevadaphyllum* Stumm, 1937; *Eurekaphyllum* Stumm, 1937; *Neozaphrentis* Miller, 1891 (fide Grove, 1935); ? *Lophophrentis* Chi, 1935; ? *Gshelia* Stuckenberg, 1896 (fide Chi, 1931); *Verneulia* Stuckenberg, 1896; *Nodalipora* Stuckenberg, 1896; *Coelocoenia* Duncan, emend. Volz, 1896 *Zaphrentula* Bolchovitina, 1916; *Heterolasma* Ehlers, 1919 (non *Heterelasma* De Koninck, 1872); ? *Polydilasma* Hall, 1851 (Lindström, 1833—founded upon imperfect specimens); ? *Duncania* De Koninck, 1872; ? *Phraganophyllum* De Koninck, 1872; ? *Aphylostylus* Whiteaves, 1884; ? *Pycnostylus* Whiteaves, 1884 = *Orthopodium* Schlüter, 1889 (fide Lambe, 1901); ? *Caninophyllum* Lewis, 1929; *Craterophyllum* Tolmatchoff, 1931 (preoccupied); *Disophyllum* Tolmatchoff, 1931.

COMMENTS.—A detailed reorganization and redescription of the genera of this family is necessary. It should be more up to date and inclusive than that of M. O'Connell, 1914. The distinctions between the genera are in many cases minor characters, such as the direction of the arching of the tabulae, the character of the fossula, and the length of the septa. Many genera should be classed as subgenera or synonyms of others.

The family as a whole, being of rather simple type, is often confused with the Streptelasmaidae from which they probably arose and from which they are distinguished by the prominent cardinal fossula, the presence of well-developed tabulae, and the acceleration of the septa in the cardinal quadrants. The Streptelasmaidae generally lack these features.

A recent paper of O. H. Schindewolf (1938) presented the idea that many, if not all, of the European Carboniferous genera previously placed in the family Zaphrentidae are, in reality, allied with *Hapsiphyllum*. He did not deal with all of the European Zaphrentids but, after studying *Zaphrentoides*, *Triplophyllum*, and *Hapsiphyllum*, he proposed a new family, the Zaphrentoididae, for these types. This work is discussed in some detail under the family Hapsiphyllidae.

### 13. Family CYATHOPHYLLIDAE M. Edwards and J. Haime, 1850.

Family Cyathophyllidae M. Edwards and J. Haime, 1850, 1851; L. De Koninck, 1872; W. Dybowski, 1873; C. Rominger, 1876; K. von Zittel, 1876-1900; F. Roemer, 1883; F. Frech, 1885; M. Neumayr, 1889; H. A. Nicholson and R. Lydekker, 1889; W. Sherzer, 1891; W. Weissermel, 1894; L. Lambe, 1901; P. Pocta, 1902; A. W. Grabau, 1915<sup>2</sup>; F. Reed, 1922; E. Sochkine, 1925; Y. S. Chi, 1931, 1935; C. C. Yü, 1933; W. Lang and S. Smith, 1935.

**FAMILY DESCRIPTION.**—*Habit* solitary or compound; *form* conical to cylindrical, fasciculate to prismatic; *calyx* of moderate depth; *theca* usually present, absent in some prismatic forms.

*Septa* continuous, in rare cases acanthine, commonly may be interrupted in peripheral area; *symmetry* radial; *acceleration* not conspicuous; *primary septa* usually similar to secondaries; *secondary septa* numerous, reaching to or nearly to the center; *tertiary septa* may be present; *fossulae* lacking (inconspicuous cardinal fossula indicated in rare cases); *tabulae* sparse, confined to central area, horizontal or convex upward; *dissepiments* usually abundant, forming a conspicuous peripheral zone and in some interrupting the septa; cystosepiments may be present; *axial structure* lacking (septa may join in center with or without twisting); *inner wall* commonly present, formed in many ways; *inner zonation* varied with one or more of the following: stereozone, cystosepiments alone, dissepiments alone, dissepiments and septa, tabulae with septa, tabulae alone, central joining of septa.

#### **GEOLOGIC RANGE.**—Ordovician to Permian.

**INCLUDED GENERA.**—The many genera referred to this family are arranged below in six groups, the first closely similar to *Cyathophyllum*, the second like *Paleosmilia*, the third like *Campophyllum*, the fourth like *Phillipsastrea*, the fifth like *Columnaria*, and the sixth a miscellaneous residue.

<sup>2</sup> Grabau, A. W.: "Devonian Corals of Michigan," Vol. I (Ms.) (from Chi, 1931), 1915.

Group I: *Cyathophyllum* Goldfuss, 1826 [synonyms: *Fascicularia* Dybowski, 1873 (preoccupied) (fide Weissermel, 1849); *Exostega* Rafinesque and Clifford, 1820; *Peripoedium* Hempr. and Ehrenberg, 1834; *Pterorhiza* Hempr. and Ehrenberg, 1834; *Ellipsocyathus* D'Orbigny, 1850; *Endophyllum* Edwards and Haime, 1851; *Bothrophyllum* Trautschold, 1879; *Elasmophyllum* Hall, 1884 (fide Lindström, 1883); *Astrophloeothylacus* Ludwig, 1866 (fide Lang and Smith, 1935); subgenus *Thamnophyllum* Pencke, 1893 (fide Reed, 1922)]; *Disphyllum* Fromentel, 1861 [synonyms:

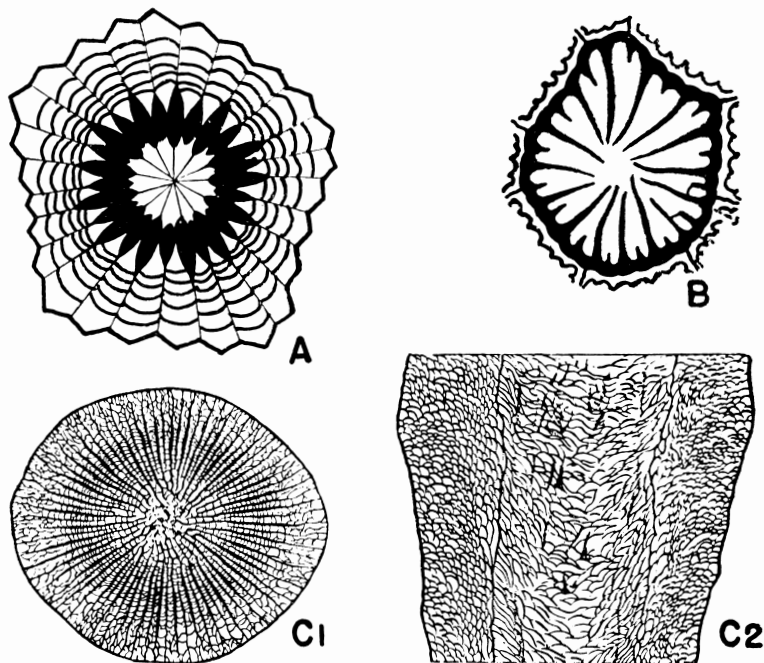


Fig. 14. FAMILY CYATHOPHYLLIDAE.

- A. *Prismaephyllum*. Diagram of a transverse section. (after Grabau).  
 B. *Columnaria calicina*. Diagram of a transverse section. X 2½. (after Nicholson).  
 C. *Cyathophyllum heterophyllum*. (after Nicholson).  
 C<sub>1</sub> — Diagram of a transverse section.  
 C<sub>2</sub> — Diagram of longitudinal section through the center.

*Phacellophyllum* Gurich, 1909 (Lang and Smith, 1935); *Taeni dendrolopas* Ludwig, 1866; *Taeni dendrocyathus* Ludwig, 1866; *Astrocalamocyathus* Ludwig, 1866; *Synaptophyllum* Simpson, 1900; *Cylindrophyllum* Simpson, 1900; *Spinophyllum* Wedekind, 1922; *Schlueteria* Wedekind, 1922 (fide Lang and Smith, 1935)]; *Prismaephyllum* Simpson, 1900 [synonyms: *Polyphyllum* Fromentel, 1858; *Hexagoniophyllum* Gurich, 1909; *Astroblastocyclus* Ludwig, 1866; *Astroblastothylacus* Ludwig, 1866; *Astrochartodiscus* Ludwig, 1866; *Astrophloeocyclus* Ludwig, 1866]; *Discophyllum* Hall, 1847; *Syringophyllum* Dana, 1846 (fide Edwards and Haime, 1851); *Mesophylloides* Wedekind, 1922; *Stylophyllum* Tolmatchoff, 1924; *Ceratophyllum*

Gürich, 1895; *Tabulophyllum* Fenton and Fenton, 1924 (fide Stumm, 1937); *Acanthophyllum* Dybowski, 1873 (fide Reed, 1905); *Blothrophyllum* Billings, 1859; *Peetzia* Tolmatchoff, 1924; *Keyserlingophyllum* Stuckenber, 1896; *Timania* Stuckenber, 1896; *Chlamydoephyllum* Pocta, 1902; *Heterocamina* Yabe and Hayasaka, 1920 (fide Yü, 1933); *Radiastrea* Stumm, 1937; *Schistotecholasma* Stewart, 1938; ? *Storthyophyllum* Weissermel, 1895; ? *Thecocyathus* Janensch, 1902; ? *Palastrea* M'Coy, 1849.

Group II: *Paleosmia* Edwards and Haime, 1848 = *Strephodes* M'Coy, 1849 (fide Smith and Lang, 1927); subgenus *Yabeela* Yü, 1933; subgenus *Kueichouphyllum* Yü, 1931; *Amygdalophyllum* Benson Dunn, and Browne, 1920.

Group III: *Campophyllum* Edwards and Haime, 1850; *Craterophyllum* Barbour, 1911 (preoccupied ?); *Charactophyllum* Simpson, 1900; *Glossophyllum* Wedekind, 1924; *Heliophyllum* Hall, 1846 (fide Wedekind, 1924); *Apolythophyllum* Walther, 1928; *Omphyma* Rafinesque and Clifford, 1820; *Ptychophyllum* Edwards and Haime, 1850; *Ketophyllum* Wedekind, 1927; *Dokophyllum* Wedekind, 1927.

Group IV: *Phillipsastrea* D'Orbigny, 1856 [synonyms: *Pachyphyllum* Edwards and Haime, 1850; *Medusoephyllum* Roemer, 1855; *Streptastrea* Sandberger, 1856; *Haplothecha* Frech, 1885; *Macgeea* Webster, 1890 (fide Lang and Smith, 1935)]; subgenus *Billingsastrea* Grabau, 1917; *Aulinia* Smith, 1917; *Stauria* Edwards and Haime, 1850; *Holocystis* Edwards and Haime, 1850; *Metriophyllum* Edwards and Haime, 1850; *Ceraster* Lindström, 1883; *Decaphyllum* Frech, 1885.

Group V: *Columnaria* Goldfuss, 1826 [synonyms: *Cyathophylloides* Dybowski, 1873; *Fasciphyllum* Schlüter, 1885 (fide Lang and Smith, 1935); *Lithostroma* Rafinesque (fide Bronn); *Favistella* Hall, 1847; *Palaeophyllum* Billings, 1858 (fide Lambe, 1901)]; subgenus *Densiphyllum* Dybowski, 1873; subgenus *Loyolophyllum* Chapman, 1914; *Acervularia* Schweigger, 1820 [synonyms: *Floscularia* Eichwald, 1829; ? *Favastroea* Blainville, 1830 (fide Lindström, 1883)]; subgenus *Diplophyllum* Hall, 1852 (fide Smith and Lang, 1931); *Grabauphyllum* Foerste, 1917; ? *Rhaphidophyllum* Lindström, 1882.

Group VI: *Crepidophyllum* Nicholson and Thomson, 1875; *Acrophyllum* Nicholson and Thomson, 1876 (fide Lambe, 1901); *Fasciculophyllum* Thomson, 1883 (placed here); *Ptycholopas* Ludwig, 1886 (fide Smith and Lang, 1927); ? *Coleophyllum* Hall, 1884 (doubtful); ? *Briantia* Barrois, 1889; *Edaphophyllum* Simpson, 1900; *Arachnaastroea* Yabe and Hayasaka, 1916; *Aphrophyllum* Smith, 1920 (fide Hill, 1933); ? *Phaulactis* Ryder, 1926; ? *Mesactis* Ryder, 1926; ? *Pycnactis* Ryder, 1926; *Kyphophyllum* Wedekind, 1927; *Entelophyllum* Wedekind, 1927; *Peziphyllum* Walther, 1928; *Temnophyllum*; ? *Enygmophyllum* Fomitchew, 1931; ? *Pinnatophyllum* Grabau, Ms. (fide Bassett, 1935); ? *Xylodes* Lang and Smith, 1927 (placed here); ? *Patrophrontes* Lang and Smith, 1927; ? *Petrozium* Smith, 1930 (placed here); ? *Ptilophyllum* Smith and Tremberth, 1927 (placed here); *Rhysodes* Smith and Tremberth, 1927 (placed here); *Stylophyllum* Tolmatchoff, 1924.

COMMENTS.—This family contains a great number of genera which are sufficiently diverse to constitute at least three additional families and probably more. The grouping given here is tentative.

In the past this family has served as a catch-all for indefinite genera. This was due partly to the poor understanding of the genus *Cyathophyllum* and more so to the broad, all-inclusive diagnosis of the family. Lang and Smith (1935), Wedekind

(1927), and others are doing much to clarify the genus but the family still remains generalized.

The numerous attempts to segregate genera from the family and establish new families have not been followed. The family Columnariadae Lambe (1901) includes only the genus *Columnaria* which has been placed with such diverse types as the tabulate corals and the Zaphrentidae. Ogilvie (1896) placed this genus in the Amphistraeidae containing both hexacorals and tetracorals.

The family Phillipsastraeidae Roemer (1883) was not adopted. Frech (1885) showed that the genera were similar to species of *Cyathophyllum*. Lang and Smith (1935) found evidence that the group evolved from a number of different subgenera of *Cyathophyllum* S. L. and is therefore composite. The family Stauridae Edwards and Haime, 1850, has not been accepted.

Since there is a definite evolutionary trend from one genus to another, it is unreliable to base families on the characters of one genus as the Campophyllidae and Amygdalophyllidae of Grabau.

Wedekind (1937) suggested the family Kyphophyllidae for a special type of *Cyathophyllum*, *Kyphophyllum*, based on the nature of the septa and peripheral zone. Variations of these structures, however, are indistinguishable from other genera of the Cyathophyllidae. Walther (1928) proposed the family Pexiphyllidae based upon inner zonation. This is a very uncertain and variable criterion.

#### 14. Family CALOSTYLIDAE F. Roemer, 1883.

Family Calostylidae F. Roemer, 1883; F. Frech, 1890; M. Neumayr, 1889; W. I. Robinson, 1917; S. Smith, 1930.

FAMILY DESCRIPTION.—*Habit* solitary or compound; *form* conical, curved to cylindrical, fasciculate; *calyx* of moderate depth; *theca* present, poorly developed.

*Septa* poorly developed, radial; *primary septa* present, indistinguishable from secondary septa; *secondary septa* present, numerous; principal septa reaching to or nearly to center of coral; *tertiary septa* present; *fossulae* lacking; *tabulae* present or absent, thin irregular tabulae may be present, uparching near the theca in *Calostylis*; *dissepiments* probably lacking, difficult to distinguish from tabulae; *axial structure* lacking, the irregular trabeculae of the septa reaching the center may form an irregular central spongy tissue; *inner wall* lacking.

GEOLOGIC RANGE.—Silurian.

INCLUDED GENERA.—*Calostylis* Lindström, 1868; *Helminthidium* Lindström, 1882.

COMMENTS.—Due to the character of the septa, the location of this group was long in doubt. Lindström, Zittel, Nicholson, Etheridge, and Duncan placed *Calostylis* among the Hexacorals. Roemer, Neumayr, Frech, and Bernard found evidence showing it to be a Tetracoral. The evolution of ideas is well summarized by both W. I. Robinson (1917) and S. Smith (1930) and the conclusions reached, based upon many different studies, are that they are a distinct family of the tetracorals.

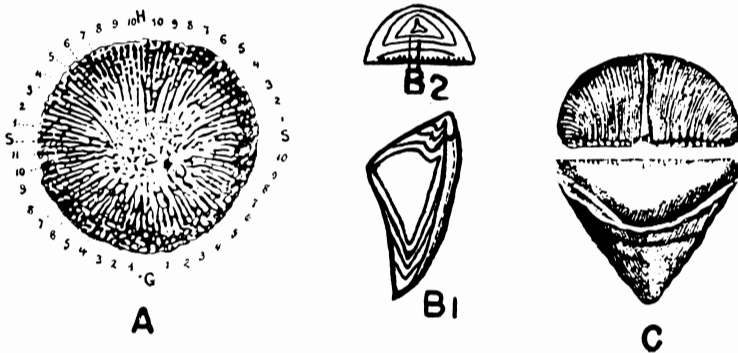


Fig. 15. FAMILY CALOSTYLIDAE.

A. *Calostylis denticulata*. Diagram of a transverse section. Natural size. (after Frech).

FAMILY CALCEOLIDAE.

B. *Calceola*. (after Wedekind).

B<sub>1</sub>—Diagram of longitudinal section through the center.

B<sub>2</sub>—Diagram of a transverse section.

B<sub>3</sub>—Diagram of the entire coral and operculum. Side view.

15. Family CALCEOLIDAE G. Lindström, 1882.

Family Calceolidae Lindström, 1882, 1883a; F. Roemer, 1883; H. A. Nicholson and R. Lydekker, 1889; M. Neumayr, 1889; P. Pocta, 1902; R. Wedekind, 1937.

FAMILY DESCRIPTION.—*Habit* solitary; *form* calceoloid to pyramidal; *calyx* deep, covered with an operculum made up of one or four interlocking plates containing septa-like ridges on the inner faces; *theca* distinct.

*Septa* continuous to discontinuous (acanthine septa, septal grating, septal cones), may be interrupted in peripheral area; *symmetry* radial; *acceleration* not pronounced; *primary septa*

usually indistinguishable from the secondaries and of the same size; *secondary septa* generally reduced to mere ridges or spines on the theca (*Goniophyllum* shows well-developed continuous septa reaching part way to the center); septal grating or septal cones present in other forms (Wedekind, 1937); *tertiary septa* lacking?; *fossulae* lacking; *tabulae* generally lacking; in some cases small horizontal tabulae occur in the central region; *dissepiments* well developed, especially in the peripheral region but also present throughout the thecarium; cystosepiments may be present; *axial structure* lacking; *inner wall* rarely present.

**GEOLOGIC RANGE.**—Silurian to Carboniferous.

**INCLUDED GENERA.**—*Calceola* Lamarck, 1809; *Rhizophyllum* Lindström, 1865; *Platyphyllum* Lindström, 1882; *Goniophyllum* Edwards and Haime, 1850; *Rhytidophyllum* Lindström, 1882; *Araeopoma* (also *Aeropoma*) Lindström, 1882; *Protoeropoma* Ting, 1937; *Holophragma* Lindström, 1896 (fide Wedekind, 1937).

**COMMENTS.**—A diagnosis of the operculate corals was made by Dybowski (1873) in which he proposed the family Goniophyllidae. The work of Lindström (1882, 1883 and later), although more detailed than that of Dybowski, differed little from it. The classification of Lindström was followed and his family, Calceolidae, was adopted by subsequent workers. Wedekind (1937) has suggested that this family be raised to the rank of suborder Calceolacea to correspond with the Strepelasmacea from which they were probably derived.

The presence of an operculum in these corals should not be the main taxonomic feature of the group. The different types of opercula formed of from one to four plates and the different endothecal structures present make it possible but very improbable that more than one family is represented here.

**16. Family CYSTIPHYLLIDAE** M. Edwards and J. Haime, 1850.

Family Cystiphyllidae M. Edwards and J. Haime, 1850, 1851; W. Dybowski, 1873; K. von Zittel, 1876-1900; F. Roemer, 1883; M. Neumayr, 1889; L. Lambe, 1901; P. Pocta, 1902; R. Wedekind, 1924, 1925, 1927, 1937; W. Scheffen, 1933.

**FAMILY DESCRIPTION.**—*Habit* solitary; *form* conical to cylindrical; *calyx* variable; *theca* distinct, thin.

*Septa* usually discontinuous, rarely continuous; acanthine, septal fillets, septal grating, septal cones present; strong development of stereoplasm in the thecarium; *symmetry* of septa, radial; *acceleration* indeterminate; principal septa generally absent, poorly developed when present; *primary septa* indis-

tinguishable from secondaries; *tertiary septa* lacking ?; *fossulae* lacking, an obscure cardinal ? fossula extremely rare; *tabulae* lacking or very small and confined to the central area; *dissepiments* abundant, filling the entire thecarium, concentrated especially in peripheral area; cystosepiments common next to the theca and often throughout the thecarium; *axial structure* lacking; *inner wall*, stereotheca or sclerotheca may be present; *inner zonation* generally not marked, zones of stereozone, cystosepiments alone, dissepiments alone, and possible tabulae with or without septa.

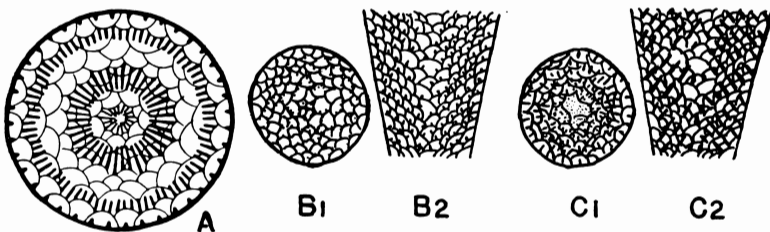


Fig. 16. FAMILY CYSTIPHYLLIDAE (after Wedekind).

- A. *Atelophyllum*. Diagram of a transverse section.  
 B. *Cystiphyllum*.  
   B<sub>1</sub>—Diagram of a transverse section.  
   B<sub>2</sub>—Diagram of longitudinal section through the center.  
 C. *Hedstroemophyllum*.  
   C<sub>1</sub>—Diagram of a transverse section.  
   C<sub>2</sub>—Diagram of longitudinal section through the center.

GEOLOGIC RANGE.—Silurian to Carboniferous.

INCLUDED GENERA.—The many genera referred to this family were grouped by Wedekind into sections of families as indicated below. Additional genera are placed in their proper groups.

Group I: *Cystiphyllum* Lonsdale, 1839; *Plasmophyllum* Dybowski, 1873; *Clisiophylloides* Dybowski, 1873 = ? *Cystiphyllum* Lindström, 1883; *Microplasma* Dybowski, 1873 = *Diplochone* Frech, 1886 (fide Reed, 1905); *Hedstroemophyllum* Wedekind, 1927; *Gyalophyllum*; *Skoliophyllum* ? (fide Wedekind, 1937).

Group II (Section *Pholidophyllida* of Wedekind): *Pholidophyllum* Lindström, 1870; *Polyorpe* Lindström, 1882; *Holmophyllum* Wedekind, 1927; *Stortophyllum* Wedekind, 1927; (Kodonophyllidae ? Wedekind, 1927) *Kodonophyllum*, 1927 = *Paterophrontes* Lang and Smith, 1927; *Zelophyllum* Wedekind, 1927; *Pseudomphyma* Wedekind, 1927; *Pilophyllum* Wedekind, 1927; doubtful, *Donacophyllum* Dybowski, 1873 (fide Wedekind, 1927); (Actinocystidae ? Wedekind, 1927) *Actinocystis* Lindström, 1882; *Rhabdophyllum* Wedekind, 1927; (Stratiphyllidae ? Scheffen, 1933) *Stratiphyllum*

Scheffen, 1933; *Phragmophyllum* Scheffen, 1933; *Chonophyllum* Edwards and Haime, 1850—subgenus *Craterophyllum* Foerste, 1911 (preoccupied ?); *Naos* Lang, 1926; *Arachnophyllum* Dana, 1846 (fide Lambe, 1901) [synonyms: *Lamellopora* Owen, 1844; *Cylicopora* Steininger, 1849; *Actinocyathus* D'Orbigny, 1850; *Darwinia* Dybowski, 1873 (fide Lindström, 1883); *Astraeophyllum* Nicholson and Hinde, 1874 (fide Lambe, 1901)]; *Strombodes* Schweigger, 1820 = *Strombastrea* Blainville, 1830.

Group III (Section Cystiphyllida of Wedekind): *Aulacophyllum* Edwards and Haime, 1850 (fide Wedekind, 1927); ? *Odontophyllum* Simpson, 1900; *Lykocystiphyllum* Wedekind, 1927; *Rhegmaphyllum* Wedekind, 1927; *Semaiophyllum* Vollbrecht, 1926; (*Neocystiphyllidae* Wedekind, 1927); *Neocystiphyllum* Wedekind, 1927; *Desmophyllum* Wedekind, 1927; *Lamprophyllum* Wedekind 1927; (*Digonophyllidae* Wedekind, 1924) *Digonophyllum* Vollbrecht ? (fide Wedekind, 1924); *Zonophyllum* Wedekind, 1924—subgenus *Legnophyllum* Wedekind, 1924; *Pseudozonophyllum* Wedekind, 1924; *Lekanophyllum* Wedekind, 1924; (*Ptenophyllidae* Wedekind, 1924) *Ptenophyllum* Wedekind, 1924, subgenus *Astrophyllum* Wedekind, 1924, subgenus *Rhopalophyllum* Wedekind, 1924; *Keriophyllum* Wedekind, 1924; *Trematophyllum* Wedekind, 1924; *Dohmophyllum* Wedekind, 1924; *Mochlophyllum* (fide Wedekind 1937); (*Stenophyllidae* Wedekind, 1925) *Stenophyllum* Amanhauser (emend. Wedekind, 1925); *Grypophyllum* Wedekind, 1921; *Sparganophyllum* Wedekind, 1925; ? *Pseudocosmophyllum* Wedekind and Vollbrecht, 1932.

Group IV (Lytrophyllacea of Wedekind): (*Lytrophyllidae* Wedekind and Vollbrecht, 1932) *Lytrophyllum* (*Lythrophyllum*) Wedekind, 1925; *Paralytopyllum* Wedekind, 1925; *Nardophyllum* Wedekind, 1925; *Plagiophyllum* Wedekind and Vollbrecht, 1932; *Cosmophyllum* Vollbrecht, 1924; *Arcophyllum* Markov, 1929; *Hemicosmophyllum* Wedekind (fide Wedekind and Vollbrecht, 1932); (*Stringophyllidae* Wedekind, 1921) *Stringophyllum* Wedekind, 1921; *Spongophyllum* Edwards and Haime, 1851; ? *Spongophylloides* Meyer, 1882; *Neospongophyllum* Wedekind, 1921—subgenus *Loipophyllum* Wedekind, 1925; *Schizophyllum* Wedekind, 1925; *Crinophyllum* Jones, 1933; ? *Cymatelasma* Hill and Butler, 1936; *Mesophyllum* Schlüter, 1889 (fide Wedekind, 1925); *Neostriophyllum* Wedekind, 1921; *Dialytrophyllum* Amanhauser ? (fide Wedekind, 1925); *Atelophyllum* Wedekind, 1925; *Enteleiophyllum* Walther, 1928.

(Other Cystiphyllidae) *Fletcheria* Edwards and Haime, 1851 (fide Lindström, 1883); *Humboldtia* Stuckenberg, 1896; *Cayugaea* Lambe, 1901; *Mictocystis* Etheridge, 1908; *Vesicularis* Rominger, 1876 (preoccupied for a bryozoa); *Cantrillia* Smith, 1930 (fide Hill, 1926).

COMMENTS.—Until the last few years there were but few genera included in this family, but with the work of Wedekind (1924, 1925, 1927, and 1937) several new “families” as well as a multitude of new genera have been added. Much of this work is doubted not only because of the variability of the characters upon which the groups have been based but also because the family included many types closely allied to *Cyathophyllum*. Wedekind placed all of the *Cyathophyllum*-like genera in either the Cystiphyllacea or the Streptelasmacea. Therefore a number of his genera, especially from his “families” Lykophyllidae, Ptenophyllidae and Stenophyllidae, belong with the Cyathophyllidae.

It is recognized that many structures such as cystosepiments, septal gratings, fillets and cones and stereozones have been overlooked or neglected. Wedekind relies heavily upon these features in proposing his new families and genera. The writer believes that these features, while important, are doubtful criteria for families. Many of them are mere superficial deposits of stereoplasm; others are inconstant in appearance; and still others show all intergradations between the various types. They may, however, serve as generic characters.

Until a detailed study is made of the genera and families proposed by Wedekind they are placed tentatively in their suggested arrangement under the Cystiphyllidae.

#### UNRESOLVED GENERA.

In 1883, Roemer proposed the family Palaestraeidae based upon two indefinite genera which contained very irregular inter-ramifying septa. Otherwise the genera were unlike; they were even doubted to be tetracorals until studies were made by Robinson (1917) and others. The genera: *Heterophyllia* M'Coy, 1849; *Battersbyia* Edwards and Haime, 1851.

Other genera placed here: *Mortieria* De Koninck, 1842; and *Cyclocrinites* Eichwald, 1846 (fide Edwards and Haime, 1850); *Hexaphyllia* Stuckenbergh, 1904. They are not a cognate group and do not represent a family.

A number of corals of indefinite character were placed with the Cyathaxonidae on the basis of the lack of tabulae and dissepiments. With a re-diagnosis of this family, the genera not allocated to new families are those possessing largely negative characters. Such are: *Centrotus* Lindström, 1883 (preoccupied); *Hemiphyllum* Tomes, 1887; *Gigantostylis* Frech, 1890 (in subfamily Gigantostyliinae).

A large number of genera have not been included in any proposed families. Of this group there are some genera which are unlike all other types: *Heptaphyllum* Clark, 1924; and *Caenophyllum* Clark, 1926; *Agassizia* Thomson, 1883.

From the plates and descriptions of the following genera no reliable allocations can be made: *Tryplasma* Lonsdale, 1845 (*Spinifera* Penecke); and *Xiphelasma* Smith and Lang, 1931; *Sarcinula* Lamarck, 1816 (fide Dana, 1846); *Protocyathus* (*Protocyathophyllum*) Thomson, 1883; *Cyathopsis* D'Orbigny, 1876 ?; *Cyathospongia* Hall, 1884; *Placophyllum* Simpson, 1900; *Cylindroheliium* Grabau, 1911; *Onychophyllum* Smith, 1930.

A number of genera have not been accepted by later workers: *Campsactis* Rafinesque and Clifford, 1820—incomplete description; *Patinula* Eichwald, 1829—based on an indeterminable specimen; *Ceratophyllum* Eaton, 1832; *Faviphyllum* Hall, 1852—no generic description—a questionable form; *Siphonaxis* Dybowski, 1873—indeterminable fragment (fide Lindström, 1883).

Before 1850, a generic name was often given to a number of corals of widely different types and no genotype was designated (fide Lindström, 1883); *Erismolithus* Martin, 1809 (included specimens of *Lithostrotion* ? and *Smithia* ?); *Caryophyllia* Lamarck, 1816—(*Acervularia* ? and *Lithodendron*); *Fungia* Lamarck, 1816 (*Paleocyclus*, *Ptychophyllum*, etc.); *Astrea* Lamarck, 1816—(*Acervularia* and *Cyathophyllum*); *Fungites* Schlotheim, 1820—(*Ptychophyllum* and others); *Turbinolopsis* Lamoureux, 1821—(aporoze corals and Paleozoic corals); *Cladocora* Ehrenberg, 1834—(Paleozoic and recent corals).

The references for the following corals are unavailable and the genera have not been described by subsequent workers: *Plerodictyum* Goldfuss, 1829; *Streptolasma* D'Orbigny, 1850; *Stylastraea* De Fromentel, 1861; *Astrocyathus* Ludwig, 1866; *Coelostylis* Lindström, 1880; *Cyathopoedium* Schlüter, 1889; *Mucophyllum* Etheridge, 1895 ?; *Salpingium* Smyth; *Triadophyllum* Weissermel, 1926; *Kwangsiphyllum* (*Syringophyllum*) Grabau and Yoh, 1929; *Heterophyllum* (fide Thomson, 1883); *Cystelasma* (fide Girty, 1927).

#### GROUPING OF THE FAMILIES.

Upon the basis of the diagnostic characters, the families naturally fit into nine major groups:

- |                     |                    |
|---------------------|--------------------|
| 1. Petraiaidae      | 5. Lophophyllidae  |
| Polycoelidae        | Clisiophyllidae    |
| 2. Lindströmiidae   | Lithostrotiontidae |
| Cyathaxonidae       | 6. Zaphrentidae    |
| 3. Paleocyclidae    | 7. Cyathophyllidae |
| 4. Streptelasmaidae | 8. Calostylidae    |
| Hapsiphyllidae      | 9. Calceolidae     |
| Laccophyllidae      | Cystiphyllidae     |

The characters of the groups and the similarities and differences of the included families are shown in the large table. (See Table I.)

KEY TO THE FAMILIES OF TETRACORALS  
( ALL CHARACTERS ARE GENERALIZED )

FAMILY	HABIT	CALYX	THECA CHARACTER	S CHARACTER	E P ACCELERATION	T PRINCIPAL	A TERTIARY	CURVING FOSSULA	TABULAE	DISSEPI- MENTS	AXIAL STRUCTURE	INNER WALL	GEOLOGIC RANGE
1. PETRAIADAE	Solitary	Deep	Present	Continuous	—	Short to long	Absent	Absent	Absent	Absent	Absent	Absent	Ordovician to Devonian
2. POLYCOELIDAE	Solitary	Deep	Present	Continuous	—	Long	(Present)	Absent	Absent	Absent	Absent	Absent	Permian
3. LINDSTRÖMIADAE	Solitary (compound)	Deep	Present	Continuous	—	Long	Present	Absent or obscure	Present	Absent	Columnella	Absent	Silurian to Devonian
4. CYATHAXONIDAE	Solitary	Deep	Present	Continuous	Counter	Long	Present	Present or obscure	Present	Absent	Columnella	Absent	Silurian to Carboniferous
5. PALEOCYCLIDAE	Solitary discoid	Shallow	Present	Continuous or discontinuous	—	Long	Present	Present	Absent	Absent	Absent	Absent	Silurian to Penn.
6. STREPTELASMAIDAE	Solitary	Medium depth	Present	Continuous	Counter	Long (short)	Present	Absent (present)	Absent	Sparse	Absent (pseudocol.)	Present	Ordovician to Permian
7. HAPSIOPHYLLIDAE	Solitary	Deep	Present	Continuous	Counter	Long	(Present)	Present	(Present)	Present	Absent	Present	Devonian to Permian
8. LACCOPHYLLIDAE	Solitary	Medium to deep	Present	Continuous	—	Long	Present	(Obscure)	Present	Sparse	Absent	Present	Silurian to Permian
9. LOPHOPHYLLIDAE	Solitary	Medium depth	Present	Continuous	Counter	Long	Present	Present	Present	Sparse	Columnella	(Present)	Miss. to Permian
10. CLISIOPHYLLIDAE	Solitary or compound	Medium depth	Present or absent	Continuous or discontinuous	—	Long	Absent	(Present)	Present	Present	Pseudocol.	Present	Miss. to Permian
11. LITHOSTROTIONIDAE	Compound	Shallow	Present (absent)	Continuous	—	Long	Present	Present (absent)	Present	Present	Columnella (absent)	Present	Silurian to Carbon.
12. ZAPHRENTIDAE	Solitary	Medium depth	Present	Continuous	Cardinal	Long (short)	Present	Present	Present	Sparse	Absent	Absent	Silurian to Carbon.
13. CYATHOPHYLLIDAE	Solitary or compound	Medium to shallow	Present (absent)	Continuous or discontinuous	—	Long	Present	Absent (obscure)	Sparse	Present	Absent	Present	Ordovician to Permian
14. CALOSTYLIDAE	Solitary or compound	Medium depth	Present	Discontinuous	—	Short (long)	Present	Absent	Present	Absent	Absent	Absent	Silurian
15. CALCEOLIDAE	Solitary	Deep operculate	Present	Continuous or discontinuous	—	Long	Absent	Absent	Absent	Present	Absent	Absent	Silurian to Carbon.
16. CYSTIPHYLLIDAE	Solitary	Deep to shallow	Present	Discontinuous	—	Absent or short	Absent	Absent	Sparse	Abundant	Absent	Present	Silurian to Carbon.

( ) - indicates character of a few forms

## PRESENT TRENDS IN TAXONOMIC STUDY.

With the further perfection of the technique of sectioning corals, and with better facilities for microscopic study, the attention of taxonomists is becoming more centered upon the detailed makeup of the various endothecal structures and their relationship to the *living* animal.

The structure of the septa has been especially studied. R. Wedekind (1925) believed septal structures were formed from two layers in the corallite: 1) from trabeculae, or 2) from stereoplasm which formed distinctive structures such as septal cones. Upon these deductions he based great taxonomic value. (See comments upon the Cystiphyllidae.)

D. Hill (1936) is making a study of the trabeculae, especially those present in corals with acanthine septa which she believes constitute a cognate group—the family Acanthocyclusidae. Before this character can be accepted as a valid one for a new family, it must be proved that in evolution acanthine septa do not give rise to continuous septa or vice versa and later revert to the original state. It seems altogether likely that this may have taken place in geologic history more than once or in more than one group.

Further detailed studies are also being made upon axial structures and inner walls but more attention should be directed to microscopic study of the theca and the nature of the dissepiments and cystosepiments.

In interpreting the coral structures it is necessary to keep always in mind that they were secreted about the base and sides of a living polyp. Although the nature of the tentacles and the oral disc of these extinct corals is unknown, a wax squeeze from a well-preserved calyx gives a faithful reproduction of the basal part of the polyp about which the skeletal structures were secreted. Such artificial casts prove useful in visualizing the origin and relation of some of the skeletal elements.

## CONCLUSIONS.

Grouping of the genera of tetracorals into families must be based on a combination of characters rather than on any single criterion.

Of 45 families heretofore proposed only 16 are here recognized. Many of the others are synonyms, or were never adequately founded or are groups believed to be of rank inferior to the family.

A few of the 16 here recognized are probably composite and need further revision and subdivision. This is particularly true of the Cyathophyllidae and the Cystiphyllidae.

Convergent evolution and homeomorphy are common among the tetracorals, and families like the Cyathophyllidae and Cystiphyllidae, as at present constituted, may represent a stage of evolution reached by parallel stocks rather than a natural generic group.

Of 496 genera thus far proposed, at least 82, and probably many more, are synonyms or are of no more than subgeneric value.

There is need of more critical study in deciding what should be accepted as generic criteria in the tetracorals.

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